

A Literature Review on the Relationship Between Mathematical Proficiency and Students' Positive Attitudes Toward Mathematics Learning

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ABSTRACT

This study aims to comprehensively analyze the relationship between students' mathematical proficiency and their positive attitudes toward mathematics learning through a systematic literature review of 20 national and international articles published between 2019 and 2025. Using a descriptive method with a Systematic Literature Review (SLR) approach, this study synthesizes findings related to the five components of mathematical proficiency, namely conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition) and their interaction with students' attitudes, including confidence, motivation, perseverance, and perceived usefulness of mathematics. The review shows a reciprocal and reinforcing relationship between the two constructs, where higher mathematical proficiency supports stronger positive attitudes, and positive attitudes, in turn, enhance students' cognitive engagement and reasoning development. The study also identifies key influencing factors such as individual characteristics, teacher affective disposition, learning environments, digital learning tools, and social support, which shape the interplay between cognitive and affective domains. Furthermore, a cross-study comparison highlights consistencies and variations in findings, while an examination of research limitations points to gaps in longitudinal evidence and metacognitive mediators. This study contributes by offering an integrated synthesis, proposing future research directions, and presenting theoretical, practical, and policy implications for improving mathematics instruction and fostering balanced cognitive–affective growth.

Keywords: *Mathematical Proficiency, Positive Attitude, Mathematics Learning, Literature Review, Productive Disposition.*

1) INTRODUCTION

Mathematics is a discipline that plays a fundamental role in shaping logical, analytical, and critical thinking skills, and is the main basis for the development of technology and science in the modern era. Mastery of mathematical concepts is not only important in the context of formal education, but also in everyday life and in data-driven decision making (Farinta & Mahmudi, 2024). In line with this, contemporary mathematics learning emphasizes the importance of conceptual understanding, interrelationships between ideas, and the application of mathematical principles in real-life situations

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that enable students to construct more meaningful understanding (Ncube & Luneta, 2024). Thus, the quality of mathematics learning cannot be measured solely by calculation skills, but also by deep thinking processes and creative problem-solving skills.

In this context, mathematical proficiency has become one of the comprehensive frameworks widely used as a reference for measuring the quality of students' mathematical abilities. Mathematical proficiency encompasses five main components, namely conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition, which work together to form comprehensive mathematical skills (Corrêa & Haslam, 2020; Haji et al., 2019). Research shows that students with good mathematical proficiency tend to have more mature reasoning skills and more effective problem-solving strategies (Jr. & Asoy, 2025; Saputro et al., 2023). In addition, the link between conceptual understanding and adaptive thinking strategies has been shown to strengthen students' ability to connect abstract concepts with real-life situations (Diputra et al., 2025; Pasigon, 2024).

In addition to cognitive aspects, affective factors such as a positive attitude toward mathematics also play an important role in learning success. A positive attitude that includes interest, motivation, self-confidence, and perception of the value of mathematics has been shown to be closely related to perseverance in learning and the ability to deal with complex problems (Irman et al., 2022; Pizon & Ytoc, 2022). Research shows that students with positive attitudes are more enthusiastic in exploring problem-solving strategies and have greater resilience when facing learning challenges (Wu et al., 2022). In fact, a literature review found that positive self-perceptions of mathematics are closely related to the development of adaptive reasoning and the willingness to overcome learning obstacles (Shone et al., 2023; Yanti et al., 2021). Thus, the formation of positive attitudes is an integral part of mathematics education because it supports the growth of cognitive abilities.

The relationship between mathematical proficiency and positive attitudes among students has been proven through various studies. Aini & Khuzaini (2024) found that positive mathematical disposition significantly influences conceptual understanding. This finding is reinforced by Supianti et al. (2022) which confirms that learning that emphasizes reflection and conceptual connections can improve students' productive dispositions and mathematical connection skills. Other systematic reviews also show that positive attitudes contribute to improved procedural fluency and the ability to

apply appropriate strategies when solving mathematical problems (Chan et al., 2023). Overall, these results indicate that mathematical ability and positive attitudes reinforce each other.

