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Innovation in mathematics learning through discovery learning and flashcard media in elementary madrasahs

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ABSTRACT

Mathematics learning in Madrasah Ibtidaiyah often faces significant obstacles due to a lack of interest and motivation in learning among students. This is often associated with using traditional and less interesting teaching methods, which do not meet students' basic psychological needs. The purpose of this study is to develop innovation in mathematics learning through the application of discovery learning and flashcard media to enhance concept understanding and student engagement in elementary madrasahs effectively. To overcome this problem, this study used qualitative methods and purposive sampling to select respondents according to the study's needs. Data were collected through passive observation, semi-structured interviews, and documentation techniques, which were then analyzed using an interactive analysis model. This process facilitated an in-depth evaluation of the impact of using the Discovery Learning model supported by flashcard media. The results of this study indicate an increase in student engagement and motivation with the implementation of the Discovery Learning model and flashcards, characterized by increased interaction during learning sessions and a better understanding of mathematical concepts. Based on these results, it is recommended that educators integrate interactive and student-centered teaching methods, such as Discovery Learning, to increase engagement and motivation in learning mathematics. This study contributes by demonstrating that integrating Discovery Learning with flashcards enhances student engagement, motivation, and conceptual understanding in mathematics. The findings suggest that interactive, student-centered approaches can improve learning effectiveness and serve as practical strategies for educators in fostering active and meaningful mathematics learning experiences.

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INTRODUCTION

Mathematics learning in Madrasah Ibtidaiyah faces various challenges, especially low student interest and motivation in learning (Xia et al., 2022; Waswa & Al-Kassab, 2023). Low learning motivation is often caused by the unfulfilled basic needs of students, such as a sense of security and social support, as expressed in Abraham Maslow's motivation theory (Henwood et al., 2015; Hayre-Kwan et al., 2021; Bowen, 2021). On the other hand, mathematics is also often considered difficult and tedious due to a less interactive and uninteresting teaching approach (Fung et al., 2018; Russo et al., 2020; Atamosa & Dioso, 2024). These challenges indicate the need for updates in learning methods to make students more actively involved (Castro & Zermeno, 2020; Kwangmuang et al., 2021; Konak et al., 2024). This study aims to apply the Discovery Learning model supported by flashcard media as an innovative approach to increase student motivation and participation in mathematics learning. This model is designed to help students understand concepts more contextually and enjoyably, which aligns with the Ministry of Education and Culture policy, which emphasizes the importance of a scientific approach in teaching and learning.

Previous studies have shown that low motivation is a significant challenge in mathematics learning in Madrasah Ibtidaiyah (Waskitoningtyas, 2016; Hardi et al., 2022). In this context, Maslow's motivation theory, applied by Alhashem (2022), emphasizes the importance of fulfilling students' basic needs to increase learning motivation. Contextual and interactive learning approaches, as proposed by Suryawati & Osman (2018) and Pratiwi et al. (2024), along with Piaget's constructivism theory (Pagán, 2006; Mensah, 2015), are effective in improving mathematical understanding. In addition, as discussed by Flora et al. (2020), Vygotsky's social interaction and scaffolding theories also play an essential role in children's cognitive development. The emphasis on learning media, such as flashcards, which support students' creativity and activity, has been proven by Yowaboot & Sukying (2022). However, mathematics is still often considered a scary subject (Chand et al., 2021; Weir, 2023). Based on these findings, this study aims to analyze the planning, implementation, and evaluation of the Discovery Learning learning model in mathematics learning with flashcard media to overcome these challenges.

This study uses the Discovery Learning model and flashcards to analyze three main aspects of mathematics learning. First, the planning process involving these two tools must be evaluated. Second, to investigate the effect of implementing this model on student interaction and engagement in learning sessions. Third, to assess the model's effectiveness in improving students' mathematical understanding. This study contributes significantly to mathematics education by increasing student engagement through independent exploration, supporting the development of critical thinking skills, and providing practical evaluation of learning, which helps teachers optimize teaching strategies. In addition, the inclusive approach applied allows students of various ability levels to access the material effectively, provides insights and recommendations for more innovative and engaging teaching approaches, and produces documentation of best practices in mathematics education. This study hypothesizes that using the Discovery Learning model with flashcards will increase student engagement in mathematics learning more effectively than traditional learning methods.

