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**Effect of Problem-Solving Approach on Learner Participation in Mathematics Class in
Bondo Sub-County, Kenya**

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Abstract

Purpose: The main purpose of this study was to investigate the effect of the Problem-Solving Approach on learner participation in mathematics class group discussions in bondo sub-county, Kenya.

Methodology: This study examined the impact of the Problem-Solving Approach (PSA) on learner engagement during group discussions in the Experimental Group (EG). The study adopted a quasi-experimental design involving a non-equivalent control group grounded in Social Constructivist Learning Theory. The target population comprised 2,162 Form Two students from 26 sub-county secondary schools. Purposive and simple random sampling methods were used to obtain eight schools with 784 students. Qualitative data were collected using a classroom observation guide and analyzed thematically through transcription of audio recordings and artifact documentation.

Findings: Findings revealed that PSA positively influenced learner participation through enhanced peer interaction, confidence, active participation, learner autonomy, and classroom engagement.

Unique Contribution to Theory, Practice and Policy: By examining participation patterns, the study highlights the role of PSA in transforming the mathematics classroom from a teacher-dominated environment to an interactive learning space where learners actively exchange ideas, justify reasoning, and negotiate meaning. The study may also inform teacher education institutions and faculties of education in Kenyan universities and colleges by demonstrating the importance of equipping pre-service teachers with strategies that promote active learner participation. For practicing mathematics teachers, the findings may provide practical insights into how PSA can be used to structure group activities that enhance learner engagement, especially among students who are often reluctant to contribute in conventional classroom settings. Finally, curriculum developers and education policymakers may benefit from the study by recognizing the value of embedding collaborative problem-solving strategies within instructional guidelines.

JEL Classification: 121,123,129

Keywords: *Problem Solving Approach, Mathematics Performance, Learner Participation*

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INTRODUCTION

Mathematics is central to developing critical thinking, reasoning, and problem-solving skills necessary for academic and professional success (Iqbal, 2004). Beyond mere performance, active participation in classroom discussions and collaborative problem-solving activities enhances understanding and conceptual learning. However, in many countries, including Kenya, learner participation in mathematics classrooms remains limited due to teacher-centered approaches that prioritize rote memorization over engagement (TIMSS, 2019). Studies in Africa indicate that students often struggle to actively participate in mathematics lessons due to large class sizes, inadequate teaching resources, and traditional lecture-based methods (Tshabalala & Neube, 2012; Kizito, 2020). In Kenya, secondary school mathematics classrooms largely rely on teacher-led instruction, limiting opportunities for learners to engage in discussions or collaborative problem-solving (Victor, 2020; Wambua, 2012).

Research has indicated that PSA has the potential to improve mathematics understanding by encouraging learners to analyze, discuss, and reason through problems collaboratively (Ali, Khan, Akhter, & Hukmadad, 2010; Nwoke, 2015). The approach is largely guided by Polya's four problem-solving steps: understanding the problem, devising a plan, carrying out the plan, and looking back. Each of these stages requires learners to actively engage with peers through questioning, explaining ideas, debating alternative solution strategies, recording procedures, and evaluating solutions. During problem analysis, learners discuss the meaning of mathematical tasks and identify relevant information. While devising a plan, they propose and justify possible solution strategies, often engaging in argumentation and negotiation with group members. As they carry out the plan, learners communicate procedures, explain reasoning, and document their work. In the reflection stage, they review and critique solutions, provide feedback to peers, and present conclusions. Consequently, PSA creates opportunities for frequent verbal and written interactions among learners, making participation an integral part of the learning process rather than a supplementary classroom activity.

By structuring lessons around problem-solving tasks, PSA promotes active learner participation, dialogue, and peer-to-peer learning, thereby moving beyond passive reception of knowledge (Malik, Akbar, & Hifsa, 2018). In Bondo sub-county, Kenya, mathematics classrooms continue to exhibit limited learner engagement during lessons. Observations indicate that discussions and group problem-solving activities are infrequent, which may contribute to low conceptual understanding of mathematics concepts. Implementing PSA could foster a more participatory learning environment by encouraging learners to ask questions, share ideas, justify solutions, challenge alternative viewpoints, and collaborate in small groups.

