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ChatGPT-Assisted Discovery Learning on Junior High School Students' Mathematics Learning Anxiety: A Systematic Literature Review

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ABSTRACT

Math anxiety is an emotional factor that significantly affects students' learning processes and outcomes, particularly in junior high school. Children with this disorder may have difficulty concentrating, have low self-esteem, and are more likely to be passive learners. Therefore, learning innovations are needed that can encourage a more stimulating and enjoyable learning environment. The purpose of this study was to collect the findings of previous research on the integrative potential of ChatGPT-assisted *Discovery Learning* models in lowering mathematics-related junior high school students' anxiety. The PRISMA protocol was followed in the methodology of the Systematic Literature Review (SLR) of this study. Data for scientific publications published between 2019 and 2025 were collected from Google Scholar and Garuda databases. Regarding the year range, the articles studied focused on a combination of three variables, where articles in the period before the launch of ChatGPT (2019–2022) were netted based on the study of AI *chatbots* or similar artificial intelligence technologies in mathematics education, while the articles for the period 2023–2025 focused directly on the use of ChatGPT. A total of 15 articles that met the inclusion criteria were reviewed qualitatively based on the focus of mathematics anxiety, the use of *Discovery Learning*, and the use of AI/ChatGPT. The findings suggest that internal factors (fear and emotional stress) as well as environmental factors (monotonous learning) contribute to math anxiety. The application of *Discovery Learning* can increase students' freedom and activities, while ChatGPT offers potential support in the form of brief explanations, quick feedback, and personalized assistance. The findings show that the combination of *Discovery Learning* and ChatGPT has strong integrative potential as an alternative strategy to mitigate the math anxiety of junior high school students through the creation of interactive, independent, and adaptive learning spaces.

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Introduction

Often referred to as the "queen of science," mathematics is a field of study that is crucial to the development of science and technology. Mathematics learning does not only aim to make students understand the topic theoretically, but also to improve the ability to think logically, critically, and systematically in dealing with various life problems (Nopela et al., 2020). Improving the quality of mathematics education is an important issue both nationally and internationally because it has a direct impact on students' literacy skills and their ability to compete in the global economy (Ardiansyah, 2025). In addition, the development of critical thinking skills necessary to deal with technological advances and the difficulties of contemporary life is greatly aided by mathematics (Novianty et al., 2023). However, in reality, especially in students at the Junior High School (SMP) level, they still often view mathematics as a challenging and stressful subject, which can lead to a number of affective problems, including maths learning anxiety.

Math learning anxiety is an emotional condition characterized by fear, tension, and worry when students face math activities (Reni & Munandar, 2023). Fear of math can be interpreted as math anxiety or Mathematics Anxiety (Lita & Pujiastuti, 2023). This psychological stress should not be ignored, because math anxiety can also cause real physical reactions such as nervousness, panic, and difficulty concentrating when students try to work on problems (Dina, 2022). These disturbed emotional and physical conditions directly have a negative impact on concentration levels, weakening short-term memory (Working Memory), as well as a decrease in overall student learning outcomes (Putra & Yulanda, 2022). In line with that, many studies show that students' academic achievement in maths will decrease significantly as the level of anxiety they feel increases (Suwarni, 2023). This confirms that math anxiety is a major problem at the junior high school level that needs to be addressed immediately, because if left unchecked, this affective barrier can make students stay away, be passive, avoid math learning activities, and trigger low engagement (Student Engagement) in the classroom. Previous researchers have also argued that the monotonous, rigid, and boring learning process at school, as well as low student involvement in the classroom, contribute greatly to this high level of anxiety, in addition to the internal causative factors within the students themselves.

One of the learning models that is considered potential to create a positive learning environment is Discovery Learning. This model encourages students to actively explore information, identify patterns, and discover mathematical concepts independently so as to improve concept understanding and student involvement in the learning process (Muthmainnah & Sumarsih, 2019). In addition, the application of Discovery Learning proven to be able to encourage students to be more active in discussions, dare to express opinions, and be involved in problem-solving activities (Warisma et al., 2020). Student-centered discovery activities also have the potential to increase students' curiosity, learning independence, and confidence (Harahap & Fauzi, 2025). Thus, this model can help create a more meaningful learning experience and support the development of students' affective aspects. Nevertheless, Discovery Learning has limitations because the process of finding concepts independently demands a fairly high cognitive load. If students do not receive adequate guidance or scaffolding from teachers, they risk experiencing confusion, frustration, and misconceptions in understanding the material being studied (Novianty et al., 2023). Therefore, the application of Discovery Learning It needs to be supported with the right learning assistance so that the concept discovery process can take place optimally.