The Discovery Learning model, supported by flashcard media, is designed to enhance students' understanding of mathematical concepts and improve their conceptual abilities. Through this method, students are expected to develop critical thinking skills more effectively during the learning process. The hypothesis proposes that Discovery Learning evaluation provides teachers with more in-depth and valuable feedback, enabling them to optimize teaching strategies. Additionally, integrating flashcards creates a more inclusive approach, allowing all students including those with special needs or different academic levels to access and understand the material more easily. This method aims to build a supportive and efficient learning environment that accommodates diverse learners. The model's effectiveness will be examined through systematic data collection, hypothesis testing, and the evaluation of mathematics learning outcomes, ensuring that the approach not only improves student achievement but also strengthens active participation and long-term comprehension.

RESEARCH METHOD

This study uses a qualitative approach chosen based on the research objectives. The qualitative approach aims to produce descriptive data in the form of written or spoken words from research subjects, reflecting their behavior as researchers observe (Tenny et al., 2022; Lim, 2024). The type of research applied is descriptive qualitative research, where the data collected is presented in the form of words, not numbers. This approach allows researchers to provide a detailed and factual picture of the findings in the field. Research subjects were selected using purposive sampling techniques, which are carried out deliberately by considering specific categories relevant to the research objectives (Etikan et al., 2015; Turner, 2020). This technique ensures that the selected participants have characteristics or experiences that match the research needs so that the data obtained can support a more in-depth analysis and are relevant to the problems being studied.

This study collected data through three main techniques: passive participant observation, semi-structured interviews, and documentation. In the passive participant observation technique, researchers observe without being directly involved with the subjects so that their natural behavior can be observed without intervention (Creswell, 2014). Semi-structured interviews are used to obtain in-depth information flexibly but remain focused on the research objectives (Kvale & Brinkmann, 2009). Meanwhile, documentation techniques involve collecting relevant written and visual notes to support the research results (Bowen, 2009).

The data analysis process follows the interactive analysis model proposed by Miles and Huberman (1994), which consists of three main stages: data condensation, data presentation, and conclusion. In the data condensation stage, the information obtained is summarized and focused on relevant aspects of the research. The summarized data is then organized and presented clearly in the data presentation stage. In the final stage, conclusions are drawn by identifying patterns and insights from the available data and verifying them through further analysis. The validity of the data is ensured through triangulation of sources and techniques. Information is verified by comparing data from various sources and using multiple collection techniques, thus providing the reliability and accuracy of the research findings (Patton, 2002). This method allows for valid and credible research results, supporting the overall objectives.

RESULTS AND DISCUSSION

Result

Discovery learning planning with flashcards in mathematics learning

A comprehensive learning planning strategy and Discovery Learning approach have been implemented to improve the quality of mathematics learning at Madrasah Ibtidaiyah Al-Ma'arif 02 Jombang. Planning activities involve the preparation of documents, such as annual programs and lesson plans, which begin two weeks before learning begins. By implementing the Discovery Learning model, students actively explore and build knowledge, with the support of interactive learning methods such as PMRI and STEM and using varied learning media such as flash cards. This initiative makes the material more interesting and helps deepen students' understanding of mathematical concepts effectively.

Table 1
Learning Planning In Elementary Madrasahs

No	Findings	Description
1	Comprehensive Planning	Mathematics teachers at MI Al-Ma'arif 02 Jombang carry out comprehensive planning, including annual programs, semester programs, syllabuses, and Learning Implementation Plans (RPPs). This preparation begins two weeks before learning is implemented.
2	Implementation of Discovery Learning Model	The discovery learning model is adopted as the primary approach. In this model, students actively explore and build knowledge through problem-solving and investigation, encouraging deeper engagement and interaction.

3	Fun Learning Methods	Various methods are applied that support fun learning, including Realistic Mathematics Education (PMRI), project-based learning, and STEM, all of which support a deep understanding of mathematical concepts in authentic contexts.
4	Readiness of Learning Resources	Teachers prepare various learning resources, including textbooks, worksheets, and online resources, that support comprehensive and varied learning activities.
5	Use of Learning Media	Learning media used include flashcards, picture cards, and natural objects. These media facilitate the effective delivery of educational information and help visualize mathematical concepts.

