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The Influence of the Discovery Learning Model on Students' Mathematical Problem-Solving Ability

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Abstract: These findings are useful for evaluating the impact of the Discovery Learning (DL) model on students' mathematical problem-solving skills. This was conducted using a Systematic Literature Review (SLR) approach. Of the 30 articles found, 19 were selected based on topic relevance and publication years 2021–2025. The findings demonstrate that the use of problem-solving models has a positive impact on students' analytical skills, conceptual understanding, learning interest, creativity, and activeness. Combined with learning media, tailored to learning styles, and considering student characteristics such as resilience and personality, DL increases its effectiveness. Furthermore, recent research shows that DL is relevant for application across various teaching materials and educational levels. Furthermore, DL has the ability to overcome the shortcomings of conventional approaches, which tend to be passive. Therefore, Problem Solving Skills can be used as a useful alternative teaching module to help students acquire mathematical skills appropriate to the modern era.

Keywords: Discovery Learning, Problem Solving, Mathematics

INTRODUCTION

Mathematics is crucial for improving students' logical, analytical, critical, and systematic thinking. Problem-solving is a crucial skill to learn when studying mathematics. Students need this skill not only for academic purposes but also to fulfill their need for critical thinking in real-world situations. Unfortunately, many findings show that students still perform poorly in solving math problems. Students can often complete examples or practice exams provided by teachers. However, dealing with non-routine problems requires reasoning and creative problem-solving strategies.(Firman, 2024).

One cause of this inability is the dominance of teacher-centered learning. Teachers use conventional approaches, such as lectures or example problems, while students passively receive information. This process diminishes students' skills in critical thinking, exploration, and independent discovery. As a result, students lack interest or desire to learn

mathematics.(Dikdas et al., 2023)also said the same thing. They said that students can learn mathematics more effectively if they actively participate in the process of constructing knowledge rather than simply receiving information.

A learning model is needed that can inspire students, spark their enthusiasm and curiosity to learn more, and provide them with the opportunity to explore ideas through direct experience. Approaches such as the Discovery Learning Model meet this need. This model emphasizes that students must participate in the process of concept discovery. This process consists of identifying problems, formulating hypotheses, gathering information, and finally drawing conclusions. The teacher acts as a facilitator and guides students. Therefore, students not only memorize formulas but also expand their conceptual understanding through their own learning experiences.

Recent studies show that the discovery teaching model can optimize mathematics learning abilities.(Innovation et al., 2024)found that students who learned using this method had better problem-solving skills compared to conventional learning. They also demonstrated positive attitudes toward implementation.(Learning, Innovative, Laela, et al., 2024)found similar results, stating that Discovery Learning helps students solve problem-solving problems with more critical and systematic concepts. In addition, research conducted by(Heroes & Tambusai, 2023)explained that the use of this model in mathematics lessons in elementary schools was able to increase learning completion from 66.05% to 87.1% in two learning cycles.

This model not only helps solve problems, but also helps students learn skills such as logical thinking, innovation, interaction, synergy, and collaboration.(Yulia et al., 2023)Discovery learning contributes to strengthening the Pancasila Student Profile by encouraging students to participate actively, independently, and develop the ability to solve practical problems. Similar results were also reported by(Khaerunisa & Fisher, 2024), which found that using Discovery Learning and a culturally responsive learning approach optimized students' mathematical memorization skills. Therefore, it is clear that students' mathematical problem-solving skills remain a problem that needs to be addressed. Discovery Learning has proven to be a strategic solution to improve the quality of learning. Consequently, this study was conducted to further explore the effects of the Discovery Learning teaching module on students' mathematical problem-solving skills.

METHOD

Systematic Literature Review

The focus of this research is the influence of the Discovery Learning model on students' ability to solve mathematical problems. The purpose of using the Systematic Literature Review (SLR) method is to identify, investigate, evaluate, and interpret all findings relevant to the research subject. Paul et al. (2012) stated that SLR is a systematic research method based on published scientific evidence to answer specific research questions. In this finding, the SLR process is divided into several steps, namely: (1) creating research questions relevant to the topic; (2) finding articles that match certain keywords; (3) evaluating the relevance of articles based on inclusion and exclusion criteria; (4) summarizing research results from relevant articles; and (5) interpreting the results to answer the research questions (Putra & Andriani, 2021; Siregar et al., 2020).