To overcome these limitations, the integration of artificial intelligence technology, especially ChatGPT (Chat Generative Pre-trained Transformer), can be positioned as a form of digital scaffolding that supports the process of concept discovery in Discovery Learning. As

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one of the innovations based on Artificial Intelligence (AI), ChatGPT is able to provide explanations quickly, direct feedback, and support a more flexible and efficient learning process (Fitriyani & Mutaqin, 2025;Sakti et al., 2024). Unlike digital learning media that tends to be one-way, ChatGPT offers adaptive and personalized two-way interaction according to the learning needs of each student (Nuramin & Rikayanti, 2025). In context Discovery Learning, ChatGPT can help students get through difficult phases in finding concepts by providing triggering questions, providing examples of relevant questions, alternative explanations tailored to students' level of understanding, and providing instant feedback. This support has the potential to increase students' motivation, creativity, and understanding of learning materials (Aminuddin et al., 2024). In addition, the existence of ChatGPT as an always-available learning assistant can create a sense of psychological security for students when experiencing difficulties, thus helping them manage negative emotions and reduce anxiety during the math learning process. However, its use still requires teacher supervision so as not to cause dependence, reduce the depth of thinking, or encourage the practice of plagiarism in learning (Anwari & Soebagyo, 2025), so a systematic study is needed to map the integrative potential of both as an alternative solution in reducing mathematics anxiety in junior high school students.

Although it has a great opportunity, the use of ChatGPT in mathematics learning is not free from academic risks if applied without proper direction and supervision from teachers. The presence of this technology has the potential to trigger cognitive dependence, reduce the depth of critical thinking, and open up opportunities for plagiarism if students simply copy instant answers without going through the process of independent reasoning. Therefore, ChatGPT integration must be proportionally placed in the Discovery Learning syntax, where the control and reinforcement of concepts remain under the full control of the math teacher.

Effective learning occurs when students actively create their own knowledge through educational experiences and interactions with the learning environment, according to constructivist theories (Sindiana et al., 2022). According to this approach, ChatGPT can serve as a digital scaffolding that offers adaptive learning assistance, while Discovery Learning (Discovery Learning) allows students to discover concepts on their own. However, there is currently little research on the integration of these two methods in mathematics education, especially in studies that examine how they affect the anxiety of junior high school students related to mathematics learning. To present a more complete picture of the potential of combining Discovery Learning and ChatGPT in reducing the mathematics learning anxiety of junior high school students, a Systematic Literature Review (SLR)-based study is needed to consolidate relevant research findings. Therefore, the systematic synthesis of the combination of ChatGPT and Discovery Learning in the context of reducing the anxiety of junior high school students related to mathematics learning is what makes this research new.

Although studies on these components are beginning to develop, research that specifically synthesizes the relationship between discovery learning models and AI assistants at the junior high school level is still very limited and tends to be separate. Based on this background, this study aims to conduct *a Systematic Literature Review* (SLR) to analyze and synthesize various studies related to the use of ChatGPT-assisted Discovery Learning models in reducing mathematics learning anxiety in junior high school students. This study is focused on identifying the factors that cause mathematics learning anxiety, analyzing the advantages and limitations *of Discovery Learning* in mitigating such anxiety, and the potential of ChatGPT as a digital *scaffolding* that supports more interactive and emotionally friendly mathematics learning.

Method

Types of Research

This study uses the Systematic Literature Review (SLR). This method is used to identify, evaluate, and synthesize a wide range of relevant research in a systematic and structured manner (Pratamasari et al., 2025). The review process follows guidelines Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) which consists of the identification, screening, eligibility, and inclusion stages (Sumarna et al., 2025). A thorough search of Google Scholar and Garuda (Digital Reference Library) databases yielded these articles. Publications from 2019 to 2025 are the focus of the search. To find articles relevant to the research topic, a combination of keywords and Boolean operators is used in the search. The following search terms are used: "Discovery Learning" AND "math learning anxiety" OR "Discovery Learning" AND "mathematics anxiety" OR "junior high school math learning anxiety" OR "ChatGPT" AND "math learning" OR "Artificial Intelligence" AND "math learning" OR "Discovery Learning" AND "ChatGPT". In the first search, 40 articles were found from Google Scholar and 43 articles from Garuda, bringing the total to 83 articles. After 6 duplicates were eliminated, 77 articles remained. At the title and abstract screening stage, fifty-one articles were removed because they did not fit the research subject. After that, the 26 articles underwent a full-text evaluation. Eleven articles were disqualified for not explicitly addressing anxiety related to learning math, discovery learning, or using ChatGPT. As a result, 15 articles were used in the data synthesis process as they met all inclusion requirements.