While PSA has been studied extensively for its impact on mathematics achievement, few studies in Kenya have investigated its effect on learner participation in group discussions. Understanding how PSA influences classroom interaction is crucial because participation indicators such as contributing ideas, asking questions, explaining reasoning, responding to peers, and engaging in collaborative problem-solving are essential for meaningful mathematics learning. This study therefore investigated the effect of the Problem-Solving Approach on learner participation in group discussions among secondary school mathematics students in Bondo sub-county, Kenya. The findings are expected to inform teaching strategies that enhance student engagement and collaborative learning in mathematics classrooms.

Problem Statement

Active learner participation is essential for meaningful mathematics learning because it promotes discussion, reasoning, and collaborative problem-solving. However, participation in many secondary school mathematics classrooms remains inadequate, with instructional practices often dominated by teacher-centered approaches that limit learners' involvement in classroom interactions. In Kenya, students are frequently given few opportunities to contribute ideas, ask questions, explain their thinking, or engage in group problem-solving activities. Although the Problem-Solving Approach (PSA) has been recognized as an effective strategy for improving mathematics learning, most existing studies have focused on its impact on academic achievement rather than its influence on learner participation. In Bondo Sub-County, limited classroom engagement and infrequent group discussions continue to be observed during mathematics lessons. This situation necessitates an investigation into the extent to which the Problem-Solving Approach can enhance learner participation in group discussions among secondary school mathematics students in Bondo Sub-County, Kenya.

Purpose of the Study

The main purpose of this study was to investigate the effect of the Problem-Solving Approach on learner participation in mathematics class group discussions in bondo sub-county, kenya.

Objective of the Study

To explore the effect of PSA on learner participation in group discussions within the Experimental group.

Theoretical Framework

Constructivism is a knowledge paradigm that prioritizes active learning, whereby students develop their comprehension of the world via experiences and social interactions (Schunk, 2016). Unlike conventional teaching paradigms where students passively absorb knowledge, constructivism advocates for active learner engagement with ideas, peer collaboration, and gradual refinement of understanding. This idea is mostly linked to the contributions of Jean Piaget and Lev Vygotsky, who asserted that knowledge building is a dynamic process including both individual cognitive growth and social interaction (Vygotsky, 1978). Social constructivism, based on Vygotsky's theories, asserts that learning is both an individual and a social process. Knowledge is collaboratively developed via interactions with others, especially peers and educators. Vygotsky's idea of the Zone of Proximal Development (ZPD) posits that learners attain elevated levels of comprehension when supported by educators or more knowledgeable peers (Vygotsky, 1978). The ZPD denotes the gap between a learner's autonomous capabilities and their potential accomplishments with assistance and support. This indicates that the learning process is non-linear; rather, it encompasses cooperation, feedback, and scaffolding, wherein learners progressively attain independence as their abilities and comprehension develop.

In the social constructivist classroom, the teacher's position transitions from a major knowledge provider to that of a facilitator or guide. Educators cultivate an atmosphere that facilitates learners' engagement in problem-solving activities, exploration of novel topics, and interaction with peers. Instead of providing material via direct teaching, educators within a constructivist framework pose open-ended questions, provide strategic clues, and furnish little direction to promote independent problem-solving among learners. This methodology enables students to have an active part in their education, enhancing engagement and cultivating critical thinking (Boud & Feletti, 2017).

The Problem-Solving Approach (PSA) in the classroom exemplifies the practical application of social constructivism, especially in disciplines such as mathematics. PSA is commonly operationalized through Polya's (1945) four-step problem-solving model: understanding the problem, devising a plan, carrying out the plan, and looking back. These steps align closely with the major components of social constructivism. The understanding the problem stage promotes social interaction and collaborative knowledge construction as learners discuss the problem, identify relevant information, and clarify concepts with peers and teachers. The devising a plan stage reflects scaffolding and negotiation of meaning, whereby learners generate, compare, and justify alternative solution strategies with support from peers and teachers. The carrying out the plan stage corresponds to guided learning within the Zone of Proximal Development (ZPD), as learners apply strategies, explain procedures, and receive feedback that helps them accomplish tasks beyond their independent capabilities. The looking back stage promotes reflection and knowledge reconstruction as learners evaluate solutions, consider alternative approaches, and refine their understanding. Through these stages, learners actively construct mathematical knowledge while engaging in meaningful social interactions.

Through the use of PSA and the guidance of more knowledgeable peers or teachers, learners navigate challenges within their Zone of Proximal Development (ZPD). During problem analysis and planning, learners receive scaffolding through questioning, discussion, and collaborative exploration. While carrying out the solution, they engage in peer-supported learning and receive feedback that strengthens conceptual understanding. During reflection, learners critically evaluate their reasoning and consolidate newly acquired knowledge. Thus, Polya's four-step model provides a practical mechanism through which the principles of social constructivism are implemented in mathematics classrooms by promoting collaboration, scaffolding, active participation, and reflective learning.

