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Discovery Learning for Enhancing Critical Thinking Skills in Fourth-Grade Mathematics Classrooms

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ABSTRACT

Critical thinking is one of the essential competencies in primary mathematics education, yet many elementary school students continue to experience difficulties in analyzing problems, evaluating information, and formulating logical solutions. These challenges are often associated with teacher-centered instructional practices that provide limited opportunities for active inquiry and knowledge construction. This study aimed to improve fourth-grade students' critical thinking skills through the implementation of the Discovery Learning model in mathematics learning. The study employed Classroom Action Research using the Kemmis and McTaggart model, consisting of three iterative cycles: planning, action, observation, and reflection. The research was conducted at MI Al-Husaeni 2 Bandung, Indonesia, involving fourth-grade students. Data were collected through classroom observations, interviews, documentation, and critical thinking tests and were analyzed using descriptive qualitative and quantitative approaches. The findings revealed a consistent improvement in students' critical thinking skills throughout the intervention. The mean achievement score increased from 59.04 in the preliminary stage to 70.95 in Cycle I, 73.80 in Cycle II, and 77.85 in Cycle III. Likewise, the percentage of students achieving the minimum mastery criterion improved from 57% to 71%, 76%, and 86%, respectively. Observation results also indicated progressive improvements in students' critical thinking behaviours during mathematics learning. These findings contribute to the growing evidence supporting Discovery Learning as an effective student-centered instructional approach for enhancing critical thinking in primary mathematics education, particularly within the context of Islamic elementary schools, and provide practical guidance for teachers seeking to foster higher-order thinking skills through inquiry-based learning.

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1 INTRODUCTION

Mathematics education plays a strategic role in developing students' higher-order thinking skills, particularly critical thinking, problem-solving, and reasoning abilities. In the context of 21st-century learning, students are expected not only to master conceptual knowledge but also to analyze information, evaluate arguments, and make logical decisions when solving problems. Consequently, critical thinking has become one of the essential competencies emphasized in contemporary primary education worldwide[1]–[3]

The importance of critical thinking is also reflected in international educational policies and frameworks. The Organisation for Economic Co-operation and Development (OECD) highlights critical thinking as a key competency required for lifelong learning and active participation in modern society [4]. Similarly, educational reforms in many countries have shifted learning paradigms from teacher-centered instruction toward student-centered approaches that encourage inquiry, exploration, and knowledge construction [5]. In Indonesia, the Merdeka Curriculum and previous curriculum frameworks emphasize higher-order thinking skills (HOTS) as an integral component of elementary school learning, including mathematics education.[6]

Critical thinking in mathematics refers to students' ability to analyze mathematical situations, interpret information, evaluate evidence, formulate logical arguments, and draw appropriate conclusions [7]. Students who possess strong critical thinking skills are better able to solve mathematical problems, identify patterns, justify solutions, and transfer knowledge to new

contexts[8]. Therefore, developing critical thinking skills has become one of the primary goals of mathematics learning at the elementary school level.

Despite its importance, previous studies have consistently reported that elementary school students' critical thinking skills remain relatively low. Many students still rely on memorization and procedural learning rather than conceptual understanding and analytical reasoning [9]. Learning activities are often dominated by teacher explanations, while students play passive roles as recipients of information. Such instructional practices limit opportunities for students to investigate problems independently, formulate hypotheses, and construct their own understanding [10].

To address this issue, researchers have proposed student-centered learning models that actively engage learners in the knowledge-construction process. One of the approaches widely recommended in mathematics education is Discovery Learning. Rooted in Bruner's constructivist theory, Discovery Learning encourages students to explore information, identify relationships among concepts, and discover principles independently through guided inquiry activities[11]. Previous studies have demonstrated that Discovery Learning contributes positively to students' conceptual understanding, problem-solving ability, learning motivation, and critical thinking skills[12], [13]. However, most existing studies have focused on secondary education settings, while empirical evidence from primary school mathematics classrooms remains limited, particularly in Islamic elementary schools (Madrasah Ibtidaiyah).

A preliminary observation conducted at MI Al-Husaeni 2 Bandung revealed that fourth-grade students experienced difficulties in solving mathematical problems requiring reasoning and analysis. Learning activities were predominantly teacher-centered, with students mainly listening to explanations, taking notes, and completing routine exercises. When presented with contextual mathematical problems, many students were unable to explain their reasoning, formulate alternative solutions, or confidently express their ideas. These conditions indicate that students' critical thinking skills have not been optimally developed.

