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Development of an Advance Organizer–Based Mind Mapping Learning Model to Enhance Meaningful Mathematics Learning in Elementary School Students

Pengembangan Model Pembelajaran Pemetaan Pikiran Berbasis Pengorganisir Awal untuk Meningkatkan Pembelajaran Matematika yang Bermakna pada Siswa Sekolah Dasar

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ABSTRACT

Meaningful mathematics learning in elementary schools remains a challenge because classroom practices often emphasize procedural skills rather than conceptual understanding. Integrating the Advance Organizer strategy with mind mapping techniques is considered a promising approach to help students connect prior knowledge with new mathematical concepts more meaningfully. This study aims to develop and evaluate an Advance Organizer–based Mind Mapping learning model to enhance meaningful mathematics learning among elementary school students. The research employed a Research and Development (R&D) approach using the ADDIE model, which consists of analysis, design, development, implementation, and evaluation stages. The study was conducted at SDN 15 Bonto Jai during October–November 2025. The participants consisted of 72 fifth-grade students and three mathematics education experts who served as validators. Data were collected through expert validation sheets, classroom observation instruments, teacher and student response questionnaires, and mathematics learning outcome tests. Data were analyzed using descriptive statistics and effectiveness testing through a paired sample t-test. The results indicated that the developed learning model achieved a high level of validity (mean expert validation score = 3.78 out of 4.00), high practicality (teacher and student response rate = 91%), and strong effectiveness. Students' meaningful mathematics learning outcomes improved significantly after the implementation of the model ($t = 9.64$, $p < 0.001$). These findings demonstrate that the Advance Organizer–based Mind Mapping learning model is valid, practical, and effective in improving meaningful mathematics learning for elementary school students.

ABSTRAK

Pembelajaran matematika yang bermakna di sekolah dasar masih menjadi tantangan karena praktik pembelajaran di kelas sering kali lebih menekankan pada penguasaan prosedur dibandingkan pemahaman konsep. Integrasi strategi Advance Organizer dengan teknik mind mapping dipandang sebagai pendekatan yang potensial untuk membantu siswa mengaitkan pengetahuan awal dengan konsep matematika baru secara lebih terstruktur dan bermakna. Penelitian ini bertujuan untuk mengembangkan dan mengevaluasi model pembelajaran berbasis Advance Organizer–Mind Mapping untuk meningkatkan kebermaknaan belajar matematika siswa sekolah dasar. Penelitian ini menggunakan pendekatan Research and Development (R&D) dengan model ADDIE yang meliputi tahap analisis, desain, pengembangan, implementasi, dan evaluasi. Penelitian dilaksanakan di SDN 15 Bonto Jai pada bulan Oktober–November 2025. Subjek penelitian terdiri atas 72 siswa kelas V dan tiga ahli pendidikan matematika sebagai validator. Data dikumpulkan melalui lembar validasi ahli, lembar observasi pembelajaran, angket respons guru dan siswa, serta tes hasil belajar matematika. Analisis data dilakukan menggunakan statistik deskriptif dan uji efektivitas melalui paired sample t-test. Hasil penelitian menunjukkan bahwa model pembelajaran yang dikembangkan memiliki tingkat validitas tinggi (rata-rata skor validasi ahli = 3,78 dari 4,00), tingkat kepraktisan tinggi (persentase respons guru dan siswa = 91%), serta efektif meningkatkan kebermaknaan belajar matematika siswa. Skor pembelajaran matematika siswa meningkat secara signifikan setelah penerapan model ($t = 9,64$; $p < 0,001$). Temuan ini menunjukkan bahwa model pembelajaran Advance Organizer berbasis Mind Mapping valid, praktis, dan efektif dalam meningkatkan kebermaknaan belajar matematika siswa sekolah dasar.

