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The Influence of the Logan Avenue Problem-Solving – Heuristic Model on the Mathematical Reasoning Ability of Grade VIII Students of Haruru Christian Middle School

Mursaid Dahlan^{1*}, Ivatul Laily Kurniawati², Dhamas Mega Amarlitha³, and Junardin M. Masihu⁴

¹Department of Mathematics Education, STKIP Gotong Royong Masohi, Maluku, Indonesia

²Department of Elementary School Education, Universitas Negeri Malang, Malang, Indonesia

³Department of Biology Education, Universitas Islam Blitar, Blitar, Indonesia

⁴Department of Biology Education, STKIP Gotong Royong Masohi, Maluku, Indonesia

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***Correspondence:**

Address:

Asrama/Rusunawa Kompleks
Kampus STKIP Gotong Royong
Masohi, Jl. Trans Seram Belakang
Negeri Haruru

Email:

Mursaiddahlan910@gmail.com

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Abstract:

The purpose of this study was to determine whether there was any influence of the Logan Avenue Problem Solving Heuristic Model on the Mathematical Reasoning Ability of Class VIII Students of Haruru Christian Middle School, Amahai District, Central Maluku Regency. The method used in this study is a quasi-experimental method that is tested quantitatively. The population of this study was Class VIII class of Haruru Christian Middle School, Amahai District, Central Maluku Regency. The sampling technique used the Non-equivalent posttest only control group design technique. Class VIII1 students as the experimental class were given the Logan Avenue Problem Solving Heuristic model treatment and students in class VIII2 as the control class were given the Direct Learning model treatment. The calculation results obtained the average score of students from the experimental class = 82.82, while the average score of students from the control class = 58.6. Based on the normality test and homogeneity test of the two groups, it was found that the sample data were normally distributed and homogeneous so that the t test was used to test the hypothesis. The calculation results show $t_{\text{count}} = 8.6975 > t_{\text{table}} = 2.02108$ at a significance level of $\alpha = 0.05$. Thus H_0 "is rejected" and " H_1 is accepted". It means "There is an Influence of the Heuristic Logan Avenue Problem Solving Model on the Mathematical Reasoning Ability of Class VIII Students of Haruru Christian Middle School, Amahai District, Central Maluku Regency."

INTRODUCTION

Education plays a crucial role in improving the quality of human resources, which serve as a benchmark for a nation's progress and prosperity (Fajartriani et al. 2024). Therefore,

education begins at birth and continues through formal education. The school environment is the primary learning environment in formal education, fostering interaction between students and educators throughout the learning process (Pakaya and Posumah 2021).

Mathematics education in schools is aimed at students having reasoning skills, especially when solving problems in mathematics (Sumartini 2015). Hermawan and Hidayat (2018) stated that one of the tendencies that causes students to fail to master the main topics in mathematics is that students do not understand and use good reasoning in solving the problems given (Ovadiya 2025; Yang et al. 2023). Reasoning ability is one of the competencies that must be possessed by students.

Regarding reasoning, the National Council of Teachers of Mathematics states that in implementing mathematics learning, teachers must pay attention to five mathematical abilities, namely: connections, reasoning, communication, problem solving, and representations (Mundy 2000). The teacher's task is to be able to improve reasoning skills in mathematics learning to align with curriculum objectives (Choppin et al. 2022). The goal of the 2013 Curriculum is that students are expected not only to be able to apply concepts, but more so to how those concepts can be applied in various situations, and students' ability to reason and argue about how the problem can be solved (Winarti 2015). Therefore, if reasoning skills are not developed, it will give rise to students' understanding that mathematics material is only learned through a series of procedures and imitating examples without understanding their meaning and benefits (Gee 2020).

Research results (Sumartini et al. 2016) found that the lowest average percentage achieved by Indonesian students was in the cognitive domain at the reasoning level, namely 17%. Many factors influence this, one of which is the use of learning models. Therefore, teachers have a role in developing mathematical reasoning skills in students using the learning methods and approaches used. One learning model that can improve students' reasoning skills is the Logan Avenue Problem Solving – Heuristic. The basic concept of this model is to present open-ended problems to students where one student wants to know something about solving the problem so that other students also understand the problem (Aritonang and Sutopo 2022). In the LAPS-Heuristic model, learning activities tend to be student-centered, where students are given the opportunity to construct their own knowledge. (LAPS)-Heuristic is a learning model that guides students in solving problems by asking questions such as what the problem is, are there alternative solutions, is it useful, what the solution is, and how best to do it.