Although previous studies have reported positive impacts of Discovery Learning on critical thinking, several gaps remain. First, limited studies have specifically examined the implementation of Discovery Learning to enhance critical thinking skills in elementary mathematics education. Second, evidence from Islamic primary school contexts remains scarce. Third, most studies emphasize learning outcomes rather than documenting the process of improving critical thinking skills through iterative classroom interventions.

Therefore, this study seeks to address these gaps by implementing Discovery Learning in a fourth-grade mathematics classroom through classroom action research. The novelty of this study lies in its focus on improving critical thinking skills in elementary mathematics learning within a Madrasah Ibtidaiyah context through a systematic cycle of planning, action, observation, and reflection.

Accordingly, the objectives of this study are to: (1) examine the implementation process of Discovery Learning in fourth-grade mathematics learning, (2) analyze students' critical thinking skills during each intervention cycle, and (3) evaluate the improvement of students' critical thinking skills following the implementation of Discovery Learning. The findings are expected to contribute both theoretically and practically by providing empirical evidence regarding the effectiveness of Discovery Learning in fostering critical thinking skills among primary school students and offering pedagogical insights for mathematics teachers seeking to implement student-centered learning approaches.

2 RESEARCH METHOD

Research Design

This study employed a Classroom Action Research (CAR) design using the Kemmis and McTaggart cyclical model, which consists of four stages: planning, action, observation, and reflection. Classroom Action Research is appropriate for improving educational practices through systematic interventions implemented directly in classroom settings. The cyclical process enables teachers and researchers to continuously evaluate and refine instructional strategies based on evidence gathered during the learning process [14]–[16]. The research was conducted in three cycles, with each cycle designed to improve students' critical thinking skills through the implementation of Discovery Learning.

Participants and Research Setting

The study was conducted at MI Al-Husaeni 2 Bandung, Indonesia. The participants consisted of fourth-grade students enrolled in the 2021/2022 academic year. The class was selected based on preliminary observations indicating that students experienced difficulties in solving mathematical problems requiring analysis, reasoning, and critical thinking. The research focused on mathematics learning activities involving problem-solving and conceptual understanding.

Research Procedure

The intervention was implemented through three action cycles following the Kemmis and McTaggart model. Each cycle included four stages:

1. **Planning**: Preparing lesson plans based on Discovery Learning principles, instructional materials, worksheets, observation sheets, and evaluation instruments.
2. **Action**: Implementing mathematics instruction using Discovery Learning.
3. **Observation**: Monitoring students' learning activities and critical thinking behaviors during classroom instruction.
4. **Reflection**: Evaluating the outcomes of each cycle and identifying necessary improvements for subsequent cycles.

The Discovery Learning model was implemented through activities that encouraged students to identify problems, explore information, formulate hypotheses, analyze findings, and draw conclusions independently under teacher guidance. This approach aligns with Bruner's constructivist learning theory, which emphasizes knowledge construction through active discovery [17].

Research Instruments

Data were collected using observation sheets, interviews, documentation, and critical thinking evaluation tests. Observation sheets were used to assess students' critical thinking behaviors during learning activities, while evaluation tests were administered at the end of each cycle to measure students' critical thinking achievement in mathematics. The assessment of critical thinking skills was developed based on indicators proposed by Glaser, including problem identification, information analysis, interpretation, evaluation, reasoning, and conclusion drawing. These indicators are widely used to assess critical thinking in educational contexts [18].

Data Analysis

Data analysis employed both qualitative and quantitative approaches. Qualitative data obtained from observations and interviews were analyzed through data reduction, data display, and conclusion drawing. Quantitative data obtained from evaluation tests were analyzed descriptively using mean scores and percentage improvements across cycles.

Students' learning achievement was calculated using the following formula:

P=fN×100P = \frac{f}{N} \times 100P=Nf×100

where *P* represents the percentage of achievement, *f* represents the number of students achieving the expected criteria, and *N* represents the total number of students. Improvement in students' critical thinking skills was determined by comparing the results obtained in the pre-cycle, Cycle I, Cycle II, and Cycle III. The intervention was considered successful when the percentage of students achieving the predetermined mastery criteria showed consistent improvement across cycles.