Instrument

The research instruments are in the form of data extraction sheets and quality appraisal sheets which are used to evaluate the methodological quality of the selected articles. In addition to considering inclusion and exclusion criteria, each article is assessed based on the clarity of the research objective, the suitability of the research design, the validity of the instrument or data source, the accuracy of the data analysis technique, and the suitability of the conclusions with the research results (Fitriani & Rully, 2021). In addition, quality appraisal is carried out to ensure that the articles used have adequate scientific quality. The quality assessment of the article is carried out based on five indicators, namely: (1) the research objectives are clearly explained, (2) the research design is in accordance with the research objectives, (3) the instrument or data source is adequately explained, (4) the data analysis techniques are carried out appropriately, and (5) the conclusions are supported by the research results. Articles that meet at least four of the five indicators are declared worthy of further analysis. The results of the quality appraisal showed that all articles that passed the selection stage met the quality criteria that had been set, so that as many as 15 articles were declared suitable for use in the data synthesis process.

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Table 1. Inclusion and Exclusion Criteria

Criteria	Inclusions	Exclusion
Year of Publication	2019 – 2025	Less than 2019
Research Subject	Junior High School/MTs	SD/MI, SMA/SMK/MA, and students in higher education
Material	Math	In addition to math
Research Methods	Quantitative, qualitative, development, and mixed	Desk study
Article Focus	Factors that cause math learning anxiety in students, the advantages and disadvantages of the *Discovery Learning* model in reducing students' math learning anxiety, and the form of use of ChatGPT in interactive and emotionally friendly mathematics learning	-

Based on the criteria of inclusion, exclusion, and quality appraisal results, articles that meet all requirements are then analyzed and synthesized to answer research questions about the factors that cause anxiety in mathematics learning, the role of *Discovery Learning* in reducing anxiety about learning mathematics, as well as the potential use of ChatGPT in mathematics learning.

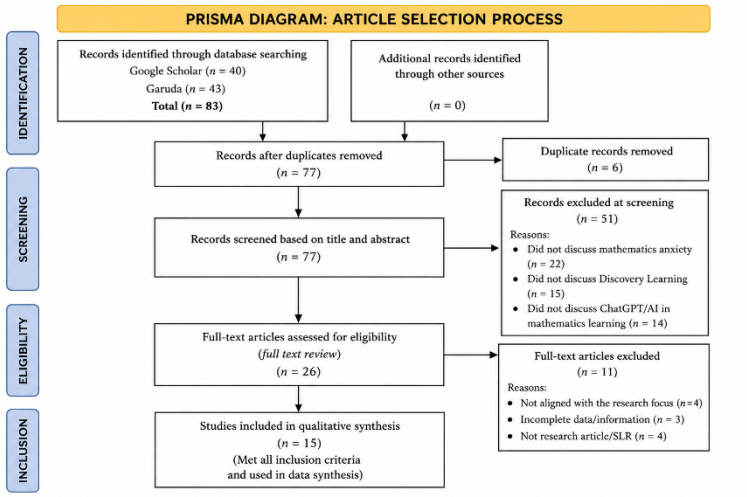

Figure 1. Digram Prisma

DataCollection

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standard, which includes identification, screening, eligibility, and inclusion, is followed in the data collection process. The keywords "*Discovery Learning* against math learning anxiety," "junior high school math learning anxiety," "*Discovery Learning* of junior high school students," and "ChatGPT in math learning" were used to search for articles published between 2019 and 2025 in the Google Scholar and Garuda databases. A total of 83 articles, 40 from Google Scholar and 43 from Garuda were found in the first search results. After deleting 6 duplicate articles, 77 articles remained, which were then selected based on titles and abstracts according to the inclusion and exclusion criteria. At the screening stage, 26 articles were eliminated because they were not relevant to the focus of the research, leaving 51 articles to be fully reviewed (full text review). Furthermore, the articles that pass are evaluated using quality

