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MATHEMATICAL REPRESENTATION ABILITY IN VIEW OF SELF-EFFICACY: SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

One of the psychological aspects of students that encourages students' mathematical representation abilities is self-efficacy. This article is a Systematic Literature Review (SLR) of 22 research published until October 2022 with the help of the Publish or Perish (PoP) application with the Scopus, and Google Scholar databases. SLR can be useful for finding research gaps from previous research. This article aims to; (1) investigate the period, index, research approach, subject matter, and subject demographics heterogeneity from 22 inclusion articles, (2) description of mathematical representation abilities in terms of self-efficacy, and (3) learning methods/approaches/strategies that can enhance self-efficacy, as well as the ability of mathematical representation. The results of the SLR research show that students with low self-efficacy have limitations in mathematical representations such as the majority involving a single representation, difficulty understanding the meaning of the questions, and lack understanding of material concepts. The ability of students' mathematical representation with moderate levels of self-efficacy experienced several problems such as difficult to solve problems, less accurate calculations, and dominantly showed moderate mathematical representation abilities. Meanwhile, students with dominant high self-efficacy also show high mathematical representation abilities. For future researchers, it is recommended to conduct research on this topic at the elementary school level, research locations outside Java Island, as well as trigonometry material.
Keywords: Mathematical Representation, Self-Efficacy, Systematic Literature Review

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PRELIMINARY

One of the subjects that must be learned in school education in Indonesia to improve the quality of education is mathematics. By learning mathematics, students are aimed at having the ability to think mathematically so that they can then use it to deal with real-life situations that are constantly changing. There are 5 mathematical thinking skills that students should have, namely representation ability, reasoning ability, problem solving ability, connection ability, and communication ability (NCTM, 2000). Mathematical representation ability is one of the 5 important mathematical thinking skills for students to master.

Mathematical representation is a key concept in learning mathematics that allows students to interpret and solve problems easily (Supandi et al., 2018). Mathematical representation can be applied to externalize and present students' findings (Kalathil & Sherin, 2000). Representation is a way of reaching mathematical concepts in various forms (graphics, symbols, and diagrams) (NCTM, 2000). Good representation skills are needed to master mathematical concepts, then communicate mathematical ideas and finally solve mathematical problems (Lutfi & Khusna, 2021). Thus, as a tool for displaying student work and conveying students' mathematical ideas, mathematical representation abilities are needed.

One of the psychological aspects that influence students' mathematical representation abilities is self-efficacy. According to Bandura, self-efficacy is an academic term that refers to how capable a person is of assessing himself in certain situations about "I can do it" or "I can't do it" (Hamilton & Ghatala, 1994). In planning and carrying out actions that lead to achieving certain goals, self-efficacy becomes an individual's assessment of his abilities (Bandura, 1997). Students' belief in their abilities contributes to expressing their ideas towards success in solving a problem (Lunenburg, 2011). Self-efficacy refers to belief in one's own ability to successfully achieve something. Every effort to achieve certain results and actions to complete student assignments is influenced by student self-efficacy.

Based on research results (Safrudin et al., 2021), self-efficacy has a positive influence on mathematical representation ability. According to Zimmerman & Schunk, for each task given in the learning process, students with high self-efficacy will enthusiastically do it, whereas students with low self-efficacy will avoid these tasks (Zimmerman & Schunk, 2004). Students with high math self-efficacy show a more positive outlook on learning mathematics (Chen et al., 2015). To get a mathematical solution, someone who has low self-efficacy tends to be prone to despair or give up, worry about getting a failed solution, feel afraid and anxious (Bandura, 1997). Students who are not confident in their abilities when faced with difficult questions are prone to giving up easily so that the results obtained are not optimal.

Even though a lot of research related to mathematical representation ability in terms of self-efficacy has been carried out in many schools, several different subjects or locations, there are definitely some gaps that are of concern and need to obtain further research to fill these gaps. Therefore, the authors want to investigate the ability of mathematical representation in terms of self-efficacy using the Systematic Literature

Review (SLR) method. An exploratory and systematic review is needed to describe and validate the mathematical representation ability in terms of self-efficacy using the SLR method. SLR is the process of collecting all publications and related documents that have met an inclusion criteria to answer certain research questions (Mengist et al., 2020). Thus, researchers can synthesize general conclusions and find research gaps to conduct further research through SLR.