3 RESULTS AND DISCUSSION

3.1. Initial Condition of Students' Critical Thinking Skills

Before the implementation of Discovery Learning, a preliminary assessment was conducted to identify students' critical thinking skills in mathematics learning. The results indicated that most students experienced difficulties in analyzing mathematical problems, identifying relevant information, explaining reasoning processes, and drawing logical conclusions. During classroom observations, students tended to rely on teacher explanations and showed limited participation in problem-solving discussions.

Furthermore, students demonstrated low confidence when asked to explain their answers and often focused on obtaining final results without providing supporting arguments. These findings suggest that students' critical thinking skills had not yet developed optimally prior to the intervention. Such conditions highlight the need for instructional strategies that actively engage students in inquiry, exploration, and independent knowledge construction.

The preliminary findings are consistent with the results of classroom observations, which revealed that mathematics learning was predominantly teacher-centered. Students were generally passive during lessons and had limited opportunities to investigate problems, formulate hypotheses, or evaluate alternative solutions. Consequently, the implementation of Discovery Learning was considered necessary to facilitate more active learning experiences and foster students' critical thinking skills.

Table 1. Summary of Initial Critical Thinking Conditions

Indicator	Initial Condition
Problem Identification	Low
Information Analysis	Low
Reasoning Ability	Low
Evaluation of Solutions	Low
Conclusion Drawing	Low
Student Participation	Limited
Learning Approach	Teacher-centered

The results of the preliminary assessment served as the basis for designing the Discovery Learning intervention implemented in Cycle I. The intervention focused on providing students with opportunities to explore mathematical concepts independently, discuss findings collaboratively, and construct conclusions through guided discovery activities.

3.2 Results of Cycle I

The implementation of Discovery Learning in Cycle I demonstrated an initial improvement in students' critical thinking skills during mathematics learning. Learning activities followed the Discovery Learning stages, allowing students to observe mathematical problems, identify relevant information, discuss alternative solutions, and formulate conclusions collaboratively. Compared with the preliminary condition, students became more actively involved in classroom discussions and demonstrated greater confidence in expressing their ideas.

The evaluation results indicated that students' critical thinking skills improved after the first intervention. The mean score increased from 59.04 in the preliminary assessment to 70.95 in Cycle I. In addition, the percentage of students achieving the

minimum mastery criterion increased from 57% to 71%, indicating a positive impact of the Discovery Learning implementation on students' learning performance.

Classroom observation also revealed improvements in students' critical thinking behaviours. The average observation score increased from 2.23 during the preliminary stage to 3.00 in Cycle I, suggesting that students began to demonstrate better abilities in identifying problems, analysing information, and participating actively in mathematical discussions. However, several students still depended on teacher guidance when formulating logical arguments and drawing conclusions.

Table 2. Improvement of Students' Critical Thinking Skills in Cycle I

Indicator	Preliminary	Cycle I
Mean score	59.04	70.95
Students achieving mastery	57%	71%
Observation score	2.23	3.00
Category	Less Critical	Fairly Critical

The findings indicate that the first cycle successfully enhanced students' participation and critical thinking performance. Nevertheless, several challenges remained, particularly students' dependence on teacher assistance during analytical reasoning. Therefore, instructional improvements were incorporated into Cycle II to strengthen students' independence and deepen their critical thinking skills.

3.3 Results of Cycle II

Based on the reflection conducted after Cycle I, several improvements were incorporated into the learning process in Cycle II. The teacher provided clearer guidance during the discovery process, encouraged more active group discussions, and facilitated students in analyzing mathematical problems through structured questioning. These modifications aimed to reduce students' dependence on teacher assistance and promote greater autonomy during problem-solving activities.

The implementation of Discovery Learning in Cycle II resulted in further improvements in students' critical thinking skills. Students became more confident in expressing mathematical ideas, evaluating different solution strategies, and presenting conclusions during classroom discussions. Collaborative learning activities also became more effective, as students actively exchanged opinions and provided feedback to their peers.

The evaluation results demonstrated continued progress in students' learning achievement. The mean score increased from 70.95 in Cycle I to 73.80 in Cycle II. Likewise, the percentage of students achieving the minimum mastery criterion increased from 71% to 76%, indicating that a greater proportion of students successfully met the expected learning outcomes.