appraisal based on the clarity of the research objectives, the suitability of the research design, the validity of the instrument or data source, the accuracy of the data analysis technique, and the suitability of the conclusions with the research results. The results of the evaluation showed that 11 articles did not meet the eligibility criteria because they did not match the focus of the research or did not have adequate methodological quality. Thus, 15 articles were obtained that meet all inclusion and quality appraisal criteria so that they are worth analyzing to answer research questions regarding mathematics learning anxiety, *Discovery Learning*, and the use of ChatGPT in mathematics learning. A summary of the article selection process is presented in Figure 1.

Data Analysis

The data sources in this study were obtained from 15 articles that met the inclusion and quality appraisal criteria. The data analysis techniques used are qualitative content analysis and narrative synthesis. The first stage is carried out by identifying and encoding data from each article based on the author, year of publication, research method, research subject, and main findings relevant to the focus of the study. The second stage is carried out by grouping the findings of the article into several themes, namely the factors that cause mathematics learning anxiety, the role of *Discovery Learning* in reducing mathematics learning anxiety, the use of ChatGPT in mathematics learning, and the potential integration of *Discovery Learning* and ChatGPT in mathematics learning. The next stage is a comparative synthesis to compare the results between studies, identify consistent patterns of findings, and formulate comprehensive conclusions based on the available evidence. To maintain the validity of the study results and minimize bias, all articles that passed the selection were also evaluated for methodological quality using a quality appraisal instrument adapted from the Critical Appraisal Skills Programme (CASP). The assessment was carried out based on five aspects, namely the clarity of the research design, the suitability and validity of the instrument, the accuracy of the data collection technique, the alignment of data analysis, and the suitability of the conclusions with the research results. The results of the assessment show that all the articles analyzed meet adequate methodological quality criteria so that they are suitable for use in the data synthesis process.

Research Findings and Discussion

The study's findings are a synthesis of 15 publications from the Google Scholar and Garuda databases published between 2019 and 2025 and have passed the PRISMA selection and quality assessment stage. According to the findings of the analysis, there have been no studies that specifically examine the application of the ChatGPT-assisted Discovery Learning model as an integrated treatment in mathematics learning for junior high school students. However, the available literature shows a strong conceptual link between Discovery Learning, the use of ChatGPT, and efforts to reduce math learning anxiety so that all three have the potential to be integrated into learning. The articles analyzed consisted of 8 articles that discussed mathematics learning anxiety and Discovery Learning and 7 articles that discussed the use of ChatGPT or artificial intelligence in mathematics learning. To obtain a more comprehensive understanding, the results of the synthesis are classified into several main themes, namely the factors that cause mathematics learning anxiety, the role of Discovery Learning in reducing mathematics learning anxiety, the use of ChatGPT in mathematics learning, and the potential for Discovery Learning integration and ChatGPT, as well as the factors that affect the success of its implementation. A summary of the results of the article analysis is presented in Table 2.

