(JIML) JOURNAL OF INNOVATIVE MATHEMATICS LEARNING
Volume 8, No. 2, June 2025
P-ISSN 2621-4733
E-ISSN 2621-4741
https://dx.doi.org/10.22460/jiml.v8i2.p28055

THE IMPLEMENTATION OF POLYA'S STRATEGY WITH LUMIO MEDIA TO ENHANCE STUDENTS' MATHEMATICAL PROBLEM-SOLVING SKILLS ON JUNIOR HIGH SCHOOL

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ARTICLE INFO

Article history:

Received Jun 19, 2025
Revised Jun 21, 2025
Accepted Jun 23, 2025

Keywords:

Mathematical Problem-Solving Skills
Polya Strategy
Lumio Media
Junior High School

ABSTRACT

Mathematics is a fundamental discipline that plays an important role in developing students' logical, analytical, and systematic thinking skills. However, many students still struggle with solving non-routine mathematical problems due to a reliance on memorization and teacher-centered learning. This study aims to improve students' mathematical problem-solving ability, especially in probability, through the implementation of Polya's problem-solving steps assisted by Lumio interactive media. This classroom action research employed the Kemmis and McTaggart model, consisting of planning, action, observation, and reflection stages conducted over two cycles. The research subjects were 12 eighth-grade students from SMP Muhammadiyah Kwandang. Data were collected through tests and observation sheets, then analyzed both quantitatively and qualitatively. The instruments included essay tests based on probability story problems and validated observation sheets for teacher and student activities. The results showed a significant improvement in students' problem-solving skills. The average score increased from 70.05% in the first cycle to 83.59% in the second cycle. The proportion of students achieving mastery also rose from 33% to 91.7%. Learning activities became more interactive and student-centered. It is concluded that integrating Polya's strategy and Lumio media is effective in enhancing students' mathematical problem-solving skills and active learning engagement.

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How to Cite:

Hanifa, Hulukati, E.P., & Isa, D.R. (2025). The Implementation of Polya's Strategy with Lumio Media to Enhance Students' Mathematical Problem-Solving Skills on Junior High School. *JIML,* 8(2), 383-389.

INTRODUCTION

Mathematics is a fundamental discipline that plays a crucial role in developing students' logical, analytical, and systematic thinking abilities. These competencies are essential not only in

academic settings but also in daily life, particularly when solving real-world problems that require critical and structured reasoning (Gagné in Amalia et al., 2023). One of the challenges in mathematics education is non-routine problems, which cannot be solved merely by memorizing formulas or applying standard procedures. These problems require students to thoroughly understand the problem, develop a solution strategy, execute the plan, and evaluate the result (Mayasari et al., 2020).

Unfortunately, many students face difficulties in solving non-routine problems because they are more accustomed to routine exercises and teacher-centered lectures that emphasize memorization. They lack familiarity with logical and critical reasoning needed to comprehend complex mathematical problems (Pauweni & Iskandar, 2020). According to Siswanto et al. (2024), Indonesian students' mathematical problem-solving skills remain relatively low, especially when dealing with word problems or real-life contextual tasks. As Hudojo emphasized (in Damayanti & Sukestiyarno, 2014), problem-solving is the core of mastering mathematics, not just an additional skill.

To make mathematics learning more meaningful and effective, careful planning is required, including the selection of appropriate teaching strategies and instructional media. Aqib (in Haluti et al., 2022) asserts that instructional media serve not only as tools to aid teaching but also as drivers of the learning process. Properly selected media can help transform abstract concepts into concrete understanding and strengthen interaction among teachers, students, and the learning environment (Mato in Aminuddin et al., 2024). Therefore, interactive and contextual learning media are essential to create a varied and engaging classroom atmosphere.

Observations conducted at SMP Muhammadiyah Kwandang revealed that most eighth-grade students had not demonstrated sufficient ability in solving mathematical word problems, especially on the topic of probability. Many of them could only solve conventional questions already covered by the teacher and struggled when presented with unfamiliar or non-traditional contexts. This issue was exacerbated by teacher-centered instruction, limited independent practice, and minimal use of interactive learning media. The students' low achievement scores also indicated weak conceptual understanding and poor problem-solving skills. The results of the daily assessment further confirmed this condition:

Table 1. List of learning outcomes of mathematics subjects in Semester of the 2022/2023 school year and the 2023/2024 school year