However, the relationship between mathematical proficiency and positive attitudes may vary depending on the educational context, student characteristics, and learning practices applied. Previous studies have shown that the relationship between cognitive abilities and affective aspects can be influenced by contextual factors such as teacher support, learning environment, and academic culture (Abbas & Rizki, 2023; Utaminingsih et al., 2021). Lynch-arroyo et al. (2023) emphasizes that teachers' affective attitudes greatly influence students' perceptions of mathematics; teachers who demonstrate confidence and positive attitudes are able to reduce mathematics anxiety and increase students' self-confidence. Similar results were found by Majid Hidayat et al. (2024) which shows that social support and a conducive learning environment strengthen the relationship between productive dispositions and mathematical achievement. These findings indicate that the learning context and the role of teachers are important factors that bridge the relationship between mathematical ability and positive attitudes.

Previous findings suggest that effective mathematics learning requires a holistic approach that not only emphasizes mastery of concepts and procedures, but also fosters positive attitudes. Learning models such as problem-based learning, collaborative learning, and the use of digital media have been shown to improve both mathematical ability and positive attitudes in students simultaneously (Go & Lomibao, 2024; Himmi et al., 2025; Saputro et al., 2023). In addition, assessment designs that comprehensively measure cognitive and affective aspects can provide richer information for understanding the development of mathematical proficiency (Kania & Kusumah, 2025; Wahyuningsih et al., 2025). Thus, a structured and supportive learning environment is key to developing both the abilities and positive attitudes of students.

Although various studies have explored the relationship between mathematical ability and positive attitudes, there are still a number of research gaps that need to be addressed. Longitudinal studies on the long-term relationship between positive attitudes and the development of mathematical ability are still very limited (Hwang & Son, 2021; Xiaoran et al., 2022). In addition, mediating factors such as metacognitive strategies and collaborative learning environments have not yet been comprehensively explored (An et al., 2024; Thi-Nga et al., 2024). Therefore, this literature study aims to summarize the latest empirical findings on the relationship between mathematical proficiency and

positive attitudes, analyze the patterns of this relationship, and provide a comprehensive overview of the direction of future research.

2) METHODS

This study is a descriptive study using the SLR (systematic literature review) method. SLR was conducted on secondary data in the form of research articles on mathematical proficiency and positive attitudes of students in mathematics learning at each level of education, including teachers and students. The steps included in this study were data collection, data analysis, and conclusions. Data were collected in the form of research articles published in international or national journals and proceedings indexed in Scopus, and other reliable databases such as Google Scholar, Science Direct, Taylor and Francis, Sage, and Eric. The studies were activated; only those that met the inclusion criteria were used. The inclusion criteria are as follows: (1) The article is a study on mathematics education. (2) The year of publication is between 2019 and 2025. (3) The article is related to mathematical proficiency and positive attitudes of students in mathematics learning.

The population in this study was all research articles on mathematical proficiency and positive attitudes of students in mathematics learning. The search results yielded 20 articles that met the inclusion criteria. After the articles were found, the author classified the articles in a table containing the article title, author, year of publication, and a summary of the research results. This study aims to analyze the relationship between mathematical proficiency and positive attitudes of students in mathematics learning through a comprehensive literature study, categorizing and comparing each article that meets the inclusion criteria. The research instrument was an observation sheet that linked the inclusion criteria with the exclusion criteria, which were classified based on the year of publication, duration of the experiment, level of education, and sample size. The presentation of articles in the table accompanied by the research results will be analyzed to obtain the relationship between mathematical proficiency and positive attitudes of students in mathematics learning 6 years ago (2019-2025).

3) RESULTS AND DISCUSSION

Results

Based on the results of systematic searching and selection of various research sources that met the inclusion criteria, 20 national and international articles were obtained that were relevant to the relationship between mathematical proficiency and positive attitudes of students in mathematics learning. These articles covered various research approaches, ranging from descriptive studies and experiments to systematic reviews that highlighted the relationship between mathematical cognitive abilities and affective aspects of student learning.