INTRODUCTION

Mathematics learning in elementary schools plays an important role in developing students' logical thinking, problem-solving abilities, and conceptual understanding. However, in many educational contexts, mathematics learning is still dominated by procedural instruction and teacher-centered approaches that emphasize memorization rather than conceptual understanding. As a result, students often experience difficulties in understanding mathematical concepts meaningfully and tend to learn mathematics mechanically without connecting new knowledge with their prior understanding. Meaningful learning is essential in mathematics education because it enables students to organize knowledge structures and apply mathematical concepts in various situations [5,21].

Meaningful learning occurs when students are able to relate new information with the cognitive structures they already possess. Learning that emphasizes conceptual relationships encourages students to construct knowledge actively rather than merely receiving information passively from teachers. Research in educational psychology shows that students' understanding becomes deeper when learning activities involve cognitive organization, visual representation, and conceptual mapping processes [10,12]. Therefore, innovative instructional approaches are needed to support meaningful mathematics learning, especially at the

elementary school level where students are still developing their conceptual foundations.

One of the instructional strategies that supports meaningful learning is the Advance Organizer learning model. This model helps students organize prior knowledge before learning new material so that the learning process becomes more structured and easier to understand. The advance organizer strategy functions as a cognitive bridge that connects students' existing knowledge with new information presented during instruction [2,19]. Previous studies indicate that the use of advance organizers can significantly improve students' conceptual understanding and learning outcomes because it facilitates cognitive readiness and structured thinking during the learning process [8,19].

Another instructional strategy that can support meaningful learning is the use of mind mapping techniques. Mind mapping is a visual learning strategy that allows students to organize information hierarchically and illustrate relationships among concepts. Through visual representation, students can easily identify connections between ideas and construct comprehensive knowledge structures. Several studies have shown that mind mapping can improve students' academic achievement, critical thinking skills, and conceptual understanding in various subjects, including mathematics [4,7,16]. In addition, visual learning approaches are particularly effective for elementary school students because they align with students' cognitive development and help simplify complex concepts [23].

The integration of visual learning strategies in mathematics education has also been widely discussed in recent educational research. Visual representations help students to transform abstract mathematical concepts into more concrete and understandable forms. According to Mayer, visual and multimedia learning strategies can significantly enhance students' comprehension because they combine verbal explanations with visual representations [12]. Similarly, research on innovative learning models highlights that instructional strategies integrating visual organization and conceptual mapping can improve students' engagement and understanding in mathematics learning [18,24].

Despite the growing interest in innovative instructional models, many elementary school classrooms still rely on conventional teaching methods. Teachers often focus on solving textbook problems and explaining formulas without providing opportunities for students to organize knowledge independently. This condition limits students' ability to develop meaningful understanding and conceptual connections in mathematics learning [11,13]. As a result, students may achieve procedural proficiency but struggle to explain the underlying mathematical concepts.

This condition was also observed in SDN 15 Bonto Jai, Pangkajene and Kepulauan Regency, where mathematics learning is still largely dominated by traditional lecture-based instruction. Based on preliminary observations conducted in the school, many students showed difficulties in explaining mathematical concepts and connecting different topics in mathematics. Students tended to memorize formulas without understanding the conceptual relationships behind them. Furthermore, classroom learning activities rarely involved visual learning tools or strategies that could help students organize knowledge structures systematically.

Considering these challenges, the development of an innovative learning model that combines Advance Organizer strategies with Mind Mapping techniques becomes highly relevant. The integration of these two approaches is expected to support meaningful mathematics learning by helping students activate prior knowledge, organize new information, and visualize conceptual relationships simultaneously. Such an instructional model can create a more structured and engaging learning environment that encourages students to actively construct their own understanding.

Although previous studies have investigated the effectiveness of advance organizers and mind mapping separately, limited research has explored the integration of these two strategies within a single instructional model designed specifically to promote meaningful mathematics learning in elementary school contexts. Therefore, this study aims to develop and evaluate an Advance Organizer–based Mind Mapping

learning model to enhance meaningful mathematics learning among elementary school students. The findings of this research are expected to contribute to the development of innovative instructional models that support effective and meaningful mathematics education.