Note: This data was obtained by the researcher through interviews with the classroom teacher

The findings from the Discovery learning planning with flashcard media at Madrasah Ibtidaiyah Al-Ma'arif 02 Jombang show an innovative approach to teaching mathematics. Although this strategy supports interactive learning, it is necessary to ensure that all teachers are adequately trained to implement this method effectively. In addition, methods such as PMRI and STEM must be integrated, followed by a systematic evaluation to assess their effectiveness in learning outcomes. Adapting learning resources to local needs and student diversity is also crucial to ensure the material is relevant to all. Finally, using learning media such as flashcards must be accompanied by teacher training to maximize their potential. By considering these factors, the learning approach at the madrasah can be more effective and comprehensively meet students' learning needs.

Implementation of discovery learning with flashcards in mathematics learning

The following table summarizes the significant findings of the mathematics learning process to assess the effectiveness of implementing the Discovery Learning model at Madrasah Ibtidaiyah Al-Ma'arif Jombang. This table covers various aspects, from the teacher's approach at the beginning of learning to the reflection and feedback stages, highlighting how various pedagogical strategies are applied to maximize student engagement and skill development. Each component in this table illustrates how combining innovative learning techniques and effective social interactions can enrich the learning experience, promote deep understanding, and facilitate the development of students' self-confidence and critical skills. This table provides an overview of how well-designed learning can produce positive learning outcomes.

Table 2
Implementation of MI Al-Ma'arif Jombang Learning

No	Findings	Explanation
1	Personal Approach at the Beginning of Learning	Initial activities involving attendance checks and questions about student well-being create a comfortable environment and encourage student motivation and participation in learning.
2	Implementation of Discovery Learning Model	This learning model emphasizes inquiry-based learning that makes the teacher act as a facilitator, allowing students to interact and construct their knowledge actively.
3	Activation of Prior Knowledge	Learning media such as flashcards and props such as protractors stimulate students' curiosity and activate prior knowledge, which helps build a more complex understanding of concepts.
4	Development of High-Order Thinking Skills	Students develop critical thinking skills such as analysis and evaluation through formulating questions and group discussions.
5	Collaboration and Social Interaction as Learning Media	Learning through group discussions and collaboration emphasizes Vygotsky's social constructivism theory, which states that social interaction enriches learning.
6	Use of Teaching Aids to Understand Abstract Concepts	The use of props in mathematics helps students visualize and understand abstract concepts, making the material more accessible.
7	Reflection and Feedback Process	The final stage of the learning process, when students compare their answers with the textbook material, is an opportunity for deep reflection and metacognitive learning. It is also an opportunity for teachers to provide feedback that strengthens understanding and increases student confidence.

Note: This data was obtained by the researcher through interviews with the classroom teacher

Implementing learning at MI Al-Ma'arif Jombang shows positive steps with a personal approach, the Discovery Learning model, and practical teaching to increase student motivation and understanding. The individual approach creates a comfortable learning environment, while the Discovery Learning model allows students to interact and construct their knowledge actively. Activation of previous knowledge through media such as flashcards and teaching aids helps students understand abstract concepts better. In addition, developing critical thinking skills and collaboration through group discussions reflects the application of Vygotsky's social constructivism theory. The reflection and feedback process at the end of learning provides opportunities for students to deepen their understanding. However, several aspects, such as providing adequate scaffolding, division of roles in groups, and more structured reflection guides, need to be improved. Overall, this implementation is exemplary, but further adjustments are required to ensure optimal learning outcomes for all students.

Discovery learning evaluation results with flashcard media

The evaluation of the Discovery Learning model in the mathematics class at Madrasah Ibtidaiyah Al-Ma'arif 02 Jombang revealed several important findings that offer meaningful insights into its effectiveness in elementary education. The results demonstrate that structured and interactive learning activities can significantly enhance students' engagement and comprehension of mathematical concepts. Moreover, the evaluation indicated that while the majority of students showed improved activity and understanding, some still required additional guidance to reach the desired learning outcomes. These findings confirm the effectiveness of combining flashcard media with the Discovery Learning approach, as both tools complement each other in simplifying material delivery and improving student participation. At the same time, the results highlight the importance of implementing more targeted support strategies for students who continue to face learning challenges.