Polya in (Rasyid 2014) states that "an important part in the form of a series of questions that are guidelines for finding solutions to problems is the selection of problem-solving strategies that are equipped with applying: (1) reading and understanding the situation; (2) exploring ideas; (3) choosing a strategy; (4) looking for solutions; (5) checking to see if it is a solution to the problem. The importance of students working to solve problems allows students to be analytical in making decisions in their lives. If students are trained to solve problems, students automatically have the ability to collect relevant information, analyze information, and realize how necessary it is to re-examine the results that have been obtained.

Based on the results of the author's interview with a mathematics teacher at Haruru Christian Middle School, Amahai District, Central Maluku Regency on February 12, 2022, the

author found that students had difficulties in the mathematics learning process, especially in mathematical reasoning abilities. This was encountered by the teacher during the classroom learning process. Indicators indicating students' low mathematical reasoning abilities can be found from several problems that occurred, namely: (1) students had difficulty presenting mathematical statements orally, in writing, or with pictures or diagrams; (2) students had difficulty providing reasons or evidence for several solutions; (3) students had difficulty manipulating and proposing conjectures; (4) students had difficulty drawing logical conclusions from a statement. Based on the description above, the researcher is interested in conducting a study entitled "The Effect of the Heuristic LAPS Model on the Mathematical Reasoning Abilities of Grade VIII Students at Haruru Christian Middle School, Amahai District, Central Maluku Regency."

METODE

This study employed a quasi-experimental design using a posttest-only control group design to examine the effect of the Logan Avenue Problem Solving–Heuristic (LAPS-Heuristic) learning model on students' mathematical reasoning ability. The design was selected because the existing classroom structure did not permit random assignment of individual participants while allowing comparison between an experimental and a control group under authentic classroom conditions.

The research was conducted at Haruru Christian Junior High School, Central Maluku Regency, Indonesia, during the 2024/2025 academic year. The study involved 42 eighth-grade students distributed into two intact classes selected through purposive sampling. Class VIII-A ($n = 21$) served as the experimental group and received instruction using the LAPS-Heuristic learning model, whereas Class VIII-B ($n = 21$) served as the control group and was taught using conventional direct instruction. Both groups studied the same mathematics topics over an equivalent instructional period delivered by the same teacher to minimize instructor-related bias.

The independent variable was the implementation of the LAPS-Heuristic learning model, while the dependent variable was students' mathematical reasoning ability. Learning activities in the experimental class followed the LAPS-Heuristic syntax, which emphasizes identifying problems, generating alternative solution strategies, selecting appropriate heuristics, implementing solutions, and evaluating the obtained results. In contrast, the control group received teacher-centered instruction through explanation, demonstration, and guided practice.

Mathematical reasoning ability was assessed using an essay-based achievement test developed according to the reasoning indicators specified in the Indonesian mathematics curriculum, including mathematical representation, logical argumentation, justification of solution procedures, and conclusion drawing. Prior to implementation, the instrument underwent expert validation to establish content validity, and a pilot test was conducted to evaluate item validity and reliability before being administered in the main study.

Data were analyzed using IBM SPSS Statistics version 26. Descriptive statistics were first calculated to summarize students' mathematical reasoning performance. Assumptions of normality and homogeneity of variance were subsequently examined using the Shapiro–Wilk and Levene's tests, respectively. Following confirmation that the assumptions were

satisfied, an independent-samples t-test was performed to determine whether significant differences existed between the experimental and control groups. Statistical significance was established at $p < 0.05$.

RESULT AND DISCUSSION

In this study, learning took place in two sessions in both the experimental and control classes. At the final meeting, after the learning session, a mathematical reasoning ability test was administered. The mathematical reasoning ability test consisted of four questions, which were validated by a validator. The research instrument used in this study was a learning implementation observation sheet, consisting of two learning models: the Logan Avenue Problem Solving (LAPS) – Heuristic model and the conventional (Direct Learning) model. Both learning models used observation sheets for the teacher and students, respectively. The observation sheets were administered during the learning process. The results of the mathematical reasoning ability test of class VIII1 students at Haruru Christian Middle School, Amahai District, Central Maluku Regency, using the Logan Avenue Problem Solving (LAPS) – Heuristic model are shown in Tables 1 and 2 below.

