

## Meta-Synthesis: Mathematical Problem-Solving Ability Reviewed from Students' Self-Efficacy

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### Abstract

Mathematical problem-solving ability is essential for individuals who study mathematics. Low mathematical problem-solving ability will result in low-quality human resources. The cause of low mathematical problem-solving ability is the lack of intensity of students doing exercises to work on mathematical problems. Mathematical problem-solving ability is closely related to students' self-efficacy. This study describes self-efficacy toward mathematical problem-solving ability, especially in mathematics learning. The method used in this study is meta-synthesis in the form of a qualitative systematic study, namely by analyzing four articles relevant to the study's title. The initial steps taken are (1) determining the questions to be studied, (2) looking for articles related to self-efficacy and mathematical problem-solving ability with a period of 2019-2024, (3) screening and selecting appropriate research articles, (4) Conducting analysis and synthesis of qualitative findings, (5) implementing quality control, and (6) concluding the final results. The analysis results concluded that self-efficacy affects students' mathematical problem-solving ability. The higher the self-efficacy, the better the ability to build mathematical knowledge through problem-solving (what is known and what is asked), the ability to solve problems that arise in mathematics and other contexts, the ability to apply and use various appropriate strategies to solve problems, and the ability to observe and reflect on the process of solving mathematical problems.

**Keywords:** mathematical problem-solving ability, self-efficacy

### Introduction

Education is critical because it can build character for the younger generation. According to Schwieger & Ladwig (2018), education can create the next generation of the nation that is superior and able to compete in other countries, as well as mathematics education. Prediger (2019) stated that mathematics is a subject that must be studied by students and taught to students. Mathematics teaches someone who studies it to think critically, logically, analytically, systematically, and creatively (Yayuk et al., 2020). Based on this, mathematics is essential for survival, and it is hoped that students will have good mathematical skills, one of which is problem-solving skills (Listriani & Aini, 2019; Asmana, 2020) in line with Dasaprawira et al. (2019) which states that a person is said to have good mathematical skills if they can solve problems related to mathematics.

Mathematical problem-solving skills are essential for individuals who study mathematics (Medyasari et al., 2020). Problem-solving is not only a goal in learning mathematics but also aims for students to be able to solve problems they face in everyday life. Students are said to have mastered mathematical problem-solving skills if they have

met all indicators of mathematical problem-solving skills (Agustin et al., 2023). According to NCTM (2000), indicators for measuring students' mathematical problem-solving skills include (1) building mathematical knowledge through problem-solving, (2) solving problems that arise in mathematics and other contexts, (3) applying and using various appropriate strategies to solve problems, and (4) observing and reflecting on the process of solving mathematical problems.

Low mathematical problem-solving ability will result in low-quality human resources (Shaturaev & Bekimbetova, 2021; Indriana & Maryati, 2021; Lusiana et al., 2022). This is because, so far, learning has not provided students with opportunities to develop their problem-solving abilities (Cahyani & Setyawati, 2016; Sopian & Afriansyah, 2017). This is in line with the statement of Kusumawati & Irwanto (2016), who stated that the cause of low mathematical problem-solving ability is the lack of intensity of students practicing working on math problems. Mathematical problem-solving ability is closely related to student self-efficacy.

Subaidi (2016) states that student self-efficacy is essential in solving mathematical problems. The higher the student's self-efficacy, the more successful the student will be in solving problems. Bandura (in Subaidi, (2016)) states that students with low self-efficacy have difficulty solving tasks and consider the task a threat to themselves. Students with low aspirations and weak commitment to goals tend to give up (Sumartini, 2020; Dewi & Nuraeni, 2022). On the other hand, students who have high self-efficacy, high aspirations, and high commitment to goals, complex tasks are considered as challenges to be solved rather than threats to be avoided (Rapsanjani & Sritresna, 2021; Prajono et al., 2022).

According to Nuutila et al. (2021), self-efficacy is one of the critical factors in determining a person's mathematical achievement, especially in carrying out tasks in the form of problem-solving questions, and it can be seen that problem-solving ability and self-efficacy have a positive and mutually supportive relationship. If students have good mathematical problem-solving skills, then they also have good self-efficacy.

Based on the previous researcher's discussion, mathematical problem-solving ability is needed to solve practical problems, and how self-efficacy affects mathematical problem-solving ability. From the background above, a study will be conducted to answer the research question: how self-efficacy is described in relation to mathematical problem-solving ability in mathematics learning? The purpose of this study is to describe self-efficacy toward mathematical problem-solving ability in mathematics learning. This

explanation clearly and deeply shows the importance of conducting a comprehensive meta-synthesis regarding the influence of self-efficacy on mathematical problem-solving ability in mathematics learning as a whole.