METHODS

This study employed a Research and Development (R&D) approach aimed at developing an instructional model based on the integration of the Advance Organizer strategy and Mind Mapping technique to enhance meaningful mathematics learning among elementary school students. Research and Development is a systematic method used to produce educational products and evaluate their effectiveness through iterative stages of design, development, testing, and revision [20]. This approach is widely used in educational research because it enables researchers to design instructional innovations based on real classroom needs and empirically test their effectiveness.

The development process in this study followed the ADDIE instructional design model, which consists of five stages: analysis, design, development, implementation, and evaluation [3]. The ADDIE model is commonly used in instructional design research because it provides a systematic and flexible framework for developing educational products, including learning models, instructional materials, and teaching strategies. The model allows researchers to ensure that the developed learning model is conceptually valid, practically applicable, and empirically effective in improving learning outcomes.

The research was conducted at SDN 15 Bonto Jai, Pangkajene and Kepulauan Regency, South Sulawesi, Indonesia, during the period of October to November 2025. The selection of this school as the research site was based on preliminary observations indicating that mathematics learning in the school still relied heavily on conventional teaching methods and that students experienced difficulties in understanding mathematical concepts meaningfully. The research participants consisted of elementary school students who were involved in the implementation and testing of the developed learning model.

During the analysis stage, the researcher conducted a needs assessment to identify problems related to mathematics learning in elementary schools. This stage involved classroom observations, interviews with teachers, and analysis of students' learning outcomes. The purpose of this stage was to understand the existing learning conditions, identify gaps in instructional practices, and determine the necessity of developing an innovative learning model. Previous studies have emphasized that the analysis phase is essential in instructional design because it ensures that the developed learning product addresses real educational problems and classroom needs [3].

The design stage focused on planning the structure and components of the Advance Organizer–based Mind Mapping learning model. At this stage, the researcher formulated the learning objectives, designed the learning syntax, and prepared instructional materials and assessment instruments. The learning model was designed to incorporate stages that activate students' prior knowledge, organize new information through advance organizers, and facilitate conceptual mapping through mind mapping activities. These instructional components were designed to support meaningful learning by encouraging students to connect new mathematical concepts with their existing cognitive structures [10,12].

The development stage involved the creation of the prototype learning model, including lesson plans, learning activities, student worksheets, and evaluation instruments. The developed model was then validated by experts in mathematics education and instructional design. Expert validation aimed to evaluate the conceptual accuracy, instructional feasibility, and clarity of the developed learning model. Validation by experts is an important step in R&D research because it ensures that the developed educational product meets academic standards and theoretical foundations before being implemented in real classroom settings [1].

After the development process, the learning model was tested in the implementation stage through limited classroom trials. During this stage, the

researcher implemented the learning model in mathematics learning activities and observed the teaching and learning process. The implementation stage aimed to evaluate the practicality of the learning model and to determine whether the instructional procedures could be effectively applied in classroom settings. Classroom observations and student participation data were collected to analyze how the model supported meaningful learning processes during instruction.

The evaluation stage was conducted to determine the effectiveness of the developed learning model in improving students' meaningful mathematics learning. The evaluation included both formative and summative assessments. Formative evaluation was conducted during the development and implementation stages to identify potential weaknesses and improve the learning model. Meanwhile, summative evaluation was conducted after the implementation stage to measure the overall effectiveness of the model in improving students' learning outcomes.

Data in this study were collected using several research instruments, including observation sheets, validation questionnaires, student response questionnaires, and learning outcome tests. Observation sheets were used to document classroom learning activities and evaluate the implementation of the learning model. Validation questionnaires were used to obtain expert judgments regarding the validity of the developed learning model. Student response questionnaires were used to assess the practicality of the learning model from the learners' perspective. In addition, learning outcome tests were used to measure students' understanding of mathematical concepts before and after the implementation of the learning model.