Table 3
Student Learning Outcomes in Mathematics Learning

Activeness of Class IV A1 Students			Clas IV A2 Student Activity		
No	**Category**	**Percentage**	**No**	**Category**	**Percentage**
1	Very active	31%	1	Very active	35%
2	Active	56%	2	Active	53%
3	Quite active	-	3	Quite active	12%
4	Less Active	-	4	Less Active	-
5	Very less active	-	5	Very less active	-
	Average value	84		Average value	85

Note: Distribution of student activity levels and knowledge assessment scores in Class IV A1 and A2 of Madrasah Ibtidaiyah

Based on the collected data, student activity in class IV A1 shows that 13% of students are categorized as quite active, 56% as active, and 31% as very active. The average final student activity score reaches 85, which falls into the active category, with 12% quite active, 53% active, and 35% very active. The application of the Discovery Learning model combined with flashcard media has proven to facilitate the delivery and comprehension of learning materials, as well as improve students' ability to solve problems. Nevertheless, some students remain less active and prefer to engage in play rather than focus on learning, which causes difficulties in understanding the material. In the knowledge assessment for class IV A1, nine students scored above the KKM, three scored just above the KKM, and four scored below it. Meanwhile, in class IV A2, 12 students achieved scores above the KKM, one scored just above, and four scored below.

This indicates that some students have not yet achieved mastery in mathematics learning. The data below highlights varying performance levels, showing that while many students meet or exceed the expected standards, several still fall short and require additional support to improve their understanding and outcomes.

Table 4
Mathematics Learning Outcomes

Knowledge Assessment Data for Class IV A1 Students			Knowledge Assessment Data for Class IV A2 Students		
No	**Rating result**	**Number of students**	**No**	**Rating result**	**Number of students**
1	Value above KKM	9	1	Value above KKM	12
2	KKM pass value	3	2	KKM pass value	1
3	Value below KKM	4	3	Value below KKM	4
	Amount	16		Amount	17

Note: Knowledge assessment data display the distribution of students' scores in relation to the minimum mastery criteria (KKM) for Classes IV A1 and A2

From the mathematics knowledge assessment results for grade IV A1 and A2 students at Madrasah Ibtidaiyah Al-Ma'arif 02 Jombang, it can be seen that most students have successfully achieved and exceeded the Minimum Completion Criteria (KKM). In grade IV A1, nine students achieved scores above the KKM; in grade IV A2, the number increased to 12. However, four students in each class still score below the KKM, indicating the need for further educational intervention. The inconsistency in achieving the KKM pass score between the two classes, with three students in grade IV A1 and only 1 in grade IV A2, indicates differences in learning effectiveness that may be influenced by teaching methods or individual student factors. These data underscore the importance of a more in-depth analysis of teaching methods and the implementation of remedial strategies to help struggling students and curriculum adjustments to improve overall learning outcomes.

Discussion

Effective collaboration in discovery learning preparation

The learning preparation process at Madrasah Ibtidaiyah Al-Ma'arif 02 Jombang shows how effective collaboration between teachers and principals can strengthen the implementation of the Discovery Learning model. This collaboration, which is based on Vygotsky's (1978) social learning theory, emphasizes that learning is a process that occurs socially and becomes more effective through active interaction between students and their environment (Okita, 2012; Huang & Lajoie, 2023). The stages of this collaboration start from annual and semester program planning to developing a detailed Learning Implementation Plan (RPP) (Suharsono et al., 2024). References from Rayuni (2010) and Koto (2020) help compile RPPs that are not only by academic standards but also relevant to current educational needs. With the active involvement of the madrasah principal, all critical aspects of the learning process, such as the preparation of portals, the creation of promissory notes, and the preparation of syllabuses, are guaranteed to be ready by the prevailing educational demands, ensuring that every step of the teaching and learning process in this madrasah is designed to achieve optimal learning outcomes (Fairuz, 2020; De Felice et al., 2023).

This collaboration not only facilitates administrative preparation but also strengthens the pedagogical strategies employed by teachers in the classroom. Darling-Hammond et al. (2019) emphasize that effective teaching requires teachers to act as facilitators who guide students through inquiry and problem-solving rather than relying on traditional instruction. Almulla (2020) supports this by noting that Discovery Learning demands active teacher involvement in structuring activities that promote exploration. The approach is also rooted in Piaget constructivist theory, which highlights the centrality of direct experience in fostering deeper understanding and meaningful knowledge construction. In practice, collaboration ensures that lesson planning and implementation are aligned with these theoretical principles. Könings et al. (2020) argue that joint planning enhances curriculum relevance, while de Jong et al. (2022) highlight its role in creating interactive and engaging learning opportunities. Together, these perspectives demonstrate that collaborative preparation is vital for maximizing student participation and sustaining effective Discovery Learning practices.