This theory was pertinent to the study because it explains how learners construct mathematical knowledge through social interaction, collaboration, and guided problem-solving. The Problem-Solving Approach, implemented through Polya's four problem-solving steps, provides opportunities for learners to actively participate in discussions, share ideas, justify solution strategies, explain reasoning, and reflect on their learning. Specifically, understanding the problem encourages questioning and discussion, devising a plan promotes collaborative decision-making and justification of ideas, carrying out the plan facilitates peer interaction and guided learning within the ZPD, while looking back supports reflection and evaluation of solutions. Consequently, the theory provides a foundation for examining how the Problem-Solving Approach influences learner participation in group discussions and mathematics learning outcomes.

LITERATURE REVIEW

Introduction

This chapter focuses on related literature and reviews key concepts around the influence PSA has on learner participation within the group discussions in the experimental group.

Problem Solving

According to Chris (2005), Problem Solving (PS), in any academic area, involves being presented with a situation that requires a resolution. For one to be termed as a problem solver, he/she is required to come up with means to resolve the problem to satisfaction since the ultimate goal of problem solving is to improve students' performance at solving problems correctly. Polya in 40s, 50s and 60s laid foundation for heuristics PS as the first person to

describe how heuristics in PS could be taught. In 1963, he further claimed that for one to construct new knowledge in mathematics, one should consider a suitable problem then apply the previous existing knowledge so as to solve the problem. This he referred to as rediscovery. Later, other researchers in mathematics education that emerged in 1970s such as Lucas, Goldberg, Cantowski, Putt among others extended Polya's ideas to show how heuristics can be of help to one when solving problems. Early work of PS such as that of Polya focused on describing the PS process but recent work focuses on identifying attributes of the problem solver that can lead to PS success. Some of the early researchers such as Schoenfeld (1985a) in his book "Mathematical Problem Solving" focused on analyzing how and why people are successful or not when they are solving problems. Some of the researchers who came after Polya like Carlson and Bloom (2005) developed a broad taxonomy to characterize major PS attributes that they identified as relevant to the success of PS. Polya was the first to describe how PS could be taught but the other researchers who came after him were interested in building on the Polya ideas on PS. This is the reason why the researcher chose PS instruction through Polya's four phases of problem solving that are described in his book "How to Solve it". Therefore, this study adapted four phases of PS generalized and defined by Polya in 1973 which are:

- i. **Understanding the Problem:** This phase involves learners working together to read, interpret, and clarify the problem. Group members discuss the information provided, identify what is known and unknown, ask questions, and share their understanding of the task. Through these interactions, learners actively participate in discussions and collaboratively construct meaning before attempting a solution.
- ii. **Devising a Plan:** In this phase, learners collaboratively generate and evaluate possible solution strategies. Group members propose ideas, justify their reasoning, compare alternative approaches, and negotiate the most appropriate method for solving the problem. This process promotes active participation through discussion, argumentation, and shared decision-making.
- iii. **Carrying out the Plan:** This phase involves implementing the selected strategy while working collaboratively with peers. Learners explain procedures, share responsibilities, provide feedback, and support one another in completing the solution. Active participation is demonstrated through communication, cooperation, and the exchange of mathematical ideas throughout the problem-solving process.
- iv. **Looking Back:** In the final phase, learners collectively evaluate the solution obtained and reflect on the problem-solving process. Group members discuss the accuracy of the solution, identify possible errors, consider alternative methods, and provide constructive feedback to one another. This reflective discussion promotes deeper understanding and encourages learners to actively contribute their perspectives and insights.

PSA on Learner Participation in Small Group Discussions

Student engagement in classroom learning is a vital element that may signify comprehension of the subject presented. Researchers have discovered that pedagogical methods fostering teacher-learner talks may enhance active learning among students, if the interactions are sufficiently substantive (Miheso-O'Connor, 2011). Yadgarorna and Husenorich (2020) identify numerous advantages of small group discussions, including enhanced learner participation across varying achievement levels, improved comprehension of content, effective

communication among peers, time efficiency for the instructor, facilitated observation of learner engagement, and opportunities for self-evaluation within specific groups. Students who engage in classroom activities and contribute to the learning process exhibit a positive attitude towards their peers and education (Richter & Tjosvoid, 1950), resulting in improved mathematics performance (Clarke & Wan, 2010; Muhonon, Pakarinen, Poikkeus, Lerkkanen & Rasku-Puttonen, 2018).