The collected data were analyzed using both descriptive and inferential statistical techniques. Descriptive analysis was used to describe the validity, practicality, and implementation of the developed learning model based on expert validation results, observation data, and student responses. Inferential statistical analysis was used to examine the effectiveness of the learning model by comparing students' learning outcomes before and after the implementation of the model. Statistical testing was conducted to determine whether the learning model significantly improved students' meaningful mathematics learning outcomes.

To ensure the validity and reliability of the research findings, several data validation strategies were applied. Expert validation was conducted to ensure the content validity of the developed learning model and research instruments. In addition, triangulation of data sources was employed by combining observation data, questionnaire responses, and learning outcome tests to obtain comprehensive information regarding the effectiveness of the learning model. Such triangulation strategies are commonly used in educational research to enhance the credibility and reliability of research results [5].

Through these systematic stages, the Research and Development approach used in this study enabled the researcher to design, develop, and evaluate an innovative learning model that integrates Advance Organizer strategies and Mind Mapping techniques. The model is expected to support meaningful mathematics learning by helping students organize knowledge structures, visualize conceptual relationships, and actively construct their understanding of mathematical concepts.

RESULTS

Needs Analysis Results

The results of the needs analysis were obtained through classroom observations, teacher interviews, and analysis of existing learning practices at SDN 15 Bonto Jai. The analysis aimed to identify the current condition of mathematics learning and determine the necessity for developing an innovative instructional model that supports meaningful learning.

The classroom observation results indicated that mathematics learning was still dominated by conventional teaching practices. Teachers mainly explained mathematical concepts using lectures and examples from textbooks, while students were required to complete routine exercises. Learning activities rarely involved visual learning tools or strategies that help students connect prior knowledge with new mathematical concepts. Consequently, many students experienced difficulties in explaining mathematical ideas

and understanding conceptual relationships between topics.

Interviews with teachers revealed that most students struggled to understand abstract mathematical concepts, particularly when solving contextual problems. Teachers also reported that students tended to memorize formulas rather than understand the reasoning behind mathematical procedures. This situation resulted in low student engagement during learning activities and limited opportunities for meaningful knowledge construction.

The analysis of students' initial learning outcomes also showed that many students had difficulty achieving the expected level of conceptual understanding. The average score of the preliminary mathematics test conducted before the implementation of the learning model was 64.21, which was below the minimum mastery criterion applied in the school. These findings indicate that improvements in instructional strategies are needed to support meaningful learning processes in mathematics classrooms.

Based on the results of the needs analysis, it was concluded that the development of a learning model that integrates Advance Organizer strategies with Mind Mapping techniques is necessary to improve students' conceptual understanding and learning engagement in mathematics.

Development of the Advance Organizer–Based Mind Mapping Learning Model

Based on the results of the needs analysis, the researchers developed an instructional model that integrates Advance Organizer strategies with Mind Mapping techniques. The development process followed the stages of the ADDIE model, which includes analysis, design, development, implementation, and evaluation.

The resulting learning model consists of several instructional stages designed to facilitate meaningful learning. The first stage involves the presentation of an advance organizer to activate students' prior knowledge and provide a conceptual overview of the learning material. In this stage, teachers present key ideas or conceptual frameworks related to the topic being studied.

The second stage focuses on concept exploration, where students participate in guided learning activities that encourage them to analyze mathematical problems and discuss conceptual relationships. During this stage, students work collaboratively to understand mathematical concepts through problem-solving activities.

The third stage involves the construction of mind maps, where students visually represent the relationships between mathematical concepts using diagrams. This activity enables students to organize knowledge hierarchically and connect different mathematical ideas.

The fourth stage is reflection and discussion, where students present their mind maps and explain their understanding of mathematical concepts. Teachers provide feedback and clarification to ensure that students develop accurate conceptual understanding.

The final stage is evaluation, in which students complete learning tasks or assessments designed to measure their conceptual understanding and meaningful learning outcomes.

The developed learning model was accompanied by supporting instructional materials, including lesson plans, student worksheets, and mind mapping templates designed to facilitate classroom implementation.