### **Method**

This research is a meta-synthesis type of research, namely a literature review method that identifies, interprets, and assesses all findings on the research topic to answer previously determined research questions (Krisnawati et al., 2022). Furthermore, meta-synthesis, by definition, is a technique for integrating data to obtain new concepts or theories to gain a deeper and more comprehensive understanding (Hadi et al., 2020).

This research will produce a qualitative analysis that is described according to the essential components in meta-synthesis. According to Francis & Baldesari (2006), the steps of meta-synthesis are as follows.

- 1) Formulating research questions (formulating the review equation), determining the questions to be studied, namely how to describe the effect of self-efficacy on students' mathematical problem-solving abilities.
- 2) Developing a protocol (conducting systematic literature research), looking for articles related to self-efficacy and mathematical problem-solving abilities within 2019-2024.
- 3) Conduct screening and selecting appropriate research articles; articles that have been obtained are chosen by considering the content of the article using qualitative methods, containing mathematical problem-solving skills and self-efficacy.
- 4) Conduct analysis and synthesis of qualitative findings (analyzing and synthesizing qualitative findings), analyze and synthesize previously selected articles.
- 5) Implement quality control (maintaining quality control) and ensure that the resulting article meets the requirements to be said to be an article with a qualitative meta-synthesis method.
- 6) Summarize the final results (summarizing) and make conclusions from the results and discussions that have been compiled.

The research to be conducted is the influence of self-efficacy on students' mathematical problem-solving abilities. The data obtained are from scientific journals on Google Scholar, Publish or Perish 8, and Scimago using the keywords self-efficacy, mathematical problem-solving ability, and mathematics problem-solving ability. In this study, four articles will be analyzed. After obtaining relevant articles related to the title of

the survey, explore the articles and look for essential parts, namely the influence of self-efficacy on students' mathematical problem-solving abilities.

### Results and Discussion

Four articles have been selected and analyzed. The articles will be described individually according to the components to be studied, namely research objectives, research results, data analysis techniques, and data collection techniques. The data obtained will be processed using meta-synthesis steps. The following are the data from the four articles to be analyzed.

**Table 1.** Analyzed Articles

No	Title	Author and Year	Journal
1	Analisis Kemampuan Pemecahan Masalah Matematis Ditinjau dari Tingkat Self-Efficacy	(Rahmawati et al., 2021)	EQUALS; JURNAL ILMIAH PENDIDIKAN MATEMATIKA
2	ANALISIS KEMAMPUAN PEMECAHAN MASALAH MATEMATIS DAN SELF-EFFICACY SISWA SMP	(Damianti & Afriansyah, 2022)	INSPIRAMATIKA   Jurnal Inovasi Pendidikan dan Pembelajaran Matematika
3	Analisis Kemampuan Pemecahan Masalah Matematis dan Self-efficacy Siswa Tingkat SMP pada Materi Kubus	(Agustin et al., 2023)	RADIAN Journal: Research and Review in Mathematics Education
4	ANALISIS KEMAMPUAN PEMECAHAN MASALAH MATEMATIS DAN SELF-EFFICACY SISWA PADA MATERI SPLDV	(Disparilla & Afriansyah, 2022)	SIGMA: JURNAL PENDIDIKAN MATEMATIKA

The first article analyzed is "Analysis of Mathematical Problem-Solving Ability Reviewed from the Level of Self-Efficacy." This study aims to describe the results of mathematical problem-solving ability reviewed from the level of self-efficacy. The students' determination was selected based on the self-efficacy questionnaire scores obtained by students. This study consisted of 3 students, one each in the high, medium, and low self-efficacy categories. The selected students were then given a social arithmetic problem-solving ability test. This study uses data analysis techniques: data reduction,

presentation, and conclusion. The stages of data reduction were given to students through a self-efficacy questionnaire. Then, three people were selected, who would be given mathematical problem-solving ability test questions and interviews. The following are the results of the study that have been analyzed based on indicators of mathematical problem-solving ability reviewed from self-efficacy. Students with high self-efficacy meet all indicators of mathematical problem-solving ability, namely understanding problems, making plans, solving problems according to plans, and re-checking. Students with moderate self-efficacy meet two indicators of mathematical problem-solving ability, namely solving problems according to plan and rechecking. Students with low self-efficacy are only able to meet one indicator of mathematical problem-solving ability, namely understanding the problem.