INCLUSION CRITERIA

Several inclusion criteria were established to obtain information that supports the research's merits. These criteria included: the article was the result of research in mathematics education examining the effectiveness of the Discovery Learning module on students' mathematical problem-solving skills; the article was published between 2021 and 2025; and the article was published in indexed national scientific papers and verified international articles.

These criteria were used to ensure that the selected articles were truly relevant, up-to-date, and could provide a strong scientific basis for the analysis.

During the data collection process, the researcher used a combination of keywords "Discovery Learning", "problem solving", and "mathematics" to identify 30 initial articles from the Google Scholar, ERIC, DOAJ, and Garuda Portal databases. To ensure the novelty of the research, the search was limited to the years 2020 to 2025. Of the 30 articles, 11 were irrelevant, and 19 were relevant. These were then summarized and tabulated in a table that included the title, author, journal identity, research results, and reviews.

RESULTS AND DISCUSSION

Below is a table containing several relevant research articles on problem solving models assisted by teaching aids in mathematics.

Table 1. Research Results of Problem Solving Teaching Modules with the support of concrete facilities in Mathematics Learning

Title, Author, Journal Identity	*Research result*	*Review Results*
Title: The Relationship between the Discovery Learning Model and Cognitive Conflict Strategy on Students' Mathematical Problem Solving Ability. **Author:** Dedi Saputra Siagian, Ellis Salsabila, & Etti Dwi Wiraningsih (2023). **Journal:** Griya Journal of Mathematics Education and Application.	Students improved at solving math problems using the Problem Solving learning module and cognitive conflict strategies. Learning scenarios helped students understand the problem, plan a solution, implement the plan, and review the results according to Polya's stages.	Students can improve their critical and creative thinking skills, be more active in finding ideas, overcome misconceptions, and optimize their math problem-solving skills in a gradual and systematic manner by combining discovery learning and cognitive conflict.
Title: The Effect of Discovery Learning Model Assisted by Articulate Storyline Animation Media on the Mathematical Problem-Solving Ability of Grade VIII Students in Odd Semester of SMP Negeri 16 Bandar Lampung in the 2022/2023 Academic Year. **Author:** Anggita Rahayu, Aty Nurdiana, & Hesti Noviyana (2023). **Journal:** Scientific Journal of Mathematics Education Students, STKIP PGRI Bandar Lampung.	According to the t-test results, the t value = 2.69 and the t value = 2.01, which indicates that the Problem Solving teaching module assisted by animative learning devices through Articulate Storyline has a significant influence on students' ability to solve mathematical problems. The experimental academic findings (71.97) show superiority over the control class (63.55).	Compared to conventional learning, the Discovery Learning model with the help of Articulate Storyline media can optimize students' views on methods, increase student activity, and optimize mathematical problem-solving skills.
Title: The Influence of Guided Discovery Learning on Problem Solving Skills in the Fiqh Subject of Class X MAS Jam'iyah Mahmudiyah Tanjung Pura. **Author:** Mida Fitriana, Muhammad Saleh, & Ahmad Zaki (2022). **Journal:** Journal of Education, Social Sciences, and Community Service.	The research findings indicate a significant and unidirectional relationship between discovery-guided learning and students' problem-solving abilities. The correlation value of rxy = 0.818, indicating a strong/high correlation level. According to the regression equation, Y = 19.76 + 0.66X, problem-solving skills can increase by 0.66 units for every one-unit	Students gain enhanced evaluative and analytical thinking skills, as well as problem-solving skills, through the guiding discovery learning module. Students actively identify problems, analyze data, make predictions, and conclude solutions. This model is suitable for Islamic jurisprudence (fiqh) learning because it facilitates students' mastery of ideas and systematic problem-solving.