Expert Validation Results

The validity of the developed learning model was assessed by three experts in mathematics education and instructional design. The validation process aimed to evaluate the feasibility of the learning model before its implementation in classroom settings.

The experts evaluated the learning model based on several criteria, including instructional design, content relevance, clarity of learning syntax, language appropriateness, and feasibility for elementary school students. The results of the expert validation are presented in Table 1.

Table 1. Expert Validation Results

Validation Aspect	Average Score	Category
Learning Model Design	3.82	Very Valid
Content Accuracy	3.75	Very Valid
Learning Syntax	3.80	Very Valid

Language Clarity	3.71	Very Valid
Implementation Feasibility	3.84	Very Valid

The overall average validation score obtained from the expert assessments was 3.78 out of 4.00, which indicates that the developed learning model is categorized as very valid. The experts concluded that the learning model is appropriate for classroom implementation with minor revisions related to the clarity of instructions in the student worksheets.

Practicality Test Results

The practicality of the developed learning model was evaluated based on the responses of teachers and students after the implementation stage. The practicality test aimed to determine whether the learning model could be easily implemented in classroom settings and whether it was well received by students.

The teacher response questionnaire results indicated that the learning model was easy to implement and supported meaningful learning activities. Teachers reported that the integration of advance organizers and mind mapping helped students understand mathematical concepts more clearly.

Similarly, the student response questionnaire results showed positive perceptions of the learning model. Students expressed that the use of mind mapping activities made learning more interesting and helped them understand relationships between mathematical concepts.

The results of the practicality evaluation are presented in Table 2.

Table 2. Practicality Test Results

Respondent	Practicality Percentage	Category
Teacher Responses	92%	Very Practical
Student Responses	90%	Very Practical
Average	91%	Very Practical

The average practicality score of **91%** indicates that the developed learning model is categorized as **very practical** for classroom implementation.

Effectiveness Test Results

The effectiveness of the learning model was evaluated by comparing students' mathematics learning outcomes before and after the implementation of the learning model. A pre-test and post-test design was used to measure improvements in students' meaningful learning outcomes.

The results of the pre-test and post-test are presented in Table 3.

Table 3. Students' Learning Outcomes

Test	Mean Score
Pre-Test	64.21
Post-Test	82.47

The results indicate that the average score of students' learning outcomes increased significantly after the implementation of the Advance Organizer–based Mind Mapping learning model.

To determine the statistical significance of the improvement, a paired sample t-test was conducted. The results of the statistical analysis are presented in Table 4.

Table 4. Paired Sample t-Test Results

Variable	t-value	Significance (p)
Pre-test – Post-test	9.64	0.000

The statistical analysis shows that $p < 0.05$, indicating that there is a significant difference between students' learning outcomes before and after the implementation of the learning model. This result suggests that the developed learning model is effective in improving students' meaningful mathematics learning outcomes.

Improvement of Students' Meaningful Learning

In addition to improvements in learning outcomes, the implementation of the learning model also improved students' meaningful learning processes. During classroom observations, students were more actively involved in learning activities, particularly when constructing mind maps and discussing mathematical concepts with their peers.

Students demonstrated improved ability to explain mathematical ideas, identify relationships between concepts, and apply mathematical knowledge to solve contextual problems. These improvements indicate that the integration of Advance Organizer strategies and Mind Mapping techniques supports deeper conceptual understanding and meaningful learning experiences.

Overall, the results of this study demonstrate that the Advance Organizer–based Mind Mapping learning model is valid, practical, and effective in enhancing meaningful mathematics learning among elementary school students.

DISCUSSION

The results of this study indicate that the development and implementation of the Advance Organizer–based Mind Mapping learning model contributed positively to improving meaningful mathematics learning among elementary school students. The findings demonstrate that the learning model is valid, practical, and effective for classroom implementation. The integration of advance organizer strategies and mind mapping techniques provided a structured learning process that facilitated students in organizing prior knowledge and constructing new conceptual understanding.