This literature review emphasizes that mathematical proficiency is not limited to mastery of concepts and procedures, but also involves productive dispositions, adaptive reasoning, and strategic competencies that shape mathematical thinking as a whole. Meanwhile, a positive attitude towards mathematics, which includes interest, self-confidence, and perceptions of the usefulness of mathematics, plays an important role in encouraging active engagement and perseverance in learning among students.

The results of the study show that these two aspects have a mutually reinforcing relationship: good mathematical proficiency fosters self-confidence and interest in mathematics, while a positive attitude contributes to increased motivation and willingness to further develop mathematical abilities. This relationship is consistent across various levels of education and learning contexts, whether through contextual learning, the use of technology, or problem-solving approaches.

The following table summarizes the research results from 20 articles that served as the main references in this literature study.

Table 1: *20 Articles Referenced in the Literature Study*

Number	Article Title	Author (Year)	Research Findings
1	Improving Students' Productive Disposition through Realistic Mathematics Education with Outdoor Approach	Haji et al. (2019)	Realistic mathematics learning with an outdoor approach improves students' productive disposition through direct involvement and contextual experiences that foster confidence and perseverance in problem solving.

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2	Mathematical Proficiency as the Basis for Assessment: A Literature Review and its Potentialities	Corrêa & Haslam (2020)	This study shows that mathematical proficiency can be used as the basis for developing assessment instruments because it covers aspects of conceptual understanding, procedural fluency, and adaptive reasoning that are integrated with each other.
3	Analyzing The Productive Disposition and Its Correlation with Mathematics Achievement of Islamic Junior High School Students	Husniah et al., (2021)	The results showed a significant positive correlation between productive disposition and mathematics learning achievement; students with positive attitudes had higher motivation and persistence in mathematics learning.
4	Exploring Learners' Productive Disposition Towards Learning Mathematics: A Phenomenological Analysis	Go & Lomibao (2024)	Phenomenological analysis reveals that a positive attitude toward mathematics is formed through enjoyable learning experiences, good relationships with teachers, and meaningful conceptual understanding.
5	Improving Students' Mathematical Proficiency Through Synchronous and Asynchronous Approaches Using Digital Modules	Saputro et al. (2023)	The use of synchronous and asynchronous digital modules effectively improves students' mathematical proficiency, especially in terms of procedural fluency and adaptive reasoning, as well as fostering independent learning.
6	Determinants of Mathematical Proficiency in Algebra Among Mathematics Education Students: A Structural Equation Model	Jr. & Asoy (2025)	The SEM modeling results show that conceptual understanding and learning strategies significantly influence students' mathematical proficiency in algebra
7	The Mathematical Proficiency Promoted by Mathematical Modelling	Corrêa (2021)	Mathematical modeling-based learning promotes the improvement of strategic competencies and adaptive reasoning, as students learn to

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			relate mathematical concepts to real-world phenomena.
8	Development of a Productive Disposition Skills Instrument for Elementary School Students	Rohman et al. (2023)	The study produced a valid and reliable instrument for measuring the productive disposition of elementary school students, covering the dimensions of self-confidence, perseverance, and positive perceptions of mathematics.
9	Students' mathematical proficiency in linear equation material reviewed from mathematical resilience	Zandy (2024)	A positive relationship was found between mathematical resilience and mathematical proficiency; students with high learning resilience were able to demonstrate more varied and reflective problem-solving strategies.
10	Descriptive analysis of students' productive dispositions in mathematics learning from a gender perspective	Fallah (2024)	There is no significant difference between the productive dispositions of male and female students; both show positive attitudes when learning is designed to be collaborative and problem-solving oriented.
11	Math is beautifully intimidating: Analyzing the conflict between teacher affective disposition and observed positioning-by-others	Lynch-arroyo et al. (2023)	This study reveals that teachers' affective attitudes influence students' perceptions of mathematics; teachers who display positive beliefs can reduce students' anxiety about mathematics.
12	The influence of mathematical disposition on high school students' understanding of mathematical concepts	Aini & Khuzaini (2024)	A positive mathematical disposition has a significant influence on mathematical concept understanding; students with high interest and confidence demonstrate deeper understanding
13	Mathematical proficiency among female teachers of the first three grades in Jordan and its	Alfayez (2022)	Female teachers with high mathematical proficiency tend to have a more systematic mathematical mindset and are able to relate concepts to reflective teaching practices.