Title, Author, Journal Identity	*Research result*	*Review Results*
	increase in discovery-guided learning.	
Title: Application of Discovery Learning Model to Improve Mathematical Problem Solving Ability of MTs Grade VIII Students. **Author:** Sifa Salamah, M. Afrilianto, & Tina Rosyana (2024). **Journal:** Journal of Innovative Mathematics Learning.	As shown by scientists in a non-pure experimental study using a pretest-posttest control group design, students in the experimental class using the discovery learning model were better at solving math problems than students in the control academic class. The N-Gain score of the experimental academic class was only 0.29, but the control class had an average score of 0.67, which is in the medium category. As evidence that there is a significant difference, the p-value of 0.000 is lower than $\alpha = 0.05$, as shown by the t-test.	As an alternative to conventional teaching, the Mathematical Problem Solving model can be used to improve MT students' mathematical problem-solving abilities because it increases self-confidence and logical reasoning skills and encourages students to reason systematically.
Title : Meta-Analysis of the Influence of the Discovery Learning Model on Students' Mathematical Abilities. **Author:** Windi Emawati Kufa & Nora Susilowaty (2022). **Journal:** Journal of Padegogik.	As a result of the analysis of 30 studies conducted between 2018 and 2021, the average effect size = 1.05 (large), problem-solving level = 1.18 (highest), junior high school level = 1.08, and SPLDV material = 1.94.	*Discovery Learning*Improves logical reasoning, creativity, problem solving, and conceptual thinking. This is excellent for junior high school and SPLDV materials.
Title : The Influence of the Discovery Learning Model on Problem Solving Skills in Mathematics Learning for Class VIII Junior High School Students. **Author:** Nurul Wali'ah & Rina Susilowati (2024). **Journal:** *Journal of Educational Mathematics and Science.*	A quasi-experimental study with 59 students in academic VIII of SMP Negeri 1 Lenangguar. There was a significant variation in the experimental class (Discovery Learning) and the conventional control class, according to the t-test findings, with a significance value of $0.013 < 0.05$. The experimental class had a posttest average of 73.17, which was higher than the control class of 63.28.	*Discovery Learning*has been shown to be more effective than lectures in optimizing mathematical problem-solving skills. This model encourages students to participate in the learning process, become independent, and be active. Understanding problems, planning, solving, and concluding are all indicators of improved problem-solving skills.
Title : Application of Discovery Learning to Mathematical Problem Solving Ability Reviewed from Learning Style. **Author:**	The quasi-experiment was conducted by 62 fourth-grade students from Mangalli Center Public Elementary School. The t-test results showed that sig. (2-tailed) $0.000 < 0.05$, which indicates that there is a significant influence of discovery learning on	Research shows that using problem-solving techniques optimizes the math problem-solving abilities of elementary school students with various learning styles (visual, auditory, and kinesthetic). This model makes students more active, critical, and

Title, Author, Journal Identity	*Research result*	*Review Results*
Princess Astina Abi, Baharullah, & Sulfasyah (2025). **Journal:** PEDAGOGICS.	problem-solving abilities based on learning styles. The N-Gain score of the experimental class was 0.78, which shows a high criterion, and the control value was 0.59, which shows a medium category.	systematic. The study also emphasizes that teachers must adapt the implementation of discovery learning to their students' learning styles for better results.
Title : The Influence of the Guided Discovery Learning Model on Mathematical Solving Ability. **Author:** Nova Martilina Halawa, Sadiana Lase, Yulisman Zega, & Yakin Niat Telaumbanua (2024). **Journal:** Journal of Education Torch (JSP).	The sample of ninth-grade students at SMP Negeri 3 Gunungsitoli was IX-A (experimental, directed learning) and IX-B (control, conventional). There was a significant difference, as the t-test results showed that t = 3.056 was greater than t = 2.004. The mathematical abilities of students in the experimental class exceeded the average achievement of students in the control class.	Arithmetic problem-solving skills improve significantly with discovery-guiding learning. Students become more active and better able to reason logically.
Title : Experimentation of the Guided Discovery Learning Model on Students' Mathematical Problem-Solving Abilities Reviewed from the Students' Personality. **Author:** Nuriana, Prasetyo Budi Darmono, & Isnaeni Maryam (2024). **Journal:** Journal of Education and Learning Technology.	Quasi-experiment with 2×2 factorial design on 62 seventh grade students of SMP Negeri 18 Purworejo. ANOVA results showed that directed learning helped learning better than direct instruction (Fobs = 6.07 > Ftab = 4.01). Extrovert students had lower average scores than introvert students (85.78). Learning model and personality did not interact significantly.	In terms of improving problem-solving skills, discovery learning has been shown to be superior to direct instruction. Introverted students perform better than extroverted students in both GDL and DI. Consequently, teachers must adapt their learning models to meet students' personality characteristics for better learning outcomes.
Title : Comparative Study Between Discovery Learning and Self-Directed Learning Models on Students' Problem-Solving Abilities **Author:** Dicky Ezaldi, Lussy Midani Rizki, & Zulhendri (2023) **Journal:** *Journal of Education Research*	A quasi-experiment at SMK Negeri 1 Kuok, where 72 students were in grade XI. In Grade XI Discovery Learning, the average score was 60.64, which is in the sufficient category, with a completion rate of 25%. In Grade XI ATP, the average score was 72.22, which is in the high category, with a completion rate of 58.3%. There was a significant difference between the two models, with a t-test value of 3.240.	At the vocational high school level, Discovery Learning was found less effective, as average scores remained in the moderate category with low completion rate. Self-directed learning improves students' problem-solving abilities. These findings demonstrate the importance of tailoring learning modules to student characteristics to achieve higher academic achievement.
Title : Discovery Learning Model to Improve Problem-Solving Skills from the Perspective of Mathematical Resilience **Author:** Lala Maulaya Nurmala, Nur Eva Zakiah, & Angra Meta Ruswana (2023) **Journal:** J-KIP (Journal of Teacher Training and Education)	For 72 eleventh-grade students at SMAN 1 Banjarsari, a quasi-experiment was conducted with a non-comparable pretest-posttest control group design. The Discovery Learning experimental class, consisting of 36 students, had an average N-Gain of 0.584, which is in the medium category. This was higher than the control class, which had an N-Gain of 0.315, which is in the low category. An ANOVA test showed that the	*Discovery learning*more effective than direct instruction by optimizing mathematical problem-solving skills, especially in students who are highly resilient to problems. Mathematical resilience is a critical component of successful learning, so teachers must consider student resilience when implementing the discovery learning model.