Observation data also confirmed improvements in students' critical thinking behaviours during classroom learning. The average observation score increased from 3.00 in Cycle I to 3.52 in Cycle II. This finding indicates that students demonstrated stronger abilities in identifying mathematical problems, analyzing information, evaluating alternative solutions, and formulating logical conclusions. Although several students still required occasional teacher support, most students participated more actively and independently than in the previous cycle.

Table 3. Students' Critical Thinking Performance in Cycle II

Indicator	Cycle I	Cycle II
Mean score	70.95	73.80
Students achieving mastery	71%	76%
Observation score	3.00	3.52
Category	Fairly Critical	Critical

The findings of Cycle II indicate that the instructional improvements successfully enhanced students' critical thinking skills and classroom engagement. Compared with Cycle I, students showed greater independence in exploring mathematical concepts and solving contextual problems. Nevertheless, several students had not yet achieved the expected level of critical thinking performance. Therefore, further refinement of the instructional strategy was implemented in Cycle III to maximize students' learning outcomes.

3.4 Results of Cycle III

Cycle III was conducted as the final stage of the classroom action research after reflecting on the outcomes of Cycle II. Several instructional improvements were maintained, including more intensive teacher facilitation, greater opportunities for collaborative problem-solving, and structured guidance that encouraged students to independently analyze mathematical problems and justify their solutions. These improvements aimed to maximize students' critical thinking skills and ensure that the expected learning objectives were achieved.

The implementation of Discovery Learning in Cycle III resulted in the highest level of students' participation throughout the study. Classroom observations indicated that students became increasingly confident in identifying mathematical problems, discussing solution strategies, evaluating peers' arguments, and drawing conclusions based on logical reasoning. Students also demonstrated greater independence during learning activities and required less teacher assistance than in the previous cycles.

The evaluation results showed further improvement in students' critical thinking achievement. The mean score increased from 73.80 in Cycle II to 77.85 in Cycle III. Likewise, the percentage of students achieving the minimum mastery criterion increased from 76% to 86%, indicating that the majority of students successfully met the expected learning outcomes after the implementation of Discovery Learning.

Observation data also confirmed the positive development of students' critical thinking behaviours. The average observation score increased from 3.52 in Cycle II to 3.80 in Cycle III, indicating that students had reached the critical category. Most students were able to analyze mathematical problems systematically, provide logical explanations, evaluate alternative solutions, and communicate their reasoning effectively during classroom discussions.

Table 4. Students' Critical Thinking Performance in Cycle III

Indicator	Cycle II	Cycle III
Mean score	73.80	**77.85**
Students achieving mastery	76%	**86%**
Observation score	3.52	**3.80**
Category	Critical	Highly Critical

The findings demonstrate that the implementation of Discovery Learning in Cycle III successfully achieved the predetermined success indicators. Students showed substantial improvements in mathematical reasoning, problem-solving, and critical thinking throughout the learning process. Consequently, no additional action cycle was required, as the expected level of learning achievement and critical thinking performance had been attained.

3.5 Overall Improvement of Students' Critical Thinking Skills

The implementation of Discovery Learning across the three action cycles resulted in a consistent improvement in students' critical thinking skills in mathematics. Improvements were evident not only in students' academic achievement but also in their classroom participation and critical thinking behaviours observed throughout the learning process.

The comparison of learning outcomes revealed a continuous increase in students' achievement after each intervention cycle. The mean score improved from 59.04 during the preliminary stage to 70.95 in Cycle I, followed by 73.80 in Cycle II, and reached 77.85 in Cycle III. Similarly, the percentage of students achieving the minimum mastery criterion increased from 57% in the preliminary stage to 71%, 76%, and finally 86% in Cycle III. These findings indicate that Discovery Learning contributed positively to students' mathematical understanding and critical thinking performance.

A similar pattern was observed in the classroom observation results. Students' critical thinking behaviour gradually improved throughout the intervention, with the average observation score increasing from 2.23 (less critical) during the preliminary stage to 3.00 (fairly critical) in Cycle I, 3.52 (critical) in Cycle II, and 3.80 (highly critical) in Cycle III. These improvements demonstrate that students became progressively more capable of identifying problems, analysing information, evaluating alternative solutions, and drawing logical conclusions independently during mathematics learning.