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	relationship to their mathematical thinking		
14	Investigating mathematical proficiency of elementary school students: A foundation for effective learning models	Diputra et al. (2025)	The results show that elementary school students' mathematical proficiency develops optimally through exploratory model-based learning that emphasizes conceptual understanding and adaptive strategies.
15	Mathematical Proficiency, Scientific Reasoning, Metacognitive Skills, and Performance of Learners in Physics: A Mathematical Model	Pasigon (2024)	Mathematical model analysis shows a reciprocal relationship between mathematical proficiency, scientific reasoning, and metacognitive skills on student academic performance.
16	Systematics Literature Review: Developing Mathematical Proficiency in Mathematics Education	Herlina & Juandi (2022)	A literature review found that developing mathematical proficiency requires a balance between conceptual and procedural understanding, as well as a contextual and reflective approach to learning.
17	The Quality of Mathematical Proficiency in Solving Geometry Problem: Difference Cognitive Independence and Motivation	Rahman et al. (2023)	Cognitive independence and motivation affect mathematical proficiency; independent and motivated students have better abilities in solving geometry problems.
18	The Influence of External Factors on Productive Disposition in Mathematical Competence	Majid Hidayat et al. (2024)	External factors such as parental support, learning environment, and teaching style have a significant influence on students' productive disposition and mathematical ability.
19	Analyzing The Productive Disposition and Its Correlation with Mathematics Achievement of Islamic Junior High School Students	Husniah et al. (2021)	This study confirms that productive disposition correlates positively with mathematics achievement; students with high self-confidence are more consistent in logical and reflective thinking.

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20	Concept-Based Productive Disposition Development Model with Mediators of Fluency Procedural, Strategic Competence, Adaptive Reasoning	Khaerunnisa et al. (2025)	The developed model shows a synergistic relationship between conceptual understanding and procedural fluency in forming productive dispositions, which ultimately improve overall mathematical proficiency.
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Based on a review of 20 national and international articles discussing mathematical proficiency and positive attitudes among students, several important patterns and trends were found. In general, students' mathematical abilities are proven to be influenced by a balance between mastery of cognitive and affective aspects in learning. Students who have positive attitudes toward mathematics, such as self-confidence, perseverance, and the perception that mathematics is useful in life, show significant improvements in conceptual understanding, procedural fluency, and adaptive reasoning skills.

On the other hand, the development of mathematical proficiency, which includes conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition, also contributes to forming a positive attitude toward mathematics. Learning that provides space for exploration, reflection, and application of concepts in real contexts encourages students to enjoy the learning process more and reduces anxiety toward mathematics.

Most studies also highlight the importance of teachers and a supportive learning environment. Teachers who apply contextual and collaborative approaches and use interactive digital media are able to increase student engagement and motivation, while strengthening the relationship between mathematical ability and positive attitudes. In addition, external factors such as family support and school culture also influence the development of productive dispositions in students.

Overall, the results of this literature study show that the relationship between mathematical proficiency and positive attitudes among students is reciprocal and mutually reinforcing. The better their mastery of mathematical skills, the more positive their attitudes toward learning mathematics; conversely, the higher their motivation and self-confidence, the stronger their ability to understand, reason, and apply mathematical concepts in a meaningful way.

Discussion

Mathematics education in the modern era has undergone a significant paradigm shift, where the focus of learning is no longer solely on procedural skills, but more on the development of comprehensive mathematical thinking skills. One of the most comprehensive frameworks used in assessing the quality of mathematical thinking is mathematical proficiency, which is an ability that includes conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition (Corrêa & Haslam, 2020; Haji et al., 2019). These five aspects interact with each other to form comprehensive mathematical abilities, where each aspect supports students' success in understanding and solving mathematical problems in a meaningful way.

On the other hand, mathematics learning is also greatly influenced by the affective factors of students, particularly positive attitudes toward mathematics, which include self-confidence, motivation, perseverance, and perceptions of the usefulness of mathematics in everyday life (Aini & Khuzaini, 2024; Go & Lomibao, 2024). Several studies show that success in learning mathematics is not only determined by mastery of concepts, but also by students' emotional readiness and belief in their own abilities. Students who have a negative attitude toward mathematics tend to avoid challenges and give up easily, even though they have adequate intellectual potential (Lynch-arroyo et al., 2023; Rahman et al., 2023).