Title, Author, Journal Identity	*Research result*	*Review Results*
	teaching module and mathematical resilience had a significant impact.	
Title : The Influence of the Discovery Learning Model on Students' Problem-Solving Skills in Science Learning on How to Take Care of a House in Grade 1 of Citra Bangsa Mandiri Christian Elementary School, Kupang **Author:** Babtista Apriano Safion, Taty R. Koroh, & Vera R. Bulu (2025) **Journal:** Education Window Journal	Using a one-group pretest-posttest design on 23 students of class 1A, the paired sample t-test obtained a p-value (2-tailed) = 0.000, which is lower than 0.05, which shows that there is a positive effect on problem-solving skills by implementing the discovery teaching module. The post-test results showed a significant increase compared to the pre-test.	In science learning, the problem-solving model encourages students to think critically, participate in active problem-solving processes, and become more independent. This model has also been proven to be more effective than conventional learning approaches. Furthermore, this model is suitable for developing problem-solving skills from an early age.
Title : The Influence of the Discovery Learning Model on the Mathematical Problem-Solving Ability of 7th Grade Junior High School Students **Author:** Nabilla Anizzulfa, Hairul Saleh, & Prahesti Tirta Safitri (2023) **Journal:** Pedagogy.	Students' mathematical problem-solving abilities are greatly influenced by discovery learning; the average class score the experimental class's achievement was greater than that of the control class.	Unlike conventional methods, Discovery Learning makes students more active, critical, and confident, and improves HOTS and problem solving.
Title : Application of Discovery Learning Model to Improve Mathematical Problem Solving Ability **Author:** Rosfarianti, Rohantizani, & Muliana (2021) **Journal:** Malikussaleh Journal of Mathematics Education	Experimental class (DL) students received an N-Gain of 0.82, which is a high value, higher than the control (0.45, a medium value).	DL is more effective than conventional methods for creating flat side spaces.
Title : Implementation of Discovery Learning to Improve Students' Problem-Solving Skills and Mathematics Learning Motivation **Author:** Julaeha, Rosli, & Hendrastuti (2022) **Journal:** *Pasundan Journal of Mathematics Education*	DL is more effective than expository, with an experimental post-test score of 78 compared to a control score of 68.41. If the t-test value is sig. 0.001, and if the significance level exceeds 0.05, then a significant difference can be assumed. Furthermore, it has been shown to increase motivation to learn. Furthermore, there is a strong correlation (r = 0.887) between motivation and problem solving.	DL makes students more active, confident, and motivated to learn.
Title : The Influence of the Discovery Learning Model on Students' Problem-Solving Ability on the Material of Substance Pressure at SMP Negeri 7 Kupang Tengah	The average score on the posttest increased to 75.52 from 64 on the pretest. There is a significant relationship between discovery learning and problem-solving skills.	In science learning, discovery learning makes it easier for students to understand, plan, solve, and evaluate problems more actively.