Until now, there has been no SLR research on the ability of mathematical representation in terms of self-efficacy which has been discussed in its entirety from previous existing research. Thus, this systematic literature review aims to; (1) investigate the period, index, research approach, subject matter, and subject demographics heterogeneity from 22 inclusion articles, (2) description of mathematical representation abilities in terms of self-efficacy, and (3) learning methods/approaches/strategies that can enhance self-efficacy, as well as the ability of mathematical representation.

METHODS

This research applies the systematic literature review (SLR) method. SLR is used to accumulate secondary data collected from research results related to the ability of mathematical representation in terms of self-efficacy. SLR consists of three main stages, namely review planning, review implementation, and review reporting. In the planning stage, researchers identify the need for a review, define research questions, and develop a review protocol. In the implementation stage of the review, the researcher identifies and selects the main research, extracts, analyzes and synthesizes data. At the review reporting stage, the researcher writes a report to disseminate the findings from the literature review (Xiao & Watson, 2019). This research uses descriptive quantitative data analysis techniques.

In this research, the data collection technique to collect research related to mathematical representation abilities in terms of self-efficacy is by utilizing the Publish or Perish (PoP) application with databases from Scopus and Google Scholar. The data is sorted using inclusion criteria which will determine which research will be included in the relevant collection of research that has been selected (Stapić et al., 2012). The research instrument in this SLR is in the form of a set of inclusion criteria. The following is a set of inclusion criteria defined to define the review boundaries:

1. Articles dealing with the problems of mathematics education, mathematical representation and self-efficacy, regardless of school level.

2. The article has been published in a journal or conference proceedings.
3. Articles whose research was carried out in Indonesia.
4. Articles published until October 2022 (the last month in which the article search was carried out), because the researcher wants to know how far the research related to mathematical representation ability in terms of self-efficacy has been carried out. A pre-systematic search was performed on the Publish or Perish (PoP) application with databases from Scopus, and Google Scholar.
5. Focusing on articles that report empirical findings based on quantitative, qualitative, mixed-method and research & development methods. Thus, theoretical articles and literature reviews are excluded.
6. Articles published in Indonesian or English.

The protocol used for the primary study selection process is the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyzes) protocol. PRISMA refers to four steps, namely identification, screening, eligibility, and included (final result of article selection) (Moher et al., 2009; Juandi & Tamur, 2020). The following are the stages of the PRISMA protocol which was developed by Xenofontos & Mouroutsou (2022) which is shown in Figure 1.

As shown in Figure 1, at the identification stage with keywords (1) mathematical representation; self efficacy, (2) representasi matematis; self efficacy, dan (3) representasi matematis; efikasi diri, for the Google Scholar database, a total of 78 studies were obtained, while for the Scopus database, there were 5 studies. Searches using several keywords are intended to get a wider range of articles. Furthermore, at the screening stage, eliminating 39 studies in the form of theses and dissertations, and eliminating 1 study that was not related to mathematics education. Thus, articles that enter at this stage are articles published in journals or conferences. At the eligibility stage, 4 articles were eliminated that did not meet the inclusion criteria.