Table 1. Criteria for Mathematical Reasoning Ability of Students in the Experimental Group

Mathematical Reasoning Ability Score	Category	Frequency	Percentage (%)
81-100	Very good	12	71
61-80	Good	5	29
41-60	Pretty good	0	0
21-40	Not enough	0	0
<21	Very less	0	0

From Table 1 above, it can be seen in the criteria for mathematical reasoning ability that the very good category consists of 12 students with a percentage of 71%, the good category also consists of 5 students with a percentage of 29%, there are no students with a fairly good category with a percentage of 0%, there are no students with a less category with a percentage of 0%, and there are no students with a very less category with a percentage of 0%. Data on students' mathematical reasoning ability scores using the Logan Avenue Problem Solving (LAPS) - Heuristic model (Experimental Class). From the reasoning ability scores of the experimental class taught using the Logan Avenue Problem Solving (LAPS) - Heuristic model, the highest score is 94 and the lowest score is 75. The average of the calculation of students' scores is 82.82 with a standard deviation of (s) 6.64 and a variance of 44.15 with a sample size of 17 students.

Table 2. Criteria for Mathematical Reasoning Ability of Students in the Control Group

Mathematical Reasoning Ability Score	Category	Frequency	Percentage (%)
81-100	Very good	0	0
61-80	Good	11	44
41-60	Pretty good	14	56
21-40	Not enough	0	0
<21	Very less	0	0

From Table 2 above, it can be seen in the criteria for mathematical reasoning ability that there are no students in the very good category with a percentage of 0%, the good category consists of 11 students with a percentage of 44%, the fairly good category of 14 students with a percentage of 56%, there are no students in the less category with a percentage of 0% and there are no students in the very less category with a percentage of 0%. Data on students' mathematical reasoning ability scores using the Direct Learning model (Control Class). From the mathematical reasoning ability scores of the control class taught using the Direct Learning model, the highest score was 75 and the lowest score was 44. The average of the calculation of students' scores was 58.6 with a standard deviation of (s) 10.07, and a variance of 101.41 with a sample size of 25 students.

The detailed results of the descriptive test of the experimental class and control class are presented in Figure 1 below.

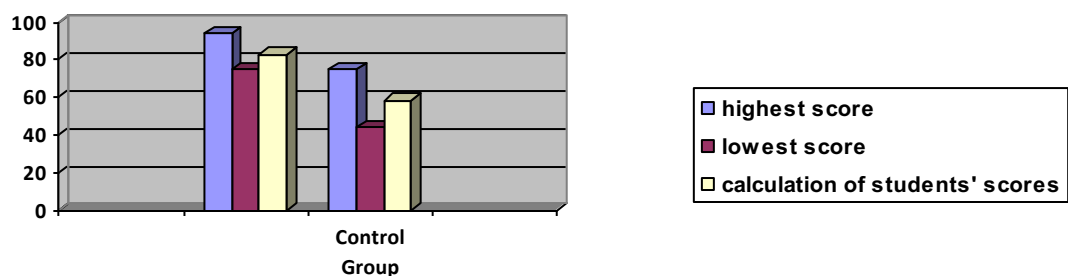


Figure 1. Descriptive Test Results of the Experimental Class and Control Class the Mathematical Reasoning Ability

The data in Figure 1 presents a comparison of students' mathematical reasoning ability scores between two groups: an experimental class and a control class, each taught using a different learning model. The experimental class, taught using the Logan Avenue Problem Solving (LAPS) - Heuristic model, consisted of 17 students. In this group, the highest score achieved was 94, while the lowest recorded score was 75, indicating that all students performed within a relatively high range. The average score for the experimental class was 82, reflecting strong overall performance and indicating that most students were able to effectively understand the material under this teaching approach. In contrast, the control class, taught using the Direct Instruction model, consisted of 25 students. The highest score in this group was 75, while the lowest score was 44, indicating a much wider spread in student performance. The average score for the control class was 58.6, significantly lower than that of the experimental class. Based on these descriptive statistics, the experimental class showed better performance than the control class both in terms of the highest score achieved and the overall average, which indicates that the LAPS-Heuristic model may be more effective than the Direct Learning model in improving students' mathematical reasoning abilities.

Hypothesis Analysis

Before conducting the hypothesis test, analysis requirements were first tested, namely data normality and homogeneity tests. A normality test was performed on a set of data to

determine whether the data population obtained was normally distributed or not. Data normality testing was performed using the Lilliefors test. The test results showed $L_{hitung} < L_{tabel}$ for both groups. In conclusion, the data were normally distributed at a significance level (α) = 0.05. The homogeneity test was conducted to obtain the assumption that the research samples originated from the same conditions. This homogeneity test analysis used the Fisher Exact Test. The calculation results showed $F(count) = 0.4354 > F(table) = 2.09$, so it can be concluded that the mathematical reasoning ability data for both data groups have homogeneous variance at a significance level of $\alpha = 0.05$.