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Table 2. Research Results

Researcher and Year	Title	Research results
Stiawan, et al.. (2024)	Penurunan Kecemasan Matematika Melalui Model Pembelajaran: Systematic Literature Review	Math anxiety is characterized by anxiety, fear, and discomfort due to unpleasant learning.
Umaroh, et al.. (2020)	Pengaruh Self-Efficacy Dan Kecemasan Matematika Terhadap Kemampuan Penalaran Matematis Siswa Smp	The demands of obtaining high grades increase students' anxiety.
Nopela, et al.. (2020)	Pengaruh Kecemasan Matematika Siswa Kelas VII Terhadap Hasil Belajar Di SMP Negeri 3 Kota Bengkulu	Fear and anxiety about mathematics have an impact on student learning outcomes.
Aini, et al.. (2024)	Metode Pembelajaran Sebagai Upaya Menurunkan Kecemasan Matematika: Systematic Literature Review	The monotonous method makes it difficult for students to concentrate and lower the learning mentality.
Haerunnisa & Imami (2022)	Analisis Kecemasan Belajar Siswa SMP pada Pembelajaran Matematika.	High anxiety and lack of confidence appear in math learning.
Julya & Nur (2022)	Studi Literatur Mengenai Kecemasan Matematis Terhadap Pembelajaran Matematika	Anxiety triggers physical symptoms such as panic, tension, and difficulty focusing.
Umayyad (2019)	Penerapan Model Discovery Learning dalam Mengatasi Kecemasan Matematika Siswa SMP	Discovery Learning encourages students to be active and develop learning activities.
Muthmainnah & Sumarsih (2019)	Penerapan Metode Discovery Learning Materi Pola Bilangan Sebagai Upaya Mengurangi Kecemasan Siswa Pada Pelajaran Matematika	Discovery Learning reduces anxiety and boosts student confidence.
Sakti, et al.. (2024)	Tinjauan Literatur Sistematis: Pengaruh Penggunaan ChatGPT dalam Proses Pembelajaran	ChatGPT is a learning tool with neat and easy-to-understand answers.
Fitriyani, et al.. (2025)	Pengaruh Pembelajaran Discovery Learning Berbantuan Artificial Intellegence Terhadap Hasil Belajar Matematika Siswa	AI helps to understand mathematical concepts and provide quick feedback.
Anwari & Soebagyo (2025)	Pemanfaatan ChatGPT sebagai Asisten Belajar Matematika: Tinjauan Kualitatif terhadap Pengalaman Siswa	ChatGPT encourages student learning independence.
Nuramin & Rikayanti (2025)	Tantangan Dan Peluang Penerapan ChatGPT Dalam Pembelajaran Matematika	ChatGPT helps to understand concepts and improve the spirit of learning.
Siregar, et al.. (2024)	ChatGPT Dalam Mendukung Pembelajaran Di Sekolah	ChatGPT increases student motivation, creativity, and activeness.
Merentek, et al.. (2023)	Implementasi Kecerdasan Buatan ChatGPT dalam Pembelajaran	ChatGPT helps with active and independent learning without stress.
Merentek, et al.. (2023)	Integrasi ChatGPT dalam Blended Learning dalam Mengoptimalkan Pemahaman Materi Pembelajaran	ChatGPT increases creativity, motivation, and learning time efficiency.

The results of the study showed that the mathematics learning anxiety of junior high school students was influenced by internal factors and external factors. Internal factors include fear of failure, low self-confidence, emotional tension, and difficulty concentrating when facing math problems. Meanwhile, external factors are related to academic demands, learning environments, and learning processes that are less varied. In addition, the results of the synthesis show that the application of the Discovery Learning model contributes to increasing students'

activeness, concept understanding, and confidence, thereby potentially reducing mathematics learning anxiety.

On the other hand, articles discussing the use of ChatGPT show that the technology can serve as a learning companion that provides adaptive explanations, hands-on feedback, and more flexible learning support for students. However, based on the results of the study of the 15 articles analyzed, no research has been found that directly tests the implementation Discovery Learning assisted by ChatGPT as a unified learning model for junior high school students. Nevertheless, the findings suggest a strong conceptual relationship between Discovery Learning, ChatGPT, and efforts to reduce math learning anxiety so that both have the potential to be integrated in math learning. These findings are further discussed in more depth in the discussion section.

According to research, students' academic performance is not the only factor that affects math anxiety but the psychological aspects and the surrounding learning environment also play a role. These findings support the idea of math anxiety, which states that emotional stress, anxiety, and fear can interfere with a person's ability to think and solve problems. These results are consistent with research showing that math anxiety affects students' focus, memory, and academic achievement (Putra & Yulanda, 2022). Therefore, efforts to reduce math anxiety must consider psychological factors as well as a conducive learning environment in addition to improving cognitive abilities.

In that context, Discovery Learning is one of the relevant approaches because it provides opportunities for students to actively build their knowledge through the discovery process. The results of this study support the view of constructivism which emphasizes that knowledge is more meaningful when acquired through direct learning experiences. These findings are also in line with research Muthmainnah & Sumarsih (2019) which shows that students' active involvement in the learning process is able to increase confidence and reduce fear of mathematics. However, some studies have also shown that Discovery Learning can cause confusion for students if the discovery process is not accompanied by adequate guidance. This shows that the effectiveness of Discovery Learning It is highly dependent on the quality of facilitation provided by teachers.