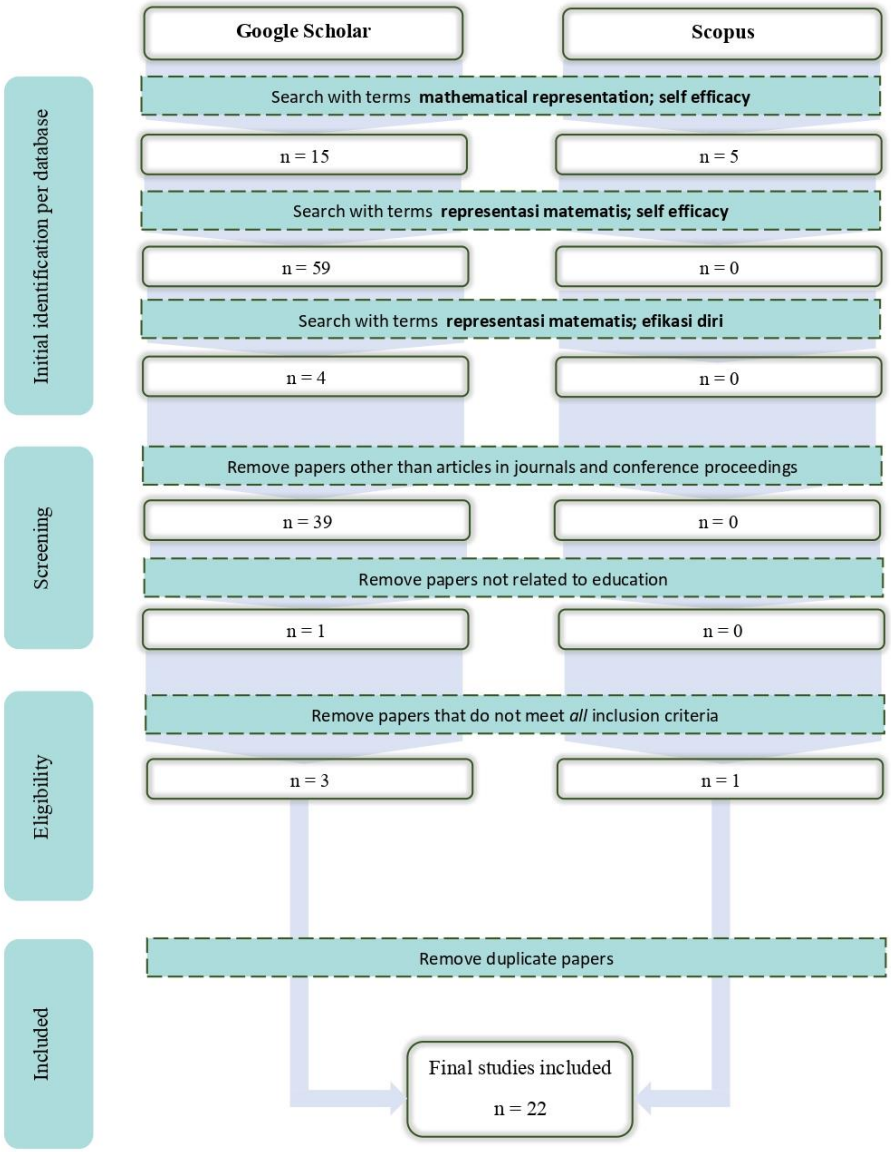

Figure 1. PRISMA Flow Diagram

Furthermore, in the final included stage, the author eliminated 17 duplicate articles. Thus, there were 22 articles that met all the inclusion criteria that were identified to be analyzed in this systematic literature review.

RESULT AND DISCUSSION

This research leads to an analysis and summary of systematic literature reviews from the Google Scholar database, and Scopus with the help of the Publish or Perish (PoP) application. 22 articles were identified that met all the inclusion criteria in this study. In the following, pictures of the heterogeneity of research on mathematical representation abilities in view of self-efficacy are presented based on the year of publication, publication

index, research approach, subject demographics, class and school level, and the scope of material used in the research to be analyzed.

Study by year of publication. The search for research in SLR is not limited to the lower limit of research years related to self-efficacy and mathematical representation ability because researchers want to know how far the research has progressed. Based on the final search results, the first published article was found in 2008. Details of the research distribution up to 2022 are presented in Figure 2.