The second article analyzed is "Analysis of Mathematical Problem-Solving Ability and Self-Efficacy of Junior High School Students." This study explores junior high school students' mathematical problem-solving ability and self-efficacy. The students in this study were six students of class VIII of SMP IT Nurul Hidayah in the 2020/2021 Academic Year in Karamatwangi Village. They were taken based on high, medium, and low categories. Data collection techniques for mathematical problem-solving ability were tests, interviews, and documentation of PAS (Final School Assessment) results, while for self-efficacy, data collection techniques were questionnaires, interviews, and field notes. Data analysis techniques in this study were data reduction, data presentation, and conclusion. The results showed that students with a high self-efficacy category in solving problems could understand problems by writing down what was known and asked, making and implementing plans using the right formula, and providing conclusions for each question. Students with moderate self-efficacy in solving problems can write down what is known and what is asked; there are few mistakes in making and running and not writing the conclusion of each question, only writing the answer. Students with low self-efficacy category do not understand the problem because they do not write down what is known and asked, and there are some mistakes in making and running plans and not making conclusions, as well as some questions that are not given the results of the solution.

The third article analyzed is "Analysis of Mathematical Problem-Solving Ability and Self-efficacy of Junior High School Students on Cube Material." This study explores students' mathematical problem-solving ability and self-efficacy in solving problems on cube material. The students in this study were class VIII A MTs Al-Muttaqin students

registered in the even semester of the 2021/2022 academic year and selected using a purposive sampling technique. Data collection used to obtain an analysis of students' problem-solving ability and self-efficacy used a test in the form of 5 problem-solving ability questions, a self-efficacy questionnaire consisting of 17 statement items containing eight positive statements and nine negative statements, and an interview instrument. Then, six students will be selected as research students based on the test results. The results of the study showed that students with a high self-efficacy category were able to meet all indicators of mathematical problem-solving ability, namely understanding problems, making plans, solving problems according to plans, and re-checking. Students with moderate self-efficacy only meet two indicators of mathematical problem-solving ability, namely solving problems according to plan and rechecking. Students with low self-efficacy are only able to meet one indicator of mathematical problem-solving ability, namely understanding the problem.

The fourth article to be analyzed is the Analysis of "Mathematical Problem Solving Ability and Students' Self-Efficacy in SPLDV Material". This study explores junior high school students' mathematical problem-solving ability and self-efficacy. The students in this study were six students of Class VIII in the 2020/2021 academic year in Pakuwon Village. Data collection techniques in this study were tests, questionnaires, interviews, and field notes. Data analysis techniques in this study were data reduction, data presentation, and conclusion. The results of the study showed that the results of the self-efficacy questionnaire of 2 students were in the excellent category, and four students were in the sufficient category. The results of the study showed that students with high self-efficacy were able to understand problems by writing down the elements that were known and asked and then writing mathematical models facilitated by the elements they had found in the questions, students were able to make and implement plans using the right formula and provide conclusions in each question. Meanwhile, students with the self-efficacy category can understand the problem by writing down the known and asked elements and then writing down a mathematical model facilitated by the elements they have found in the issue. Still, students do not understand the possible solutions to the problems and do not make conclusions. There are several problems for which the solution results are not provided.

Based on the results of the four articles, several similarities and differences can be obtained that can be new findings. The first thing discussed is several similarities; each

article discusses mathematical problem-solving skills and self-efficacy. The results of the four articles show that self-efficacy affects mathematical problem-solving skills. The following is a description that can be concluded regarding the influence of self-efficacy on students' mathematical problem-solving skills.

1) Students with High Self-Efficacy in Mathematical Problem-Solving Ability

Students with high self-efficacy can meet all indicators of mathematical problem-solving ability. Students with high self-efficacy can understand the problems in the questions well to meet the indicator of building new mathematical knowledge through problem-solving. Furthermore, students with high self-efficacy can compile and implement problem-solving plans correctly and sequentially to meet the indicator of solving problems that arise in mathematics and other contexts, applying and using various appropriate strategies to solve problems. Students with high self-efficacy can write conclusions from their work results and re-check them to meet the indicator of observing and reflecting on the problem-solving process. Students with high self-efficacy can solve their problems, always try to improve their abilities, commit to solving problems, have a positive attitude in dealing with various situations and conditions, and be guided by experience. Students with high self-efficacy in solving mathematical problems, students can complete tasks, understand and choose strategies in completing tasks (magnitude dimension), students can persist and are confident in facing tasks and challenges (strength dimension), students have confidence in completing tasks in diverse contexts (generality dimension).