Table 5. Overall Improvement of Students' Critical Thinking Skills

Indicator	Preliminary	Cycle I	Cycle II	Cycle III
Mean Score	59.04	70.95	73.80	**77.85**
Students Achieving Mastery	57%	71%	76%	**86%**
Observation Score	2.23	3.00	3.52	**3.80**
Critical Thinking Category	Less Critical	Fairly Critical	Critical	Highly Critical

Overall, the findings demonstrate that the iterative implementation of Discovery Learning progressively enhanced students' critical thinking skills throughout the classroom action research. The greatest improvement was observed in Cycle III, where most students successfully achieved the expected learning outcomes and demonstrated greater independence in mathematical reasoning and problem-solving. These findings indicate that Discovery Learning was effective in fostering critical thinking skills among fourth-grade students in elementary mathematics learning.

3.5 Discussion

The findings of this study demonstrate that the implementation of the Discovery Learning model effectively improved elementary school students' critical thinking skills in mathematics learning. The progressive increase in students' mean scores, learning mastery, and classroom observation results across the three research cycles indicates that Discovery Learning successfully facilitated students' engagement in higher-order thinking processes. Rather than relying on teacher explanations, students were encouraged to identify mathematical problems, collect and analyze information, evaluate alternative solutions, and formulate conclusions independently. These learning experiences are consistent with the constructivist perspective, which emphasizes that meaningful knowledge is constructed actively through exploration and discovery rather than passive information transmission [19], [20].

The improvement in students' critical thinking skills can be explained by the characteristics of Discovery Learning itself. During the learning process, students were provided with opportunities to investigate mathematical concepts through guided

inquiry, collaborative discussion, and problem-solving activities. Such experiences enabled students to connect prior knowledge with newly acquired information, thereby strengthening conceptual understanding and analytical reasoning. Bruner argued that knowledge acquired through discovery is retained longer and promotes deeper cognitive development because learners actively construct their own understanding instead of merely receiving information from teachers [21]–[25].

The results of this study also support previous empirical findings regarding the effectiveness of Discovery Learning in mathematics education. Plass et al. reported that discovery-oriented and game-based learning environments promote active cognitive engagement by encouraging learners to explore, experiment, and solve problems independently. Similarly, Yuo found that student-centered learning activities requiring exploration and investigation significantly improve students' reasoning ability, conceptual understanding, and academic achievement compared with conventional instruction [26]. These findings reinforce the argument that instructional models emphasizing active learning contribute positively to the development of critical thinking skills.

Another important finding concerns the gradual improvement observed across the three classroom action research cycles. The iterative process of planning, implementation, observation, and reflection allowed instructional strategies to be continuously refined according to students' learning needs. The improvement in classroom participation observed during this study further demonstrates the relationship between active learning and critical thinking development. Initially, students were reluctant to express mathematical ideas and tended to depend heavily on teacher explanations. However, after repeated implementation of Discovery Learning, students became more confident in asking questions, discussing alternative solutions, evaluating peers' responses, and communicating mathematical reasoning. This finding is consistent with Hattie's synthesis of educational research, which concludes that learning environments promoting active participation and meaningful classroom interaction substantially enhance students' cognitive achievement [27].

Furthermore, the findings align with the framework of interest and cognitive engagement proposed by Hidi and Renninger, who argue that meaningful learning activities stimulate students' curiosity and sustain cognitive involvement during the learning process [28]. When students actively investigate mathematical problems and construct solutions independently, they are more likely to engage in reflective thinking, evaluate evidence critically, and develop deeper conceptual understanding. Therefore, Discovery Learning not only improves academic performance but also strengthens the cognitive processes underlying critical thinking.

From a practical perspective, this study provides evidence that Discovery Learning can serve as an effective instructional strategy for elementary mathematics education, particularly in developing students' higher-order thinking skills. The model encourages teachers to shift from teacher-centered instruction toward student-centered learning environments where exploration, collaboration, and inquiry become integral components of classroom activities. Such instructional practices are highly relevant to current educational reforms emphasizing critical thinking, creativity, collaboration, and problem-solving as essential competencies for twenty-first-century learners [29], [30].