Furthermore, collaboration among teachers fosters a supportive environment for sharing resources and exchanging strategies, which enriches classroom practices and enhances the overall quality of education. Benchetrit and Katz (2019) emphasize that professional collaboration builds collective capacity, allowing educators to design more effective learning experiences. Similarly, Popkewitz (2022) highlights how collaboration serves as a mechanism for educational innovation, where shared practices help adapt curriculum goals to local contexts. From another perspective, Slavin (1996) argues that collaboration in education not only improves teaching effectiveness but also strengthens student motivation through more engaging instructional approaches. When compared, these views reveal that collaboration is both a structural and pedagogical necessity. In the context of the madrasah, this commitment reflects efforts to implement the 2013 curriculum in innovative ways while ensuring that mathematics learning remains meaningful, interactive, and enjoyable for all students.

Preparation in the learning process represents a crucial foundation for ensuring that teaching materials are effectively designed and implemented. The figure emphasizes collaboration among teachers, which aligns with Vygotsky's perspective on the social context of learning and Piaget's focus on cognitive development. When compared, both theories highlight the active role of students, yet Vygotsky underscores the importance of scaffolding through teacher guidance, while Piaget stresses developmental readiness. The integration of these theoretical approaches within lesson planning supports not only knowledge acquisition but also the cultivation of higher-order thinking skills. Furthermore, the figure underscores the strategic role of the madrasah principal, whose support ensures that curriculum development is both structured and sustainable. However, while the conceptual framework appears comprehensive, the figure lacks detailed evidence regarding implementation and real-life outcomes. Thus, further analysis is necessary to evaluate the practical effectiveness of these elements in addressing diverse classroom needs.

Optimizing active learning through discovery learning model

The application of the Discovery Learning model in fourth-grade mathematics at Madrasah Ibtidaiyah Al-Ma'arif 02 Jombang illustrates how active learning can be maximized when the classroom climate is carefully managed. Dewey (1938) emphasized that learning begins with meaningful experiences, and simple practices such as checking attendance and students' well-being help establish a comfortable environment that fosters motivation. Similarly, Zitha et al. (2023) and Al-Said (2023) argue that positive classroom conditions are central to sustaining participation, showing that emotional readiness and support directly enhance engagement. Within this framework, the teacher's role shifts from knowledge transmitter to facilitator. Bruner (1961) stresses the importance of guiding learners to discover principles independently, while King (1994) highlights how questioning strategies stimulate higher-order thinking and evaluation. Together, these perspectives demonstrate that Discovery Learning not only encourages students to construct knowledge through exploration but also strengthens critical thinking, making the mathematics classroom more dynamic, interactive, and student-centered.

The core activities in mathematics teaching at Madrasah Ibtidaiyah Al-Ma'arif 02 Jombang demonstrate the effective use of learning media such as flashcards and teaching aids. Chin and Osborne (2008) argue that learning is most meaningful when students actively engage in dialogue and interaction with concepts, as this activates prior knowledge and supports deeper understanding. In a complementary view, Jaaska et al. (2022) emphasize that the integration of concrete learning tools provides students with opportunities for direct engagement, which increases both motivation and comprehension. When compared, these perspectives highlight that while Chin and Osborne focus on the cognitive benefits of interaction, Jaaska et al. underline the practical role of media in creating hands-on learning experiences. Together, these insights illustrate that effective mathematics instruction requires more than passive information delivery it demands active involvement with content to foster motivation, curiosity, and conceptual mastery.

Furthermore, the learning approach applied in this activity reflects Vygotsky's (1978) social constructivist theory, which asserts that knowledge is constructed through social interaction and collaboration. In this context, students' learning becomes more meaningful when guided by dialogue and shared problem-solving experiences. Turner and Patrick (2004) reinforce this perspective by emphasizing that classroom interactions and motivational climates strongly influence student engagement and persistence. In parallel, Gastager et al. (2022) highlight how cooperative structures not only enhance conceptual understanding but also foster essential social skills, such as communication and teamwork. When compared, these perspectives illustrate that while Vygotsky provides the theoretical foundation of social learning, Turner and Patrick stress the role of classroom climate, and Gastager et al. underline its broader social implications. In practice, group discussions and collaborative tasks in mathematics class create a community of learners, where cognitive growth is intertwined with social development, reinforcing both academic and interpersonal outcomes.