On the other hand, the development of artificial intelligence technology opens up new opportunities in providing more personalized learning support. The results of this study show that ChatGPT has characteristics that allow students to get learning assistance quickly, adaptively, and flexibly. The findings support the research Nuramin & Rikayanti (2025) which states that ChatGPT can increase learning motivation and help with the understanding of mathematical concepts. When compared to conventional digital learning media, ChatGPT offers a more responsive two-way interaction so that it has the potential to function as a scaffolding digital for students who have learning difficulties.

Interestingly, a synthesis of 15 articles shows that no research has been found that directly tests the implementation of ChatGPT-assisted Discovery Learning in a single integrated learning design in junior high school students. Most studies still address Discovery Learning, ChatGPT, and math learning anxiety separately. This condition shows that there is a research gap that is still open for further study. Nevertheless, the results of the synthesis show a strong conceptual relationship between the three components. Discovery Learning encourages students to actively discover concepts independently, while ChatGPT has the potential to provide learning support when students encounter difficulties during the discovery process. Thus, the integration of the two has the potential to create more interactive, adaptive learning, and support students' emotional states so that math learning anxiety can be minimized.

This possibility must be addressed critically. Students who use ChatGPT carelessly will likely rely on quick fixes, which can limit their ability to think critically and solve problems.

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Therefore, the role of teachers as facilitators and controllers of the learning process is very important for the successful implementation of ChatGPT-assisted Discovery Learning. Instead of just getting the final answer, teachers can provide activities that encourage students to use ChatGPT as a source of help and reflection. To reduce the possibility of misunderstandings, educators should also confirm the information provided by ChatGPT. Based on these results, the conceptual synthesis that connects Discovery Learning, ChatGPT, and math learning anxiety in an integrated framework is what makes this study new. The findings of this study suggest the possibility of creating a learning model that combines a discovery approach with the support of artificial intelligence to reduce junior high school students' anxiety when learning mathematics, although direct empirical data are still scarce.

Conclusion

Based on the findings of a review of 15 selected articles, it can be said that junior high school students' anxiety related to mathematics learning is influenced by the interaction of internal factors such as fear, emotional tension, and low self-efficacy, as well as external factors such as monotony and lack of variety in the learning process. In this situation, ChatGPT can serve as a digital scaffolding that offers flexible explanations and quick feedback based on students' learning needs, while Discovery Learning has the ability to increase students' activity and confidence through the process of self-discovery of ideas. The study shows a strong conceptual relationship between the two approaches in supporting more interactive math learning and potentially reducing math learning anxiety, although no studies have been found that directly test the implementation of ChatGPT-assisted Discovery Learning in integrated learning designs. The contribution of this research is a synthesis of literature that connects ChatGPT, Discovery Learning, and mathematics learning anxiety in an integrated conceptual framework that serves as a basis for creating innovations in mathematics education. However, this study has limitations because it only uses articles obtained from Google Scholar and Garuda databases with a relatively limited number of articles, namely 15 articles. In addition, there is still limited research that empirically tests the integration of Discovery Learning and ChatGPT, causing the available evidence to be conceptual. Therefore, further research is recommended to conduct empirical testing on the effectiveness of the integration of Discovery Learning and ChatGPT in mathematics learning, especially in reducing mathematics learning anxiety of junior high school students, as well as expanding data sources and literature coverage to obtain more comprehensive and representative results..

Conflict of Interest

The authors declare no conflict of interest.

Auhor Contributions

F.F.L. conceptualized the research idea presented and collected data. The other two authors (H.P. and A.N.M.) are supervisors in this study, actively participating in the development of theories, methodologies, data organization and analysis, discussion of results and approval of the final version of the work. All authors confirm that they have read and approved the final version of this manuscript. The percentage of contributions to the conceptualization, drafting, and revision of this paper is as follows: F.F.L.: 60%, H.P.: 20%, and A.N.M.: 20%.

Data Availability Statement

The author states that the data supporting the findings of this study will be made available by the corresponding author, [F.F.L.], upon reasonable request.

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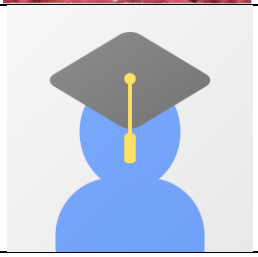	**Ade Nandang Mustafa**, is a lecturer and researcher in mathematics education, Faculty of Teacher Training and Education, Sultan Ageng Tirtayasa University, Serang, Indonesia. Affiliation: Sultan Ageng Tirtayasa University. ✉ adenmustafa@untirta.ac.id