Research has shown a favorable association between students' mathematical performance and their ability to articulate and rationalize their behaviors within the context of the scenario (Pauli & Reusser, 2015). Furthermore, student engagement in class has been favorably connected with academic success, while lack of involvement has resulted in subpar performance. Gurer (2013) demonstrated a favorable correlation between class involvement and academic success. Permatasan (2016) said that students' engagement in classroom activities with classmates and educators enhances their cognitive abilities.

Zheng and Warshauer (2015) examined the impact of student involvement on academic attainment in the USA. Results demonstrated that learners engaged actively and interacted effectively, therefore enhancing their communication and language literacy via a well-structured online debate. Gottler (2010) examined whether fifth-grade learners actively engaged in classroom activities have comprehension and grasp of the subject matter. The inquiry pertained to whether this engagement influenced their comprehension of the acquired notion. The lecture technique and inquiry teaching method were used to gather both quantitative and qualitative data about learner engagement in classroom activities. Findings indicated that participation in classroom activities among learners enhanced their experience in both teaching approaches. Students engaged differently in both instructional modalities, with those instructed using the inquiry teaching technique exhibiting more activity than their counterparts taught via the lecture method.

Ewing (2007) said that insufficient involvement among learners in the classroom may stem from their self-perception about material comprehension. Many learners who see themselves as deficient in subject refrain from engaging in classroom teaching. It was noted that students with a good opinion of the subject matter are more likely to engage actively in the classroom compared to those with a negative perception of the topic.

Gresalfi, Martin, Hand, and Greeno (2009) found that learners exhibit significant variability in their understanding of mathematical ideas when taught using both lecture and inquiry techniques. In both pedagogical approaches, it is advised that educators facilitate peer interaction among learners to foster confidence in articulating their solutions and persuading their peers of their validity.

Ifamuyiwa and Lawani (2008) assert that the method of material delivery by the instructor in Nigerian classrooms enhances learner engagement and teacher-student interaction. This signifies a good association between the method of material delivery by teachers and student involvement in the classroom. They noted that the majority of techniques used in mathematics teaching are teacher-centered, hindering active student engagement; hence, there is a need to implement learner-centered approaches. They reiterated the significance of instructors' question formulation and probing, which would enhance active learner involvement in the classroom and promote small group conversations among students.

Although Mulongo (2013) established that active teaching methodologies enhance learner participation compared to passive instructional approaches, the study did not specifically

examine the Problem-Solving Approach (PSA) as a teaching strategy in mathematics classrooms. Furthermore, while existing studies have generally demonstrated the effectiveness of active learning methods in promoting student engagement, limited empirical evidence exists on how PSA influences learner participation in group discussions among secondary school mathematics students in Kenya. Most studies on PSA have primarily focused on mathematical performance, with little attention given to participation outcomes such as contributing ideas, asking questions, explaining reasoning, responding to peers, and engaging in collaborative problem-solving.

Summary of Research Gaps

Although previous studies have established that learner participation enhances understanding and academic achievement and that active teaching approaches promote greater classroom engagement than teacher-centered methods, limited research has specifically examined the effect of the Problem-Solving Approach (PSA) on learner participation in mathematics classrooms. Most existing studies have focused on general active learning strategies, inquiry-based instruction, or the impact of PSA on mathematics achievement rather than on participation outcomes. Consequently, there is insufficient empirical evidence on how PSA influences learners' participation behaviors, such as contributing ideas, asking questions, explaining reasoning, responding to peers, and engaging in collaborative problem-solving during small group discussions.

METHODOLOGY

Introduction

This chapter discussed the research design, the target population, the sample size, and the sampling procedure. In addition, considered in this chapter were instrumentation, pilot study, validation, and reliability of research instruments, methods of data collection, data analysis techniques, and ethical considerations.