Title, Author, Journal Identity	*Research result*	*Review Results*
Author: Maria Ursula Jawa Mukin, Cludia Mariska M. Maing, & Gervansiana Jeliman (2024) **Journal:** OPTIKA: Journal of Physics Education		
Title : The Influence of the CTL-Based Discovery Learning Model on the Mathematical Problem-Solving Ability of Class VIII Students of SMP Negeri 2 Ulususua **Author:** Serasi Lina Halawa (2023) **Journal:** FAGURU: Scientific Journal of Teacher Training Students	*Discovery Learning*CTL-based learning had a positive effect. The experimental class completed more than the conventional class.	Students must be more critical, diligent, and understand the material better. Teachers must implement this broadly.
Title : The Effect of Discovery Learning Assisted by Audiovisual Media on Improving Mathematical Problem-Solving Ability **Author:** Muhammad Khaza Ilfa, Sekar Dwi Ardianti, & Mohammad Syafruddin Kuryanto (2023) **Journal:** Prismatika: Journal of Mathematics Education and Research	The posttest score increased to 80.36 from 47.84 in the pretest. The N-Gain test was 0.61, which is a moderate value.	Problem solving through media increases students' motivation and learning outcomes and helps them understand concepts more quickly.
Title : The Discovery Learning Model on the Mathematical Problem Solving Ability of Class IXE Students of Bhakti Mulya Batujajar Middle School **Author:** Novia Putri Denati, Nelly Fitriani, & Citra Megiana Pertiwi (2022) **Journal:** JPMI – Journal of Innovative Mathematics Learning	PTK 2 cycles showed an increase: 83% of students were able to understand the problem and use the right strategy to solve it.	Getting students used to thinking systematically (Polya's steps) increases KPMM gradually throughout the learning cycle.

The summary of Table 1 shows that the implementation of various variations of the Discovery Learning teaching module can improve students' mathematics learning outcomes. Because students are not actively involved in discovering ideas, a lack of problem-solving skills is a common problem during learning. To address this issue, the Discovery Learning model is used, either alone or in combination with other learning strategies or media. According to research conducted by(Siagian et al., 2023)Discovery Learning combined with cognitive

conflict strategies helps students understand, plan, complete, and re-check their work more critically, creatively, and systematically.

Similar results were produced by(Fitriana et al., 2022)They found a directional and meaningful correlation between guiding discovery learning and problem-solving skills. This model can optimize students' skills in rational, evaluative, and orderly thinking, as indicated by a correlation value of 0.818. An additional finding made by(Learning, Innovative, Salamah, et al., 2024)showed that students who used the discovery learning module had better academic performance than students in the control class. Statistical tests still showed a significant difference in results, although the N-Gain value remained in the moderate category.

Previous findings were also strengthened by the results of a meta-analysis study conducted by(Kufa et al., 2022)Of the 30 studies analyzed, the average effect size was 1.05 (large category), with the largest effect on math problem-solving ability being 1.18. In addition, a new study by(Susilowati, 2024)found a significant difference between the experimental and control classes. The experimental class students' score of 73.17 exceeded the control class' average score of 63.28. The results indicate that the Discovery Learning model, combined with cognitive conflict strategies, animated media assistance, and a meta-analysis approach, can help students solve mathematical problems. This model makes students more active and helps them understand concepts independently, which makes mathematics learning more significant.

CONCLUSION

This research found that the application of Discovery Learning (DL) develops students' problem-solving skills, conceptual understanding, learning interest, creativity, and active learning in mathematics. DL's effectiveness increases when used in conjunction with learning media, tailored to learning styles, and considering student characteristics such as personality and resilience. Thus, the discovery learning model can be a relevant alternative to help students understand aspects more deeply, think critically and systematically, and improve their mathematics learning outcomes at various levels of education.

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