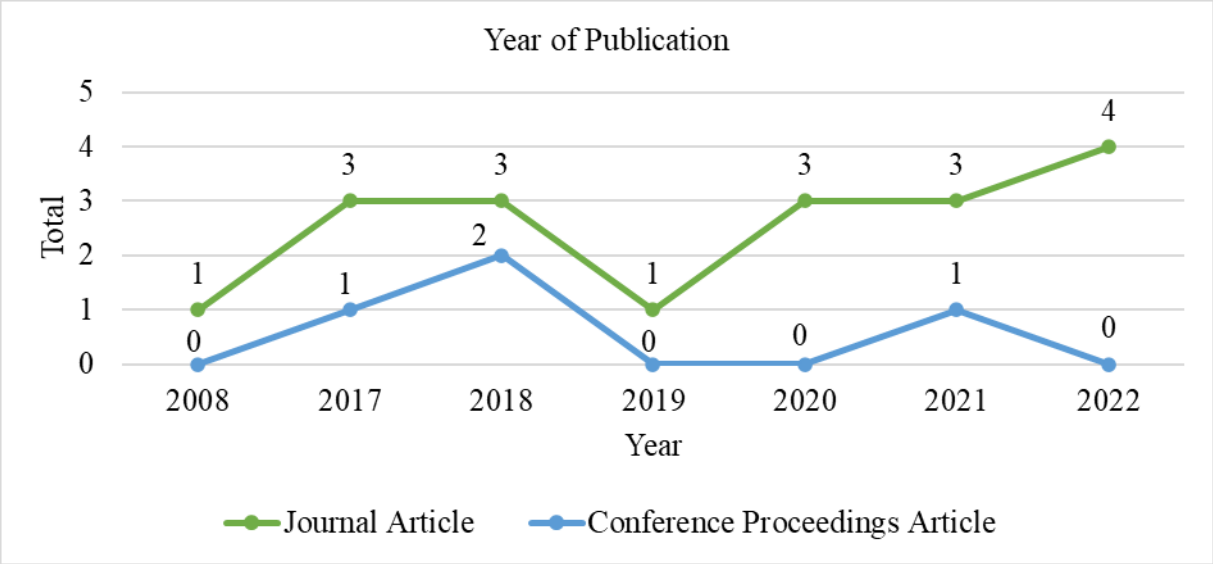

Figure 2. Study by Year of Publication

. Based on figure 2, it can be concluded that the number of published research related to mathematical representation ability in terms of self-efficacy varied and fluctuated between 2008 and 2022. Based on inclusion criteria, research related to mathematical representation ability in terms of self-efficacy was first published in 2008. For the most published articles were in 2018 with a total of 5 articles (3 articles published in journals and 2 articles in conference proceedings). Whereas specifically for publication in journals, in 2022 it will be the highest with 4 articles. In addition, the number of publications related to mathematical representation ability in terms of self-efficacy was at least in 2008 and 2009 with 1 article.

Study based on publication index. Research related to mathematical representation abilities based on self-efficacy, indexed from Scopus Q1 to Google Scholar. Details regarding the distribution of the publication index related to mathematical representation abilities in terms of self-efficacy are shown in Figure 3.

Figure 3. Study based on Publication Index

From Figure 3, it can be concluded that the results of the article's ability to represent mathematically based on self-efficacy are mostly indexed by Google Scholar with 10 articles. Second most, published articles indexed Sinta 4 with 7 articles. The third order, articles published are indexed Scopus Q4 with 3 articles, and the last order is indexed Scopus Q1 and Sinta S3 with 1 article each.

Study based on research approach. Research related to mathematical representation abilities based on self-efficacy identified in this SLR uses qualitative, quantitative, mixed-method, and R&D research approaches. The distribution of research approaches is presented in Figure 4.