Class	Number ofStudents	Average Score	KTTP
VIII-1	24	60,42	70
VIII-2	17	59,74	

This shows the need for efforts to improve learning strategies that can improvestudents' problem solving skills. One strategy that has been proven to able to encourage problem solving skills is the Polya step strategy.This strategy was developed by George Polya (1973) and consists of four systematic stages: (1) understanding the problem, (2) devising a plan, (3) carrying out the plan, and solving the problem. out the plan), and (4) reviewing the solution (looking back). Polya emphasized that problem-solving is a practical skill that can be mastered through a continuous process of imitation and practice. According to Sukayasa in Ahda (2018), Polya's strategy has advantages because the process is process is simple, the activities are easy to understand, and commonly used in solving math problems.math problems. This strategy is also supported by Ausubel's meaningful learning theory Ausubel, which states that the learning process starts from receiving information, understanding, then mastering it Darmayanti et al, (2023: 3391).

However, for Polya's strategy to be effective, it needs to be supported by learning media that can create an interesting, participatory and interactive learning atmosphere. One of the media that is relevant to today's learning needs is Lumio. Lumio is an interactive and flexible digital learning platform that allows teachers to design and share learning materials in the form of quizzes, real-time collaboration, animations, and various multimedia content. According to Saleh (2017), media is a tool that functions to transmit messages so that communication between teachers and students becomes effective. In this context, Rizal et al. (2016) stated that learning media becomes an intermediary in delivering material in a more interesting way. Lumio supports direct interaction between teachers and students and enables collaborative learning activities Wirda et al. Janah et al. (2023:8043) emphasized that Lumio can improve students' critical thinking skills through interactive content, such as images, videos, audio, and educational games.

The effectiveness of Polya's step strategy is also reinforced by various studies. Research by Suliarti et al. (2024) showed a significant increase in students' learning activities and problem solving skills after using the Polya approach. Similarly, Harinder et al. (2023) proved that Polya's strategy can help students understand math story problems more systematically and deeply. In fact, according to Habuke et al. (2022), this strategy is very relevant in learning fractions and opportunities, especially if combined with interactive learning media.

Based on the above explanation, the integration between Polya's step problem solving strategy and Lumio learning media is the right solution to improve students' math problem solving skills. Polya's strategy provides a systematic and logical thinking structure, while Lumio presents a fun and interactive learning experience. It is expected that this approach can improve students' understanding of mathematics concepts, help them solve non-routine problems independently, and encourage the achievement of optimal learning outcomes in class VIII of SMP Muhammadiyah Kwandang.

METHOD

This research is a Classroom Action Research (CAR) with Kemmis and McTaggart model design which consists of four stages in each cycle, namely: planning, action implementation, observation and evaluation, and reflection. The purpose of this study was to improve the mathematical problem solving ability of 8th grade students of SMP Muhammadiyah Kwandang on chance material. The research subjects were 12 students, consisting of 4 girls and 8 boys, who were selected because they had relatively low problem solving skills. The instruments used in this study include written tests in the form of description questions based on chance story problems, and observation sheets of teacher and student activities. The media and learning aids used included LCD projectors, laptops, whiteboards, Lumio digital media, and Learner Worksheets (LKPD) that supported learning based on Polya's steps. All instruments have been validated by three expert lecturers and one mathematics teacher, and have been tested for validity and reliability through empirical tests.

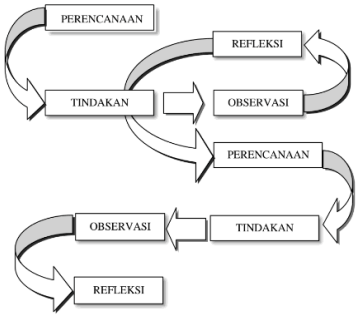

Figure 1. Kemmis & Taggart's Classroom Action Research Design

This research was carried out in two cycles, each of which consisted of the stages of planning teaching devices, implementing learning with Polya's step strategy (understanding the problem, planning a solution, implementing the plan, and checking back), observing the learning process, and reflecting to improve the action in the next cycle. Data analysis techniques are quantitative and qualitative. Quantitative data obtained from student test results, analyzed by the percentage and average formulas, with a minimum completeness criterion of 70 and a classical completeness limit of 80%. Qualitative data was obtained from the observation of student and teacher activities, then categorized into an activeness scale. The validity of the questions was tested using product moment correlation and the reliability was calculated using the Alpha formula. The indicators of the success of the action were the achievement of learning completeness by at least 80% of students, at least 80% of teachers showed good or very good performance, and 80% of students showed high activeness during the learning process.