This emphasizes that mathematics learning needs to strike a balance between cognitive and affective aspects. Improving mathematical proficiency without fostering a positive attitude will result in superficial and unsustainable mastery, while fostering a positive attitude without strengthening conceptual abilities can lead to misunderstanding. Thus, integrating the two is the key to achieving optimal learning outcomes. Based on a review of 20 national and international articles, the discussion in this literature review aims to explain the complex relationship between these two aspects through four dimensions of analysis: cognitive-affective relationships, influencing factors, learning strategies, theoretical and practical implications, comparisons of findings between studies, limitations of the studies reviewed, contributions of literature studies, synthesis of findings and directions for further research, and educational policy implications.

a. Cognitive–Affective Relationship between Mathematical Proficiency and Positive Attitude.

A literature review reveals that the relationship between mathematical proficiency and positive attitudes among students is reciprocal, mutually influential, and develops simultaneously. Conceptually, mathematical proficiency encompasses not only cognitive aspects, but also affective aspects through the component of productive disposition, which is the tendency to view mathematics as something meaningful, useful, and masterable. (Corrêa & Haslam, 2020; Haji et al., 2019). This indicates that a positive attitude is inherently part of mathematical competence itself.

Research results Haji et al. (2019) shows that meaningful and contextual learning experiences can improve students' productive dispositions, which in turn leads to improved conceptual understanding. Similar findings were reported by Go & Lomibao (2024), which confirms that learning experiences that provide space for exploration and reflection encourage students to have a more positive view of mathematics. When students feel that mathematics is relevant to their lives, a positive attitude develops naturally and encourages deeper engagement in the learning process.

Further, Aini & Khuzaini (2024) found that a positive mathematical disposition significantly influences high school students' conceptual understanding. These results reinforce the idea that attitude is not only a supporting factor, but also a direct predictor of mathematics mastery. These findings are in line with studies Zandy (2024) which shows that mathematical resilience, which is one aspect of a positive attitude, can help students face challenges in understanding the concept of linear equations.

On the other hand, strong mathematical abilities have also been shown to increase students' positive attitudes. Husniah et al. (2021) shows that students who have developed good mathematical skills also show increased self-confidence and perseverance in learning. Mastery of strategic competence and adaptive reasoning encourages students to view mathematical challenges as opportunities for thinking, rather than as a source of anxiety. Research Rahman et al. (2023) reinforces these findings by showing that strategic competence and cognitive independence correlate with increased self-confidence and positive attitudes in solving geometry problems.

Theoretically, this reciprocal relationship describes two paths of influence. First, the cognitive to affective path, where increased mastery of concepts and strategies promotes self-confidence. Second, the affective to cognitive path, where positive attitudes trigger perseverance and interest in exploring

concepts. Herlina & Juandi (2022) emphasizes that mathematical proficiency and positive attitudes cannot be separated because they reinforce each other through the processes of reflection, self-regulation, and conceptual understanding. Thus, the affective aspect cannot be separated from the construction of mathematical knowledge because both develop simultaneously and reinforce each other.

b. Factors Affecting the Relationship Between Mathematical Proficiency and Positive Attitudes.

The relationship between cognitive and affective abilities does not stand alone. This study found that there are three main groups of factors that influence the relationship between the two, namely individual factors, teacher and learning process factors, and learning and social environment factors.

1. Individual Factors

Several studies indicate that internal characteristics such as motivation, self-confidence, resilience, and metacognitive abilities contribute significantly to the relationship between mathematical proficiency and positive attitudes. Research Pasigon (2024) shows that the relationship between mathematical proficiency, scientific reasoning, and metacognitive skills is mutually influential. Students with high metacognitive awareness are better able to monitor their thinking processes, making them more reflective and confident in solving problems. Thi-Nga et al. (2024) also emphasizes the importance of metacognition as a mediator of the relationship between attitude and ability.