One important finding of this study is that the use of advance organizers helped students prepare cognitively before learning new mathematical material. The advance organizer served as an introductory framework that enabled students to activate their prior knowledge and relate it to new concepts presented during instruction. This finding is consistent with learning theories which emphasize that meaningful learning occurs when new information is integrated into existing cognitive structures [10]. By presenting conceptual overviews at the beginning of the learning process, students were able to understand the overall structure of the mathematical content and follow the learning activities more effectively.

The results of this study also support previous research showing that advance organizer strategies can significantly improve students' conceptual understanding and learning outcomes. When students are guided through structured conceptual frameworks, they tend to develop a deeper understanding of the subject matter and are better able to connect different mathematical concepts [8,19]. In this study, students demonstrated improved ability to explain mathematical ideas and relate different mathematical topics after the implementation of the learning model. This suggests that advance organizers function as effective cognitive tools that help students organize information systematically.

Another significant finding of this study is the positive role of mind mapping techniques in supporting meaningful mathematics learning. Mind mapping enabled students to visually represent relationships among mathematical concepts, making abstract ideas easier to understand. Visual learning strategies are particularly important in elementary education because they align with students' cognitive development and learning characteristics. Research has shown that visual representations can improve students' comprehension by transforming complex information into structured diagrams and conceptual networks [12].

The findings of this study are consistent with previous studies indicating that mind mapping can improve students' academic achievement and conceptual understanding. Mind mapping encourages students to actively organize information, identify relationships between ideas, and construct knowledge through visual representation [4,7]. In the present study, students were able to develop their own mind maps during the learning process, which helped them summarize and connect mathematical concepts more effectively. As a result, students demonstrated improved engagement and participation during classroom learning activities.

In addition to improving conceptual understanding, the integration of advance organizers and mind mapping also contributed to increased student motivation and active participation during the learning process. Classroom observations showed that students became more involved in discussions and collaborative learning activities when they were encouraged to create mind maps and explore conceptual relationships. This finding aligns with the constructivist learning perspective, which emphasizes that knowledge is actively constructed by learners through interaction with learning materials and social environments [10].

Furthermore, the implementation of the learning model created a more interactive and student-centered learning environment. Traditional mathematics instruction often focuses on teacher explanations and repetitive exercises, which may limit students' opportunities to actively construct knowledge.

In contrast, the Advance Organizer–based Mind Mapping model provided structured opportunities for students to explore concepts, discuss ideas, and visualize their understanding through mind maps. Such instructional practices support the development of meaningful learning experiences and promote deeper conceptual understanding [5].

The effectiveness of the developed learning model can also be explained through the integration of cognitive organization strategies and visual learning approaches. Cognitive organization strategies, such as advance organizers, help students structure information hierarchically and connect new concepts with existing knowledge. Meanwhile, visual learning tools such as mind mapping allow students to represent complex relationships between concepts in a simplified form. The combination of these two approaches creates a powerful instructional strategy that enhances students' ability to process and retain mathematical information [23].

Another important implication of this study relates to the role of innovative instructional models in improving the quality of mathematics education. Modern educational research emphasizes the need for instructional strategies that support active learning, conceptual understanding, and student engagement. Innovative learning models that integrate visual representation, conceptual organization, and collaborative learning activities have been shown to significantly improve learning outcomes in mathematics education [24]. Therefore, the development of the Advance Organizer–based Mind Mapping learning model contributes to the growing body of research on innovative teaching strategies for elementary mathematics learning.

Despite the positive findings, this study also has several limitations. The implementation of the learning model was conducted in a limited educational context, specifically in one elementary school. Therefore, the generalizability of the findings may be limited. Future research is recommended to test the effectiveness of the learning model in different schools, grade levels, and mathematical topics. In addition, further studies may explore the integration of digital mind mapping tools to enhance technology-supported mathematics learning.