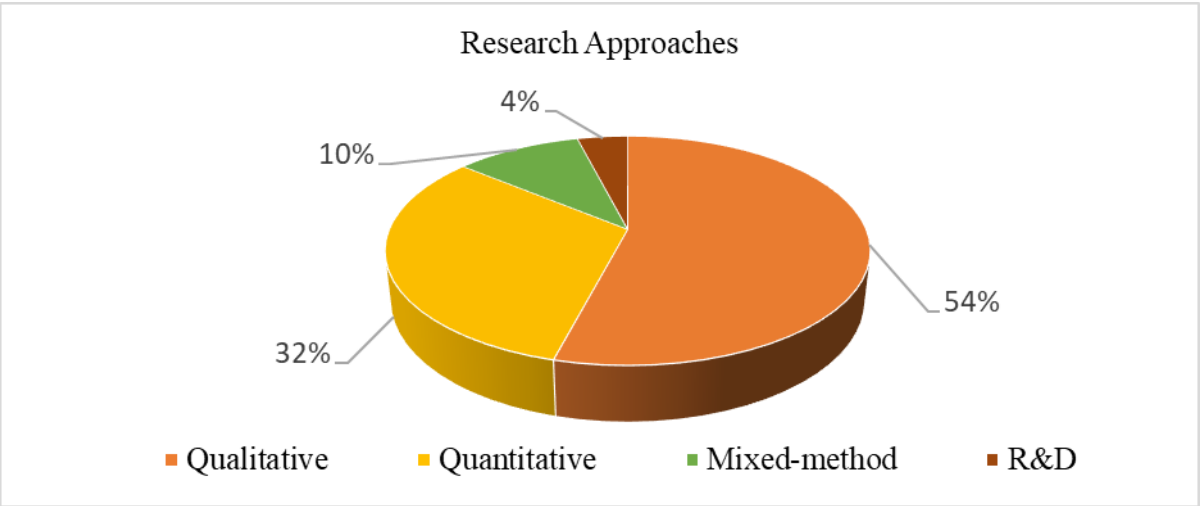

Figure 4. Research Approaches

Based on figure 4, the number of articles on mathematical representation ability based on self-efficacy using a qualitative research approach is 12 articles, a quantitative research approach is 7 articles, a mixed-method research approach is 2 articles, and a research & development (R&D) research approach is 1 article. The most widely used research approach is qualitative. This is because a qualitative approach can lead to a more holistic study of phenomena (Fraenkel et al., 2012), so it can explain the ability of mathematical representation in terms of self-efficacy to be more comprehensive and in-depth.

Study by research demographics. Research related to mathematical representation abilities based on self-efficacy identified in the SLR consists of the regions of Sumatra, Java, Kalimantan and Nusa Tenggara. The demographic distribution of research subjects is presented in Figure 5.

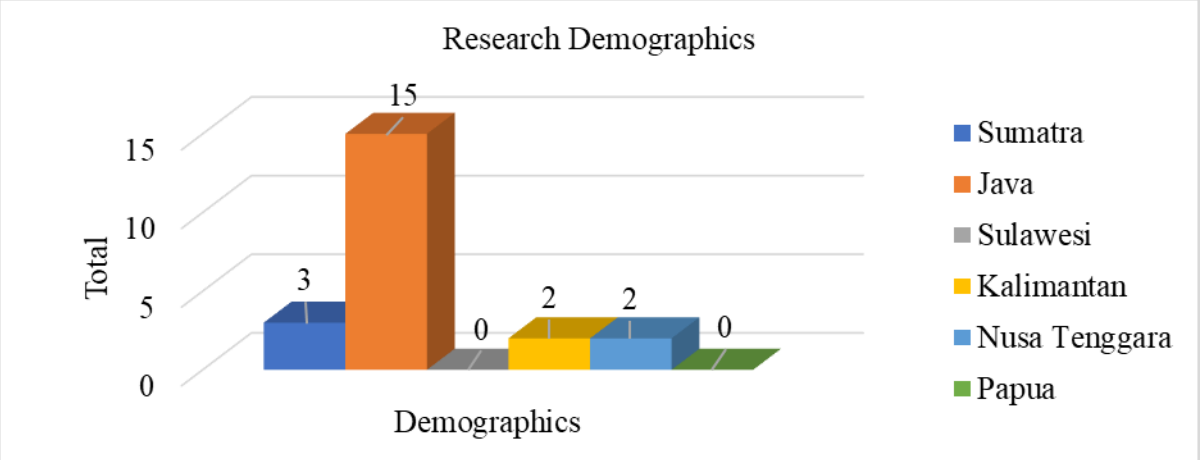

Figure 5. Research Demographics

In figure 5, research on mathematical representation abilities based on self-efficacy is dominated by the Java region with a percentage of 68% or a total of 15 studies, while for Sulawesi and Papua no research has been found. Based on research by Ariati & Juandi (2022) and Khairunnisa et al. (2022), research on mathematical abilities dominates in Java and at least in Papua. Therefore, research needs to be carried out in various provinces in Indonesia related to the ability of mathematical representation in terms of self-efficacy. Thus, the teacher is able to apply the right method to increase the self-efficacy and ability of students' mathematical representation in class.