Research Zandy (2024) shows that mathematical resilience strengthens the relationship between conceptual understanding and attitudes toward mathematics. Students with high resilience are better able to view mistakes as learning opportunities rather than failures. This is an important characteristic in forming a productive disposition. In addition, a productive disposition developed early on becomes the foundation for the development of mathematical abilities. Research Rohman et al. (2023) in elementary school students shows that self-confidence and perseverance are significant indicators related to increased procedural fluency. This means that even in the early stages of education, affective aspects play a fundamental role in developing mathematical abilities.

2. Teacher Factors and the Learning Process

Teachers play a significant role in establishing the relationship between positive attitudes and mathematical abilities. Teachers serve as the primary link between students' cognitive abilities and their psychological state in learning. Research Haji et al. (2019) emphasizing the importance of contextual

learning that enables students to experience learning success from the outset. Teachers who are able to provide constructive feedback encourage the emergence of student self-confidence. Saputro et al. (2023) emphasizes that the use of digital modules in synchronous and asynchronous formats provides opportunities for independent learning that improves procedural fluency and interest in learning mathematics. These findings indicate that technology can be an effective mediator that connects the two main variables in this study.

Further, Lynch-arroyo et al. (2023) found that teachers' affective attitudes directly influence students' perceptions of mathematics. Teachers who display positive beliefs and high enthusiasm can reduce mathematics anxiety and increase students' self-confidence. Research Fallah (2024) also shows that gender factors do not significantly affect productive disposition when teachers apply collaborative and student-centered approaches.

3. Learning and Social Environment Factors

External factors such as family support, peers, and school culture also influence the relationship between mathematical proficiency and positive attitudes. Majid Hidayat et al. (2024) found that parental support, school culture, and teacher practices contribute to students' productive dispositions. When the learning environment provides positive reinforcement, students are more confident and persistent in facing mathematical challenges.

In addition, Alfayez (2022) shows that teachers with high mathematical proficiency tend to foster a culture of positive thinking in the classroom. Teachers who have a deep understanding of mathematics are able to facilitate reflective and contextual learning, which ultimately shapes students' positive attitudes. These findings imply that strengthening teachers' abilities not only has an impact on students' cognitive learning outcomes, but also on their attitudes and motivation.

c. Learning Strategies to Improve Mathematical Proficiency and Positive Attitudes.

Certain learning strategies have been shown to improve both variables simultaneously. A review of the literature found five main approaches that consistently appear in modern research.

1. Contextual Approach and Mathematical Modeling.

The mathematical modeling approach helps students connect concepts to real life. Corrêa (2021) and Diputra et al. (2025) found that modeling-based learning improves strategic competence and

adaptive reasoning, while also changing students' perspectives on mathematics to be more positive because they understand its direct benefits.

2. Digital Technology-Based Learning

Digital learning provides opportunities for students to repeat, explore, and visualize mathematical concepts. According to Saputro et al. (2023), The use of synchronous and asynchronous digital modules can improve procedural fluency and provide a more personalized learning experience. This shows that digital learning not only improves procedural fluency but also provides space for exploration and reflection that fosters a positive attitude towards mathematics.

3. Collaborative and Reflective Learning

Go & Lomibao (2024) emphasizes that learning experiences involving social interaction, cooperation, and self-reflection contribute greatly to the formation of productive dispositions. Collaborative learning makes students appreciate the process of thinking and learning from the different strategies of their peers.

4. Formative Assessment and Affective Feedback.

Research Rohman et al. (2023) developing productive disposition measurement instruments that can be used for formative assessment. With feedback that emphasizes the thinking process, teachers can help students understand their strengths and areas for improvement. This is in line with Herlina & Juandi (2022) view that formative assessment focused on self-reflection encourages continuous development of mathematical abilities.