RESULTS AND DISCUSSION

Results

This research was conducted in two cycles in class VIII of SMP Muhammadiyah Kwandang with a total of 12 students. The purpose of this study was to improve mathematics problem solving skills through Polya's step strategy assisted by Lumio media. The results of each cycle were measured through teacher and student activity observations and problem solving ability tests.

Table 1. Average Teacher and Student Observation Cycle I

Aspect	Percentage (%)	Category
Teacher Activity	74,14	Good
Student Activity	70,43	Active

Based on table 2, on the cycle 1, teacher activity in “Good” category, which means that teacher do all of their job following the instruction. Also with lumio media-assissted Polya’s strategy, students becom active.

Table 2. Results of Students' Problem Solving Skills Cycle I

Indicator	Percentage (%)	Category
Understanding the Problem	81,25	Very High
Planning a Solution	59,38	Low
Solving the Problem	71,88	Moderate
Interpreting the Solution	67,71	Moderate
Average	70,05	Moderate

Based on table 3, we can also see that most of students are in “Moderate” category for their problem-solving skills. There are 4 indicators, students are good on the first indicator, they have 81,25% which is in “Very High” category. But they’re still poor on the second indicator, they have 59,38% which is in “Low” category. And students are enough in the third and fourth category, they have 71,88% and 67,71 which are in “Moderate” category.

Because the results in cycle I have not yet reached the minimum target of 80%, the action was improved in cycle II.

Table 3. Average Teacher and Student Observation Cycle II

Aspect	Percentage (%)	Category
Teacher Activity	89,22	Very Good
Student Activity	86,64	Very Active

Based on table 4, on the cycle II, teacher activity is increased from "Good" category to "Very Good" category. Also students activity on cycle II are increased from "Active" to "Very Active".

Table 4. Results of Problem-Solving Skills Test Cyle II

Problem-Solving Ability Indicators	Percentage	Category
Understanding Problems	85,94	Very High
Planning Solutions	84,90	Very High
Solving Problems	81,25	Very High
Interpreting Solutions	82,29	Very High
Average	83,59	Very High

Based on table 5, we can see that most of students are in "Very High" category for their problem-solving skills. All of indicators are increased, the first indicator stayed at "Very High" category, second indicator increased from "Low" to "Very High" category, third and fourth indicators are increased from "Moderate" to "Very High" category. This means that Polya's Strategy with Lumio Media can increased stuedents' mathematical problem-solving skills.

Discussions

The results showed that the application of Polya's step strategy assisted by Lumio media was effective in improving students' math problem solving skills. In cycle I, the teacher's ability and students' activities have not reached the target, so the learning has not been optimal. This is indicated by the average teacher and student observations which are still below 80%, as well as the results of the problem solving ability test which only reached 70.05%.

After improvement in cycle II, all aspects experienced significant improvement. Observations of teacher and student activities showed excellent and very active categories. Students' test results also improved with an average of 83.59% and 91.7% of students reached mastery. Lumio media supports students' active involvement, facilitates understanding of the material, and creates an interactive learning atmosphere. Polya's step strategy helps students think systematically through the stages of understanding the problem, planning, solving, and reviewing the solution. This finding is consistent with previous research by Suliarti et al. (2024) and Harinda et al. (2023) who showed the effectiveness of Polya's strategy in improving mathematics problem solving. Thus, this strategy is worth using as an innovative approach in learning mathematics.

CONCLUSION

Based on the results of research and discussion, it can be concluded that the application of direct learning model integrated with Polya's step problem solving strategy assisted by Lumio media significantly improves students' mathematical problem solving ability on chance material. The observation results showed an increase in teacher activity from 74.14% in cycle I to 89.22% in cycle II, as well as an increase in student activity from 70.43% to 86.64%. This increase also

had an impact on the test results of students' problem solving skills, from 33% of students completed in cycle I to 91.7% of students completed in cycle II. In addition, the learning process became more interactive, no longer teacher-centered, but involved active interaction between teachers and students. Lumio media acts as an effective link in integrating Polya's step strategy into direct learning, thus creating a more interesting, meaningful, and participatory learning atmosphere. Thus, the collaboration between direct learning model, Polya's step strategy, and Lumio media proved to be effective in improving the quality of mathematics learning.

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