Although the Discovery Learning model provides various benefits in stimulating critical thinking and increasing student engagement, this approach also brings challenges, primarily related to the high cognitive load that students may experience (Wang, 2024). This challenge is especially felt by students with undeveloped problem-solving skills or who struggle with mathematical concepts. While beneficial, the critical thinking required in the Discovery Learning model can be a source of stress for students who do not receive adequate support during the learning process (Chusni et al., 2021; Darling-Hammond et al., 2019). Without proper guidance, students may feel overwhelmed and frustrated, hindering their academic development rather than advancing it. This underscores the importance of the effective use of scaffolding in learning, which Wood et al. (1976) emphasized as a way to support students in incrementally building their knowledge and skills.

To address this issue, teachers must actively manage classroom activities and ensure that scaffolding is tailored to students' individual needs. Good scaffolding can include providing additional instruction, breaking tasks into smaller, more manageable steps, or providing examples and models to guide students' learning (Nowell et al., 2017; McGill et al., 2023). Mayer (2004) described the importance of adapting this teaching approach to accommodate varying student ability levels, which helps minimize frustration and maximize effective learning. Through this strategy, all students, regardless of their academic ability level, are given an equal opportunity to thrive and benefit fully from the Discovery Learning approach. Thus, while supporting the development of critical thinking and problem-solving, teachers also foster an inclusive and supportive learning environment.

Overall, the implementation of the Discovery Learning model at Madrasah Ibtidaiyah Al-Ma'arif 02 Jombang has demonstrated significant improvements in students' mathematics learning outcomes. This model encourages learners to engage actively in critical thinking, problem-solving, and the development of deeper conceptual understanding. According to Hattie and Timperley (2007), effective feedback is central to maximizing learning gains, and the Discovery Learning approach when combined with structured scaffolding creates opportunities for meaningful feedback that guides students toward higher achievement. Similarly, Dweck (2006) emphasizes the importance of fostering a growth mindset, which aligns with the model's focus on student exploration and resilience in facing challenges. When compared, both perspectives highlight that successful learning is not merely about knowledge transmission but also about cultivating attitudes and strategies that support long-term success. With careful management of scaffolding and classroom dynamics, Discovery Learning transforms mathematics into an enjoyable and meaningful experience while preparing students with essential lifelong skills.

Effective strategies in optimizing learning and assessment in mathematics classrooms

At Madrasah Ibtidaiyah Al-Ma'arif 02 Jombang, assessment in fourth-grade mathematics classes utilizes the concept of metacognition proposed by Flavell in 1979. Metacognition is students' awareness and regulation of their cognitive processes. The teacher here plays a role not only as a transmitter of material but also as a facilitator who helps students summarize and reflect on their learning (Rosi & Hopkins, 2007; Trent, 2012). This process allows students to understand better,

evaluate the material taught, and identify areas for improvement, effectively increasing comprehension and retention of the material. This approach also encourages collaborative learning, where students can discuss and share learning strategies with their classmates, creating a supportive academic and social growth environment (Le et al., 2017; McKay & Sridharan, 2023). Effective teachers who implement this method provide constructive feedback that encourages student engagement and motivation. In this way, Madrasah Ibtidaiyah Al-Ma'arif 02 Jombang teaches mathematics and facilitates the development of critical and reflective thinking skills that benefit students in the long run (White, 2007; Aryal, 2024).

O'Reilly et al. (2022) added that this reflective activity is important in helping students develop their metacognitive abilities, namely the ability to think about their thinking. By encouraging students to summarize and reflect on the material being studied actively, teachers help them strengthen concepts and deepen their understanding. This process also allows students to identify areas they may not fully understand so that learning becomes more adaptive and responsive to their needs. Critically, it is important to note that this strategy requires teachers skilled in teaching techniques that support active and reflective learning (Lindner & Schwab, 2020; Hernández-Torrano et al., 2020). This requires adequate training and skills for teachers to implement metacognitive approaches effectively, focusing not only on academic learning outcomes but also on developing students' critical and reflective thinking skills. In addition, this approach must be supported by an adequate assessment system that can accommodate and value the process of critical and reflective thinking, not just the end product of learning (Golden, 2023; Michalsky, 2024).