5. Integrating Positive Values into Learning.

Several studies also highlight the importance of positive values such as cooperation, responsibility, and curiosity in building a productive disposition (Khaerunnisa et al., 2025). These values serve as moral and emotional reinforcement in the process of learning mathematics.

d. Theoretical and Practical Implications

Theoretically, these findings reinforce the view that mathematical proficiency is a multidimensional concept that includes affective elements. By including productive disposition as one of its components, mathematical proficiency becomes a holistic framework that can explain the relationship between ability and attitude. Research Corrêa & Haslam (2020) and Go & Lomibao (2024) emphasizes that productive disposition is not only the result of mathematical ability, but also one of

its components. This means that a positive attitude toward mathematics is an integral part of mathematical proficiency.

In practice, findings from Haji et al. (2019), Rohman et al. (2023), and Majid Hidayat et al. (2024) show that learning designs that combine cognitive and affective aspects are far more effective than traditional approaches. Teachers need to apply contextual, digital, reflective, and collaborative learning to improve both aspects simultaneously.

In addition, research Fallah (2024) and Aini & Khuzaini (2024) shows that psychological and social factors such as peer support, a collaborative learning environment, and empathetic teacher feedback are important elements that should not be overlooked in the design of a modern mathematics curriculum.

e. Comparison of Findings Between Studies.

The synthesis of 20 articles shows variations in findings influenced by research methods, education levels, cultural contexts, and learning strategies used. For example, research conducted in Indonesia focuses more on the influence of productive dispositions on conceptual understanding and procedural fluency, especially at the junior high and high school levels (Aini & Khuzaini, 2024; Husniah et al., 2021; Supianti et al., 2022). Meanwhile, international studies such as Corrêa (2021) and Go & Lomibao (2024) focus more on developing strategic competencies and mathematical modeling skills through a problem-based approach.

There are also differences in findings regarding the strength of the relationship between the two variables. Some studies report a very strong relationship, especially in learning contexts that provide space for exploration, reflection, and the use of technology (Pasigon, 2024; Saputro et al., 2023). However, several studies show that a positive attitude does not necessarily have a significant impact on mathematical ability if students do not receive adequate support from their learning environment (Abbas & Rizki, 2023; Utaminingtyas et al., 2021).

These differences indicate that the relationship between mathematical proficiency and positive attitudes is greatly influenced by the quality of learning, teacher characteristics, and the social support received by students. Therefore, further research needs to consider the context in more detail in order to produce more comprehensive findings.

f. Limitations of the Reviewed Studies.

Based on a review of 20 articles, there are a number of limitations in previous studies that need to be critically examined. First, most studies used a cross-sectional design, which only describes the relationship between mathematical proficiency and positive attitudes at a specific point in time (Hwang & Son, 2021; Xiaoran et al., 2022). This approach fails to capture the long-term development of the relationship between the two variables, even though several studies show that mathematical attitudes and abilities can change significantly with varying learning experiences.

Second, most studies focus more on measuring cognitive aspects such as conceptual understanding, procedural fluency, and problem-solving skills (Husniah et al., 2021; Rohman et al., 2023). Meanwhile, affective aspects such as productive disposition, motivation, and self-perception are often only measured as additional variables without an in-depth measurement approach. This causes the relationship between the two to appear less comprehensive.

Third, the instruments used in previous studies varied greatly in terms of structure, validity, and context of use (Aini & Khuzaini, 2024; Supianti et al., 2022). Variations in instruments affect the comparison of results and the generalization of findings across studies.

Fourth, there is still little research that considers moderator or mediator variables that can explain the relationship between mathematical ability and positive attitudes. Recent studies show that metacognitive strategies (Thi-Nga et al., 2024), family support ((Majid Hidayat et al., 2024), as well as the quality of teacher interaction (Lynch-arroyo et al., 2023) play an important role, but not many studies have included these variables in their analysis models.

Given these limitations, further research needs to be designed with a stronger and more comprehensive methodological approach in order to provide a more complete picture of the relationship between the two variables.

g. Contribution of Literature Review Research

This literature study makes a significant contribution to enriching our understanding of the relationship between mathematical proficiency and positive attitudes among students. Unlike previous studies, which tended to highlight either mathematical ability or positive attitudes separately, this study integrates both aspects into a single analysis, resulting in a more comprehensive mapping of the relationship.