Research Design

Creswell (2018) defines research design as the overall plan for linking conceptual research problems to relevant and feasible empirical research. It serves as a structured inquiry that provides specific guidance on research procedures. This study adopted a quasi-experimental non-equivalent design. This research design was chosen because the study involved students in school setting, where secondary school classes are typically pre-formed and cannot be randomly restructured for experimental purposes (White & Sabarwal, 2014). The study incorporated classroom observations during the treatment phase. Key aspects of classroom observation included: Individual reflection on tasks, sharing of individual findings with the group and group discussion, reporting and harmonization of group findings, re-organization of information and reconstruction of arguments by learners. The classroom observations followed Polya's problem-solving (PS) steps:

- a. Understanding the problem: Learners analyzed and identified the problem before proceeding.
- b. Devising a plan: Students formulated strategies to approach the problem collaboratively.
- c. Carrying out the plan: Implementation of strategies was monitored through group discussions and reporting and
- d. Looking back: Learners revisited their solutions, refined their arguments, and reorganized information for better understanding.

Target Population

The target population included 2,162 Form Two learners. The researchers' choice of Form Two learners is based on the following reasons; a) Form Two learners are the only class which is interacting with the new topics for the first time since the topics are not related with the primary level curriculum like in Form One and none of the topics is continued in this class like in Form Three and Form Four, b) this is the class where learners choose the subjects they will take during their KCSE hence the critical role of the class.

Sample and Sampling Procedure

The sample size consisted of 8 schools with a population of 784 students. The schools were purposively selected based on their level in the syllabus coverage.

Data Collection Instrument

Classroom Observation

Classroom observation is a qualitative data collection method that involves systematic recording of classroom events and interactions. The researcher recorded audio of small group discussions and captured photos of students' written work (artefacts) to document the learning process and interactions.

Validation of the Instrument

To ensure this, the research instrument developed was assessed by two experts in mathematics education at the university level (supervisors) and one in mathematics department at the secondary level (KNEC examiner).

Reliability of Research Instruments

To ensure the reliability of the research instrument, the researcher pretested the tool with a small sample of learners before the actual use. The pilot study challenges prepared the researcher to overcome the same challenges if they were to arise in the course of actual study.

Procedure to Collect Data

The PSA manual induction programme of the teachers in the four schools took one week. Therefore, the researcher visited each school at a specific day. The PSA manual was prepared with reference from different books on teaching through PSA. Thereafter, the actual teaching (treatment) commenced with experimental group being exposed to PSA. Eight teachers each taught a stream in the experimental schools because the study engaged two streams in each school. After teaching one lesson, there was researcher-teacher discussion reflecting on previous lesson delivery. Observations made by the researcher on teacher use of PSA as per the manual were discussed and some adjustments were made in the next lesson. Similar topics were taught within the same length of time (40 minutes per lesson) in each school in both of the groups. During the instruction, the researcher made classroom observations whereby learners' discussions in small groups were audio recorded and the photos of their working taken (artefacts) to aid in analysis. Teaching was done for eight weeks of six lessons of 40 minutes per week in each group. The whole study (pilot test excluded) lasted 9 weeks (one week for training the experimental teachers and pretesting and eight weeks for teaching).

Summary of Data Analysis

- Data Collected: Qualitative data from classroom observations (audio recordings and photos).
- Analysis: Thematic analysis.

- Findings: Students in the experimental group exhibited higher levels of participation, engagement, and confidence in mathematical discussions compared to the control group.

Ethical Considerations

Given that the study involved mostly minors (participants under the age of 18), informed consent was obtained from their parents or legal guardians and students who were above the age of 18 years. Only participants who returned signed forms were included in the study. To uphold confidentiality, the researcher ensured that video recordings captured only students' work and not their physical appearances. This measure safeguarded privacy, fostered a sense of security, and encouraged active participation in the study.

FINDINGS

Introduction

In this chapter, the study data is analyzed and interpreted based on the research question. Thereafter, the study findings were presented.

Discussion

During the learning process through PSA, learner participation was observed in the beginning, at the middle and towards the end of the study. During the PSA induction period, teachers liked the approach but they feared that it might consume most of their lesson time and end up not completing the huge syllabus. In addition, some of the teachers were not concerned about whether or not the approach would help the learners to understand mathematics concepts better but to complete the syllabus. Since mathematics performance in all the study schools was an issue, the mathematics teachers had a feeling that they would apply the approach so as to see its end results. Towards the end of the study, it was noticed that all of the experimental schools had covered most of the chapters that were meant to be taught in term one through the use of PSA just like the chapters the control schools had covered. This perhaps implied that PSA does not affect syllabus completion in any way. This statement was supported by the findings of Odindo and Masingila (2014), who established that teachers can still cover the syllabus within the stipulated time frame through use of PSA to teaching and learning of mathematics.