Nevertheless, several limitations should be acknowledged. First, this study involved only one fourth-grade classroom in a single Madrasah Ibtidaiyah, limiting the generalizability of the findings to broader educational contexts. Second, the research employed a Classroom Action Research design without a comparison group; therefore, causal conclusions regarding the superiority of Discovery Learning over other instructional models should be interpreted cautiously. Future studies are encouraged to employ quasi-experimental or experimental designs involving larger samples from different elementary schools to provide stronger empirical evidence regarding the effectiveness of Discovery Learning in enhancing students' critical thinking skills.

Overall, this study extends the current literature on Discovery Learning by demonstrating that continuous instructional refinement through Classroom Action Research can effectively cultivate critical thinking skills in elementary mathematics classrooms. The study provides empirical evidence from an Islamic primary school context, which remains underrepresented in international educational research. Consequently, the findings broaden the applicability of constructivist learning theory in primary mathematics education while offering practical guidance for teachers seeking to integrate inquiry-oriented learning strategies to foster higher-order thinking skills. Future studies involving larger samples and quasi-experimental designs are recommended to validate and generalize these findings across diverse educational contexts.

4 CONCLUSION

The findings of this classroom action research demonstrate that the implementation of the Discovery Learning model effectively improved fourth-grade students' critical thinking skills in mathematics learning at MI Al-Husaeni 2 Bandung. The improvements were consistently observed across the three intervention cycles, as reflected in the increase in students' mean achievement scores, learning mastery, and classroom observation results. The Discovery Learning model encouraged students to actively identify mathematical problems, analyze information, evaluate alternative solutions, and formulate logical conclusions through guided inquiry and collaborative learning activities. These findings indicate that Discovery Learning provides an effective student-centered instructional approach for fostering higher-order thinking skills in primary mathematics education.

This study contributes to both theory and educational practice. Theoretically, the findings provide additional empirical evidence supporting the constructivist perspective that active knowledge construction through discovery-oriented learning

facilitates the development of students' critical thinking skills. Furthermore, this study extends previous research by demonstrating the effectiveness of Discovery Learning within the context of an Islamic primary school (Madrasah Ibtidaiyah), which remains relatively underrepresented in the international literature on mathematics education. Practically, the study offers an evidence-based instructional framework that can assist elementary school teachers in designing mathematics learning activities that encourage inquiry, collaboration, and analytical reasoning while supporting the implementation of student-centered learning aligned with twenty-first-century educational goals.

Despite these contributions, several limitations should be acknowledged. The study was conducted in a single classroom involving a relatively small number of participants, thereby limiting the generalizability of the findings. In addition, the Classroom Action Research design focused primarily on improving classroom practice rather than establishing causal relationships between instructional models and learning outcomes. Therefore, future studies are recommended to employ quasi-experimental or experimental designs involving larger and more diverse samples from different educational settings. Further research may also examine the long-term effects of Discovery Learning on students' critical thinking skills, mathematical problem-solving abilities, and other higher-order thinking competencies in elementary education.

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6 DECLARATIONS

AI USAGE STATEMENT

During the preparation of this manuscript, the authors used ChatGPT (OpenAI) to improve the language quality, grammar, readability, and academic style of the manuscript. The tool was also used to assist in organizing the manuscript structure and refining academic expressions. All AI-generated outputs were critically reviewed, verified, revised, and edited by the authors. The authors take full responsibility for the originality, accuracy, integrity, and scientific content of this publication.

AUTHOR CONTRIBUTION

Author 1: Conceptualization, Investigation, Methodology, Data Curation, Formal Analysis, Visualization, Writing – Original Draft.
Author 2: Methodology, Validation, Supervision, Formal Analysis, Writing – Review & Editing.
Author 3: Supervision, Project Administration, Validation, Writing – Review & Editing.
Author 4: Methodology Consultation, International Collaboration, Validation, Critical Revision, Writing – Review & Editing.
All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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COMPETING INTEREST

The authors declare that they have no competing interests, including financial, professional, or personal relationships that could have influenced the work reported in this manuscript.

ETHICAL APPROVAL

This study was conducted in accordance with the ethical principles of educational research involving human participants. Permission to conduct the research was obtained from the Principal of MI Al-Husaeni 2 Bandung, Indonesia, prior to data collection. Participation was voluntary, and informed consent was obtained from the school authorities and participants' parents or legal guardians where appropriate. All participant information was anonymized, and the confidentiality and privacy of the participants were maintained throughout the research process.

DATA AVAILABILITY STATEMENT

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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