Another important contribution is the focus of the study on articles from the 2019–2025 period, which provide an up-to-date picture of the direction of research development in the field of mathematics education. Recent research shows a change in learning approaches that emphasize the use of technology, reflective strategies, and context-based approaches. (Corrêa, 2021). By synthesizing these findings, this study provides a conceptual model that is more relevant to current mathematics learning conditions.

In addition, this study contributes to the development of educational policy by emphasizing the integration of cognitive and affective aspects as a whole mathematical ability. Thus, this study not only enriches the theoretical basis but also provides practical benefits for teachers, schools, and policymakers.

h. Synthesis of Findings and Future Research Directions.

From the entire literature, it can be concluded that mathematical proficiency and positive attitudes of students are two components that interact with each other in shaping success in learning mathematics. Research Herlina & Juandi (2022) and Pasigon (2024) shows a strong reciprocal relationship between conceptual mastery, learning strategies, and intrinsic motivation. To deepen understanding of this relationship, future research should conduct longitudinal studies involving more moderator variables, such as family support (Majid Hidayat et al., 2024) and school culture Alfayez (2022). In addition, digital-based learning interventions (Saputro et al., 2023) and contextual model (Corrêa, 2021) can be used as a basis for further experiments to test the effectiveness of reinforcing positive attitudes toward improving mathematical abilities.

i. Implications of Education Policy

The findings in this literature study have important implications for the development of education policy, particularly in curriculum design, assessment, and teacher professional development. First, it is important for the government to include components of mathematical proficiency, which encompass conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition, in learning achievement standards in a more explicit manner (Corrêa & Haslam, 2020; Diputra et al., 2025). This is necessary so that the learning process does not only focus on cognitive outcomes, but also integrates affective elements into the learning process.

Second, teacher training policies need to be directed towards strengthening teachers' abilities to apply modern learning strategies that have been proven to improve mathematical proficiency and positive attitudes, such as problem-based learning, contextual learning, and the use of digital technology (Go & Lomibao, 2024; Saputro et al., 2023). Improving teachers' capacity to provide affective feedback is also very important, given that appropriate feedback can boost students' confidence and reduce their anxiety.

Third, national assessment policies need to strike a balance between measuring cognitive and affective abilities. Kania & Kusumah (2025) emphasizes that HOTS assessments will not be effective if they are not supported by positive psychological conditions among students. Thus, assessments that encourage self-reflection, collaboration, and creativity need to be improved.

Fourth, policies that support parental involvement and a positive school culture are essential in shaping students' productive dispositions (Majid Hidayat et al., 2024). The government can develop family assistance programs and school collaboration as part of a national strategy to improve the quality of mathematics education.

A synthesis of 20 articles shows that developing mathematical proficiency and forming a positive attitude toward mathematics are two inseparable goals. Improving conceptual, procedural, strategic, and adaptive reasoning skills goes hand in hand with strengthening self-confidence, perseverance, and interest in learning. Effective mathematics learning is learning that provides space for reflection, collaboration, and contextual exploration so that students are not only “able to calculate” but also “enjoy mathematical thinking.” Thus, the relationship between mathematical proficiency and positive attitudes among students is not only correlational but also a complex, dynamic, and fundamental causal relationship for achieving 21st-century mathematics education goals.

4) CONCLUSIONS

Based on a systematic review of 20 national and international articles, this study concludes that mathematical proficiency and a positive attitude toward mathematics are two aspects that interact reciprocally and are the main determinants of success in mathematics learning. Mastery of the five components of mathematical proficiency, namely conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition, contributes to increased motivation, self-confidence, and perseverance in learning among students, while a strong positive attitude has been proven to strengthen students' ability to understand concepts, develop problem-

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solving strategies, and build self-regulation in the learning process. This relationship is influenced by individual factors, the quality of teacher interaction, a collaborative learning environment, the use of technology, and broader social support. Cross-research studies also reveal similarities in findings, although there are still variations based on educational context and subject characteristics, and indicate limitations such as the lack of longitudinal studies and low exploration of mediating factors such as metacognition. Therefore, further research with a more in-depth and contextual design is needed to enrich our understanding of this cognitive-affective relationship, while also supporting the design of mathematics learning that balances skills and attitudes in order to create meaningful and sustainable learning experiences.

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