At the beginning of the study, teachers introduced the approach to the learners by showing them the stages they were supposed to follow while working on problems. Since the approach was not familiar to both the teachers and the learners, it was observed that most of the learners worked on the tasks themselves but they were too shy about explaining their individual findings to the group. In addition, most of the learners were not confident enough to actively contribute knowledge in their groups and only applied the first two steps of PS by Polya.

This was confirmed by one of the learners who said;

“I am used to copying what the teacher does on the board, but today most of us will end up discussing nothing in groups because everyone has a feeling that his/her solution is incorrect”.

This statement revealed that most of the learners were shy to report their individual findings to the group members for they thought their solutions were incorrect.

At the middle of the exercise, most of learners worked individually on the tasks but a few had gained some confidence of explaining their findings to the group. Equally, some of the learners

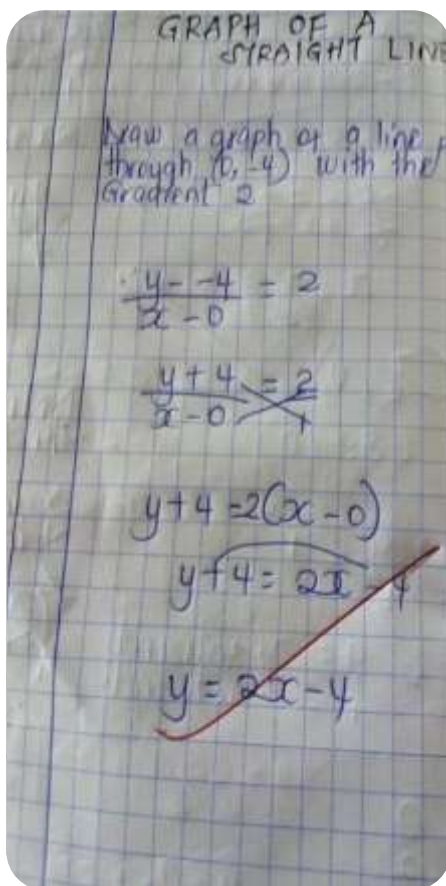
were actively engaged in the discussions and applied the three steps of PS by Polya but did not look back while solving the problems.

For instance; in one of the classes on the chapter; Gradient and equations of straight line, the following question was posed;

Question

Draw a graph of a line passing through (0,-4) with the gradient equals to 2.

For the learners to solve this problem they had to; first get the equation of this straight line through the known point, unknown point and the gradient. Thereafter, they had to draw a graph of this equation on a Cartesian plane. Some of the different individual findings before it was shared in the group for the decision to be arrived at are shown in Figures 1 and 2;



GRAPH OF A STRAIGHT LINE

Draw a graph of a line through (0, -4) with the Gradient 2

$$\frac{y - (-4)}{x - 0} = 2$$

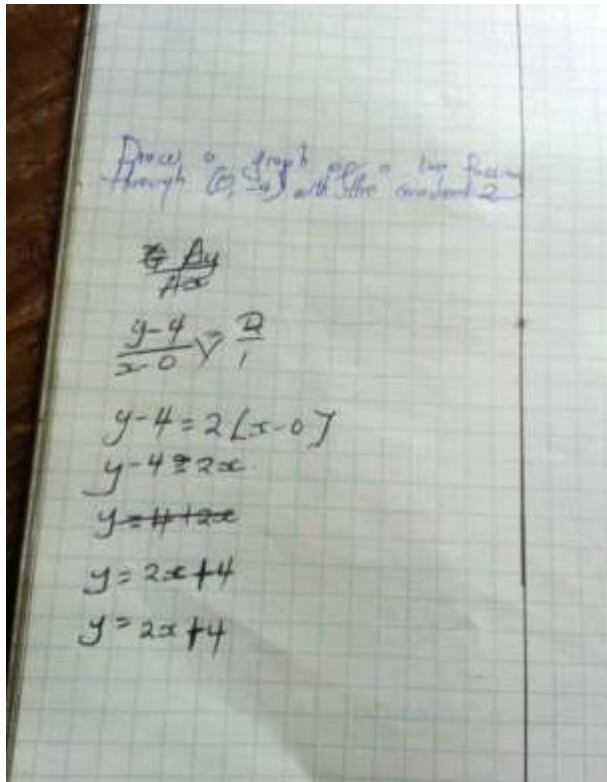
$$\frac{y + 4}{x - 0} = 2$$

$$y + 4 = 2(x - 0)$$

$$y + 4 = 2x - 0$$

$$y = 2x - 4$$

Figure 1: Solution A; Response to the Question; Find the equation of straight line through point (0,-4) with the gradient equals to 2