The hypothesis of this research is that there is an influence of the Logan Avenue Problem Solving (LAPS) – Heuristic model on the mathematical reasoning ability of Class VIII1 Students of Haruru Christian Middle School, Amahai District, Central Maluku Regency”. The calculation results show that $t_{count} = 8.6975 > t_{table} = 2.02108$ at a significance level of $\alpha = 0.05$, thus H_0 is rejected. This means that the mathematical reasoning ability of students in the experimental group is significantly different from the mathematical reasoning ability of students in the control class.

These findings are supported by (Rasyid 2014) who found that the average mathematical reasoning ability score of students in the experimental class was 22.39 with a standard deviation of 3.36. In the control class, the average mathematical reasoning ability score of students was 18.95 with a standard deviation of 3.68. The test concluded that there was a significant difference between the mathematical reasoning abilities of students in the experimental class and the control class. According to (Aritonang and Sutopo 2022), the learning process that students had gone through in the experimental class who were given the Logan Avenue Problem Solving (LAPS)-Heuristic learning model showed an increase in learning activities in the classroom. This increase had an impact on the learning process, students were more active in each lesson, and interaction between students also increased. Students noted important things and informed their group mates, collaborated with each other during the learning process, and discussed solving problems together. In contrast to the control class, students simply came, sat, listened, took notes, and memorized the material. Consequently, they were given less opportunity to develop their ideas to solve the problems presented. Consequently, their mathematical reasoning skills were low. This was evident when students were given problems that differed from those previously given by the teacher, they struggled to solve them. This was because they lacked understanding of the problem/problem; they were simply accustomed to memorizing the problem. Furthermore, when students were asked to create mathematical models from word problems, most of them failed to understand them, and when asked to explain their work, many remained confused. Consequently, their learning outcomes were low. Furthermore, the learning process was monotonous and disengaged students. Researchers found that some students were unenthusiastic about completing the practice problems given by the teacher. This was because they did not understand the material presented by the teacher (Ridha 2017).

CONCLUSION

This study demonstrates that the Logan Avenue Problem Solving–Heuristic (LAPS-Heuristic) model significantly enhances the mathematical reasoning ability of Grade VIII

students compared with conventional direct instruction. Students who learned through the LAPS-Heuristic model achieved substantially higher mathematical reasoning scores than those in the control group, indicating that structured heuristic problem-solving activities effectively promote students' abilities to analyze mathematical situations, construct logical arguments, evaluate alternative solution strategies, and draw valid conclusions. These findings confirm that student-centered learning environments emphasizing inquiry, collaboration, and reflective problem solving are more effective in fostering mathematical reasoning than teacher-centered instructional approaches.

The findings contribute to mathematics education by providing empirical evidence that the LAPS-Heuristic model is a promising pedagogical approach for strengthening higher-order reasoning skills at the junior secondary level. The model encourages active student engagement and systematic reasoning processes that are consistent with current curriculum expectations for developing critical and analytical thinking competencies. Consequently, mathematics teachers may consider integrating the LAPS-Heuristic model into classroom instruction to improve students' reasoning performance and problem-solving capabilities.

Nevertheless, this study has several limitations. The research employed a quasi-experimental posttest-only design involving students from a single school with a relatively small sample size, limiting the generalizability of the findings. Future studies should include larger and more diverse samples, adopt longitudinal or mixed-methods approaches, and examine the effectiveness of the LAPS-Heuristic model across different mathematical topics, educational levels, and learning environments. Further investigations may also explore its impact on other higher-order thinking outcomes, such as critical thinking, creativity, mathematical communication, and metacognitive skills.

AUTHOR STATEMENTS

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Authors' Contribution

Author 1 served as the corresponding author and was responsible for conceptualizing the study, designing the research methodology, supervising the research implementation, conducting data analysis, interpreting the findings, and preparing the original manuscript. Author 2 contributed to the development of the research instruments, validation of the mathematical reasoning test, statistical analysis, interpretation of the results, and critical revision of the manuscript. Author 3 participated in the implementation of the learning intervention, classroom observations, data collection, documentation, and monitoring of the experimental and control groups throughout the study. Author 4 contributed to data verification, manuscript editing, language refinement, critical review of the article, and approval of the final version for publication. All authors actively participated in discussing the research findings and approved the final manuscript before submission.