2) Students with Moderate Self-Efficacy in Mathematical Problem-Solving Ability

Students with moderate self-efficacy can meet the indicator of building new mathematical knowledge through problem-solving. So, it can be said that students with moderate self-efficacy can understand problems well, which is indicated by writing down the information that is known and asked based on the questions. Students with moderate self-efficacy can meet the indicator of solving problems that arise in mathematics and other contexts. Students with moderate self-efficacy are less able to apply and use various appropriate strategies to solve problems. Students with moderate self-efficacy are sometimes less careful in making plans and make mistakes in calculations, resulting in less precise final results. Calculation errors are caused by a lack of self-efficacy in their ability to solve problems. Furthermore, students with moderate self-efficacy can meet the indicator of observing and reflecting on the

problem-solving process, as indicated by students re-checking by examining or re-reading the steps taken. Students with moderate self-efficacy in solving mathematical problems, students can complete tasks, understand and choose strategies in completing tasks (magnitude dimension), students can persist and are confident in facing tasks and challenges (strength dimension), students have confidence in completing tasks in various contexts (generality dimension), but some students hesitate and lack confidence when they have to be in unusual situations.

### 3) Students with Low Self-Efficacy in Mathematical Problem-Solving Ability

Students with low self-efficacy in mathematical problem-solving can achieve two indicators of mathematical problem-solving ability: the indicator of building new mathematical knowledge through problem-solving and observing and reflecting on the problem-solving process. In building new mathematical knowledge through problem-solving, students can understand the problem nicely by correctly writing down the known information and asking questions based on the problem. At the stage of observing and reflecting on the problem-solving process, students tend to be able to make conclusions based on the results of solving the problem. However, in the indicator of solving issues that arise in mathematics and in other contexts and applying and using various appropriate strategies to solve problems, students have not been able to reach this stage, so students cannot determine the right approach to solving problems so that students cannot do calculations correctly and cannot complete until the final result is obtained according to what is asked in the problem. Students with low self-efficacy are less able to persist and are less confident in facing tasks and challenges (strength dimension), there are still some students who are hesitant to work on problems because they have previously experienced failure. Students are less confident in completing tasks in diverse contexts (generality dimension), and some students are hesitant and lack confidence when they have to be in unusual situations.

In addition to similarities, there are also differences in each journal. Based on research by Agustin et al. (2023) dan Rahmawati et al. (2021), problem-solving abilities, reviewed with self-efficacy, were analyzed using Polya's stages. Polya has four stages: understanding the problem, planning a solution, solving the problem according to the plan, and re-checking the results obtained.

Based on research by Rahmawati et al. (2021), Damianti & Afriansyah (2022), Agustin et al. (2023), and Disparrilla & Afriansyah (2022), students with high self-efficacy

can fulfill all indicators of mathematical problem-solving ability, namely understanding problems, making plans, solving problems according to plans, and rechecking. Students with moderate self-efficacy only fulfill two indicators of mathematical problem-solving ability, namely solving problems according to plans and rechecking. Students with low self-efficacy can only fulfill one indicator of mathematical problem-solving ability, namely understanding problems. So, it can be concluded that the higher the level of student self-efficacy, the higher the student's mathematical problem-solving ability, and the lower the level of student self-efficacy, the lower the student's mathematical problem-solving ability.

### **Conclusion and Suggestion**

Based on the description of self-efficacy at each level, it can be concluded that self-efficacy affects mathematical problem-solving ability. In the indicator of building new mathematical knowledge through problem-solving, students with high, medium, and low self-efficacy can write down the information known and ask based on the problem well. In the indicator of solving issues that arise in mathematics and other contexts, students with high and medium self-efficacy can compile a problem-solving plan correctly and coherently so that it meets the indicator. Still, students with low self-efficacy are less able to meet the indicator. In the indicator of applying and using various appropriate strategies to solve problems, students with high self-efficacy can apply and use various proper strategies to solve problems. Still, students with medium and low self-efficacy cannot meet the indicator. In the indicator of observing and reflecting on the process of solving mathematical problems, students with high, medium, and low self-efficacy can write conclusions from the results of their work and re-check the results. The higher the self-efficacy, the better the ability to build mathematical knowledge through problem-solving (what is known and what is asked), the ability to solve problems that arise in mathematics and other contexts, the ability to apply and use various appropriate strategies to solve problems, and the ability to observe and reflect on the process of solving mathematical problems.

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