Answer: Find the equation of straight line through (0, -4) with slope gradient 2

$$\frac{y - y_1}{x - x_1} = \frac{m}{1}$$

$$\frac{y - 4}{x - 0} = \frac{2}{1}$$

$$y - 4 = 2(x - 0)$$

$$y - 4 = 2x$$

$$y = 2x + 4$$

$$y = 2x + 4$$

Figure 2: Solution B; Response to the Question; Find the equation of straight line through point (0,-4) with the gradient equals to 2

It was noted that there existed an interesting argument in one of the groups on the steps that individual members had followed which resulted into different solutions. In this group, some of the group members got solution A while others had solution B. In this argument, the two different sides of learners were defending their solutions as follows;

Learner M explained;

“To get the equation of this line, I calculated the difference in Y-intercept {y- (-4)} and divided it with the difference in X-intercept (x-0) and equated this to gradient (2).

I used (x,y) to represent the unknown point since one should have at least two points so as to get the equation of the line.

Since the given y coordinate is negative (-4), to get the difference then I subtracted (-4) from y coordinate; {y- (-4)}. When two negative signs follow each translates into a positive sign; (y+4).

This resulted into an equation $y = 2x - 4$ ”.

Learner N explained;

“To find the equation of the line, I calculated the difference in the y-intercept and divided it by the difference in x-intercept by use of given coordinate (0, -4), unknown point(x,y) and equated this to the gradient (2).

The y-intercept difference was (y-4) while x-intercept difference was (x-0) and gradient was 2.

This resulted into an equation $y = 2x + 4$ ”.

From this argument, it can be deduced that some members of this group who got solution B followed the first two steps of Polya that is; they understood the problem and devised a plan. However, they solved the problem with a positive y-coordinate that is (0, 4) instead of (0,-4) and perhaps did not look back. On the other hand, members who got solution A followed the four steps by Polya (Understood the problem, devised a plan, solved the problem and finally looked back). So as to ascertain the members who were at the right direction, members decided to substitute the given values of x and y coordinates into the two different equations. Finally, solution A was accepted as the correct equation. They all came into an agreement and the steps involved in calculating solution A were reported to the entire class.

Thereafter, the equation $y=2x-4$ guided in drawing a graph of the straight line as shown by Figure 3;

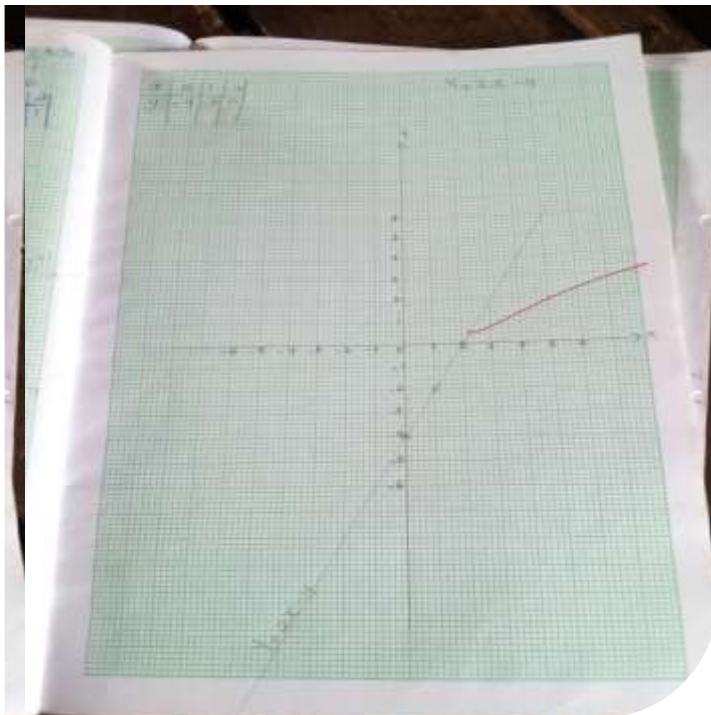


Figure 3: Graph of the Equation of Straight Line $y=2x-4$

Towards the end of the study, almost every learner's level of confidence rose. In this stage, learners were able to take part in all the four stages of learner participation. In addition, they correctly followed all the four steps of PS by Polya which then resulted to correct answers to the tasks. This perhaps could be as a result of the learners familiarizing themselves with the PSA and embracing it.