Overall, the findings of this study confirm that the integration of advance organizer strategies and mind mapping techniques can effectively support meaningful mathematics learning in elementary schools. The developed learning model provides a structured instructional approach that helps students activate prior knowledge, organize conceptual understanding, and visualize relationships between mathematical concepts. Consequently, the Advance Organizer–based Mind Mapping learning model can serve as an innovative instructional alternative for improving the quality of mathematics learning in elementary education.

CONCLUSION

This study aimed to develop and evaluate an Advance Organizer–based Mind Mapping learning model to enhance meaningful mathematics learning among elementary school students. The development process followed a systematic Research and Development approach using the ADDIE model, which consists of analysis, design, development, implementation, and evaluation stages. The results of the study indicate that the developed learning model meets the criteria of validity, practicality, and effectiveness for use in elementary mathematics learning.

The results of the needs analysis revealed that mathematics learning in elementary schools was still dominated by teacher-centered instructional practices that emphasized procedural exercises rather than conceptual understanding. Students often experienced difficulties in connecting mathematical concepts and explaining the reasoning behind mathematical procedures. These conditions indicated the need for innovative learning models that can facilitate meaningful learning by helping students connect new knowledge with prior understanding.

The development stage resulted in an instructional model that integrates Advance Organizer strategies with Mind Mapping techniques to support meaningful learning processes. The learning model includes structured instructional stages designed to activate prior knowledge, explore

mathematical concepts, construct visual representations of knowledge through mind maps, and evaluate students' conceptual understanding. This structured learning syntax provides opportunities for students to organize knowledge actively and develop deeper understanding of mathematical concepts.

The results of expert validation showed that the developed learning model achieved a high level of validity. The experts evaluated the model as conceptually appropriate, well-structured, and suitable for implementation in elementary mathematics learning. The validation results indicate that the integration of advance organizer strategies and mind mapping techniques provides a strong theoretical and instructional foundation for promoting meaningful learning.

The practicality evaluation also demonstrated positive results. Both teacher and student responses indicated that the learning model was easy to implement and supported interactive learning activities. The integration of mind mapping activities encouraged students to participate actively in the learning process and helped them visualize relationships between mathematical concepts. These findings suggest that the developed learning model can be effectively implemented in classroom learning environments.

Furthermore, the effectiveness test results showed that the implementation of the learning model significantly improved students' meaningful mathematics learning outcomes. Students' posttest scores were significantly higher than their pretest scores, indicating that the learning model successfully enhanced students' conceptual understanding. In addition, classroom observations revealed that students became more actively engaged in learning activities, participated in discussions, and demonstrated better ability to explain mathematical ideas.

Based on these findings, it can be concluded that the Advance Organizer–based Mind Mapping learning model is a valid, practical, and effective instructional approach for enhancing meaningful mathematics learning among elementary school students. The integration of cognitive organization strategies and visual learning techniques provides a learning environment that encourages students to actively construct knowledge and develop deeper conceptual understanding.

This study contributes to the development of innovative instructional models in mathematics education by providing a structured framework that integrates meaningful learning theory with visual cognitive tools. The findings of this research are expected to provide practical guidance for teachers in implementing more effective learning strategies that support students' conceptual understanding and meaningful learning experiences.

However, this study also has certain limitations. The implementation of the learning model was conducted in a single elementary school and focused on a limited mathematics topic. Therefore, future research is recommended to examine the implementation of the model in different educational contexts, with larger samples and broader mathematical topics. Further studies may also explore the integration of digital mind mapping tools to support technology-based mathematics learning.

Overall, the development of innovative learning models such as the Advance Organizer–based Mind Mapping model represents an important step toward improving the quality of mathematics education and promoting meaningful learning experiences for elementary school students.

CONFLICT OF INTEREST (If There is Exist)

The authors declare that there is no conflict of interest regarding the publication of this research. The study was conducted independently without any commercial or financial relationships that could be construed as a potential conflict of interest. All research activities, including data collection, analysis, interpretation, and reporting of the results, were carried out objectively and in accordance with academic research ethics. The authors confirm that the findings presented in this study are purely based on empirical data obtained during the research process and are not influenced by any external interests.

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