Disclosure Statement

The authors declare that there are no conflicts of interest regarding the publication of this study.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request

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REFERENCES

- Aritonang, B., and A. Sutopo. 2022. "Pengaruh Model Pembelajaran Logan Avenue Problem Solving (LAPS)-Heuristik terhadap Kemampuan Kognitif dan Soft Skill." *JEVTE: Journal of Electrical Vocational Teacher Education* 2 (1): 10–21. <https://doi.org/10.24114/jevte.v2i1.35880>.
- Choppin, J., A. Roth McDuffie, C. Drake, and J. Davis. 2022. "The Role of Instructional Materials in the Relationship Between the Official Curriculum and the Enacted Curriculum." *Mathematical Thinking and Learning* 24 (2): 123–148. <https://doi.org/10.1080/10986065.2020.1855376>.
- Fajartriani, T., A. Habibi, D. Rosalina, and W. Karsiwan. 2024. "Peran Pendidikan dalam Meningkatkan Kualitas Sumber Daya Manusia." *JEALO: Jurnal Administrasi Pendidikan* 6 (1): 9–17. <https://journal.umbogorraya.ac.id/index.php/JEALO/article/view/318>.
- Gee, E. 2020. "Hubungan Gaya Kognitif dengan Kemampuan Penalaran Matematika Siswa SMP Kelas VIII." *Jurnal Education and Development Institut Pendidikan Tapanuli Selatan* 8 (3): 225–230. <https://journal.ipts.ac.id/index.php/ED/article/view/1942>.
- Hermawan, A. S., and W. Hidayat. 2018. "Meningkatkan Kemampuan Penalaran Matematik Siswa SMP Melalui Pendekatan Penemuan Terbimbing." *JPMI (Jurnal Pembelajaran Matematika Inovatif)* 1 (1): 7–12. <https://doi.org/10.22460/jpmi.v1i1.p7-12>.
- Mundy, John F. 2000. "Principles and Standards for School Mathematics: A Guide for Mathematicians." *Notices of the American Mathematical Society* 47 (8): 868–876.
- Ovadiya, T. 2025. "Training Problem-Solving Skills by Building Connections: The Case of Struggling High School Students." *International Journal of Mathematical Education in Science and Technology*. <https://doi.org/10.1080/0020739X.2025.2512473>.
- Pakaya, I., and J. H. Posumah. 2021. "Pengaruh Lingkungan Sosial terhadap Pendidikan Masyarakat di Desa Biontong I Kecamatan Bolangitang Timur Kabupaten Bolaang Mongondow Utara." *Jurnal Administrasi Publik* VII (104): 11–18. <https://ejournal.unsrat.ac.id/v3/index.php/JAP/article/view/33692>.
- Rasyid, M. R. 2014. *Penerapan Model Pembelajaran LAPS-Heuristic dengan Pendekatan Open Ended dalam Upaya Meningkatkan Kemampuan Pemecahan Masalah dan Penalaran Matematis Siswa SMA*. Skripsi. Bandung: Universitas Pendidikan Indonesia. <https://repository.upi.edu/12180/>.

- Ridha, Moch. Rasyid. 2017. "Meningkatkan Kemampuan Pemecahan Masalah dan Penalaran Matematis dengan LAPS-Heuristic dan Pendekatan Open-Ended." *MATHLINE: Jurnal Matematika dan Pendidikan Matematika* 2 (1): 91–108. <https://doi.org/10.31943/mathline.v2i1.38>.
- Sumartini, Tina Sri. 2015. "Peningkatan Kemampuan Penalaran Matematis Siswa melalui Pembelajaran Berbasis Masalah." *Mosharafa: Jurnal Pendidikan Matematika* 4 (1): 1–10. <https://doi.org/10.31980/mosharafa.v4i1.323>.
- Sumartini, Tina Sri, J. A. Dahlan, and T. Mulyana. 2016. "Penerapan Model Pembelajaran Concept Attainment." *SIGMA DIDAKTIKA: Jurnal Pendidikan Matematika* 4: 181–190. <https://doi.org/10.17509/sigmadidaktika.v4i2.31985>.
- Winarti, S. 2015. *Analisis Kemampuan Penalaran Siswa dalam Menyelesaikan Soal Serupa PISA pada Siswa Kelas VIII*. Skripsi. Surakarta: Universitas Muhammadiyah Surakarta. <https://eprints.ums.ac.id/40554/1/NASKAH%20PUBLIKASI.pdf>.
- Yang, K. L., Y. H. Cheng, T. Y. Wang, dan J. C. Chen. 2023. "Preservice Mathematics Teachers' Reasoning About Their Instructional Design for Using Technology to Teach Mathematics." *Asia-Pacific Journal of Teacher Education* 51 (3): 248–265. <https://doi.org/10.1080/1359866X.2023.2198116>