The use of PSA was seen to positively influence the learner participation. The results of this study were in conformity with the findings by Zheng & Warshauer, (2015) from USA, Gottler (2010) as well as Mulongo (2013) from Kenya all of which established that active teaching and learning methodology like PSA contributed much to learner participation than passive teaching methodology.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Summary

This study sought to explore the effect of PSA on learner participation in group discussions within the experimental group. To achieve this objective, the researcher made a classroom observation to ascertain how different categories of learners were interacting with each other in small group discussions while solving a given task. The findings indicated a positive influence, as evidenced by increased peer interactions during discussions. As the study progressed, learners became more actively involved in group discussions, demonstrating greater engagement and participation in the learning process.

Conclusion

PSA revealed a positive effect on student participation in group discussions within Experimental group. Learners became more engaged, collaborated more effectively, and demonstrated increased confidence in tackling mathematical problems. Towards the end of the study, students actively participated in discussions, reinforcing their understanding through peer interactions.

Recommendations

Based on the objective and study finding, the following recommendations were made to help students maximize the benefits of the Problem-Solving Approach (PSA) in mathematics learning:

- Students should take an active role in group discussions by fostering engagement and confidence.
- Learners should practice collaborative problem-solving, ensuring that every group member contributes to finding a solution.
- Students should adopt role rotations in group discussions (e.g., problem presenter, solution reviewer, question generator) to enhance teamwork and leadership skills.
- Learners should embrace constructive debate and critique, respectfully challenging each other's reasoning to deepen understanding.

Suggestions for Further Study

Since this study was not exhaustive, it was suggested that future studies be done to investigate the relationship between PSA and students' interest and attitudes towards mathematics which this study did not investigate.

REFERENCES

- Ali, R. (2010). Effect of using problem solving method in teaching mathematics on the achievement of mathematics students. *Asian Social Science*, 6(2), 67–72.
- Alfieri, L., Brooks, P. J., Aldrich, N. J., & Tenenbaum, H. R. (2011). Does discovery-based instruction enhance learning? *Journal of Educational Psychology*, 103(1), 1–18. <https://doi.org/10.1037/a0021017>
- Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn: Brain, mind, experience, and school*. National Academy Press.
- Christensen, L. B., Johnson, R. B., & Turner, L. A. (2015). *Research methods, design, and analysis* (12th ed.). Pearson.
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). SAGE Publications.
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.
- Ewing, B. (2007, September). *Participation and non-participation in mathematics classrooms*. In *Proceedings of the Ninth International Conference: The Mathematics Education into the 21st Century Project*.
- Gottler, R. M. (2010). *Passive or passionate participation in mathematics: Diagnosing and improving student participation in mathematics*.
- Gresalfi, M., Martin, T., Hand, V., & Greeno, J. G. (2009). Constructing competence: An analysis of student participation in the activity systems of mathematics classrooms. *Educational Studies in Mathematics*, 70(1), 49–70. <https://doi.org/10.1007/s10649-008-9141-5>
- Ifamuyiwa, A. S., & Lawani, A. O. (2008). Interaction patterns in mathematics classrooms in Ogun State secondary schools. *Academic Leadership: The Online Journal*, 6(3), 11.
- Jonassen, D. H. (2017). *Learning to solve problems: A handbook for designing problem-solving learning environments*. Routledge.
- Mullis, I. V. S., & Martin, M. O. (2017). *TIMSS 2019 assessment frameworks*. International Association for the Evaluation of Educational Achievement (IEA).
- Nwoke, B. I. (2015). Impact of problem solving approach on senior secondary school students' achievement in mathematics. *Journal of Research in Education and Society*, 6(1), 27–33.
- Odindo, F., & Masingila, J. O. (2014). *Teaching and learning of mathematics through problem-solving*. LAP Lambert Academic Publishing.
- Polya, G. (2011). *How to solve it: A new aspect of mathematical method* (2nd ed.). Princeton University Press.
- Reusser, K., Pauli, C., & Wright, J. D. (2015). Co-constructivism in educational theory and practice.
- Schunk, D. H. (2016). *Learning theories: An educational perspective* (7th ed.). Pearson.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Zhang, D., Ding, Y., Barrett, D. E., Xin, Y. P., & Liu, R. D. (2014). A comparison of strategic development for multiplication problem solving in low-, average-, and high-achieving students. *European Journal of Psychology of Education*, 29(2), 195–214. <https://doi.org/10.1007/s10212-013-0182-y>