Students are directed to summarize the learning objectives, main keywords, and mathematical concepts learned. They are invited to pray together, create a positive and respectful classroom environment, and reinforce values and academic content. The assessment results show that most students have achieved or exceeded the Minimum Completion Criteria (KKM), but there are also students in grades IV, A1, and A2 who need additional assistance. This suggests the need for more focused and remedial instructional strategies, in line with Vygotsky's Zone of Proximal Development (ZPD) theory (Borthwick et al., 2003), which recommends interventions to guide students toward more profound understanding. Approaches such as customized tasks and adequate scaffolding by teachers (van de Pol et al., 2018; Mathé & Christensen, 2024), as well as differentiation of instruction suggested by Tomlinson (Eikeland & Ohna, 2022; Langelaan et al., 2024), can help in addressing the gaps in understanding among students. The importance of ongoing formative assessment in monitoring and adjusting students' progress and providing the feedback needed to improve their knowledge and performance cannot be overstated.

Several improvements can be implemented to improve the effectiveness of closing activities and the learning process in general, such as providing remedial support and differentiation for students who do not meet the KKM (Tomlinson, 2001). Effective time management and flexible curriculum are also vital in reducing the stress associated with limited learning time, allowing students to engage more deeply with the material (Hiebert & Grouws, 2007). In addition, increasing active monitoring and scaffolding for less engaged students is essential. Teachers can assign specific tasks to keep them focused and actively involved in learning. A more structured reflective approach at the end of the session can also help deepen students' understanding by inviting them to write about their learning experiences and areas for improvement, which will strengthen the learning process and enrich their educational experience (Flavell, 1979). These improvements can significantly improve the effectiveness of closing activities and the learning process, ensuring that every student gets the maximum opportunity to learn and develop.

The role of teachers in assessing and recognizing student abilities for effective intervention requires elaboration on optimal assessment methods for mathematics, such as formative assessment through portfolios and summative assessment through standardized tests. The importance of student metacognitive development and self-reflection is highlighted, but the figure lacks details on connecting these to concrete classroom practices, such as learning journals and group discussions. Strategies to support struggling students require further elaboration, including educational technology

and individualized learning approaches. The figure also emphasizes a positive learning environment but lacks practical examples such as inclusive classroom norms or collaborative approaches. Learning improvement plans are discussed without practical examples when integrating formative assessment and curriculum adjustments based on feedback, which could provide more insight.

CONCLUSION

Collaboration in Preparation for Discovery Learning can be realized through practical cooperation between teachers and madrasah principals to maximize the Discovery Learning model. This collaboration covers all phases, from planning to developing the Learning Implementation Plan (RPP) and compiling materials that support the constructive learning approach. In implementing this model in the fourth grade of madrasah, teaching aids and activities that stimulate students' knowledge are the focus, with teachers acting as facilitators who support critical thinking. This model faces challenges such as high cognitive load, requiring effective scaffolding to ensure all students can access and understand the material well. The approach and closing of learning emphasize the importance of reflection and formative assessment, as well as the need for remedial methods and teaching whose differentiation becomes clear through varied assessment results, aiming to optimize the benefits of the Discovery Learning model and support the academic development of all students.

The theoretical implications of this study indicate that collaboration between teachers and madrasah principals in the Discovery Learning model strengthens the constructivist learning approach that emphasizes student activeness and participation. This provides new insights into the use of scaffolding to reduce cognitive load, deepens understanding of the dynamics of collaboration in education, and highlights factors that influence its effectiveness. This study suggests increasing structured collaboration in lesson plan development and resource exchange as standard policy, training teachers in scaffolding techniques to support active and inclusive learning, and utilizing formative assessment and remedial strategies to adjust teaching based on student needs.

Recommendations for further research based on this study include comparative testing between madrasahs that use the Discovery Learning model and those that adopt traditional methods to assess student learning outcomes and satisfaction differences. Research can also focus on the long-term impact of this model on the development of students' critical and academic skills. It is also essential to evaluate the effectiveness of teacher training in implementing scaffolding and active strategies, as well as curriculum adaptation to support interactive learning. In addition, the use of technology in Discovery Learning and a multidisciplinary approach that combines psychology, sociology, and educational technology can provide deeper insights into the synergy and effectiveness of this approach in madrasah education.

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