Study by the level and class of research subjects. Research related to mathematical representation abilities based on self-efficacy is at the SMP/MTs level up to the university level. The distribution of levels and classes of research subjects is presented in Figure 6.

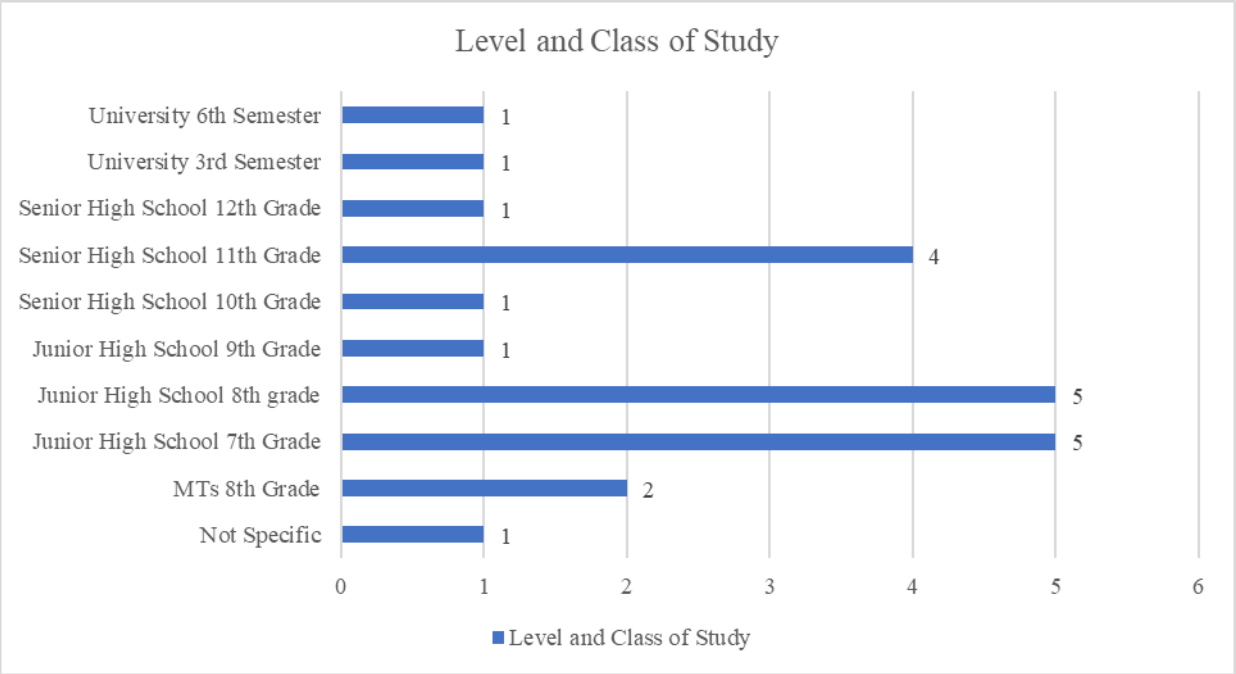

Figure 6. Level and Class of Study

In figure 6, research on mathematical representation abilities based on self-efficacy is dominated at the SMP/MTs level, with 13 articles. At the high school level, there are 6 articles, while at the college level, there are 2 articles. Meanwhile, at the elementary school level, there has been no publication of articles related to mathematical representation abilities based on self-efficacy. The ability to mathematical representation based on self-efficacy at the elementary school level is necessary because children aged 7 to 12 years, according to Piaget's stages of cognitive development, are in the concrete operational development phase. In that phase, children use concrete thinking to solve problems (Hamilton & Ghatala, 1994). Mathematical representations act as a tool for displaying student work and conveying students' mathematical ideas. In addition, good self-efficacy is needed to solve math problems and represent them mathematically.

Study by the subject matter. Research on mathematical representation abilities based on self-efficacy consists of material in the areas of algebra, probability and statistics, trigonometry, geometry, calculus, and social arithmetic. The distribution of the scope of the material is presented in Figure 7.

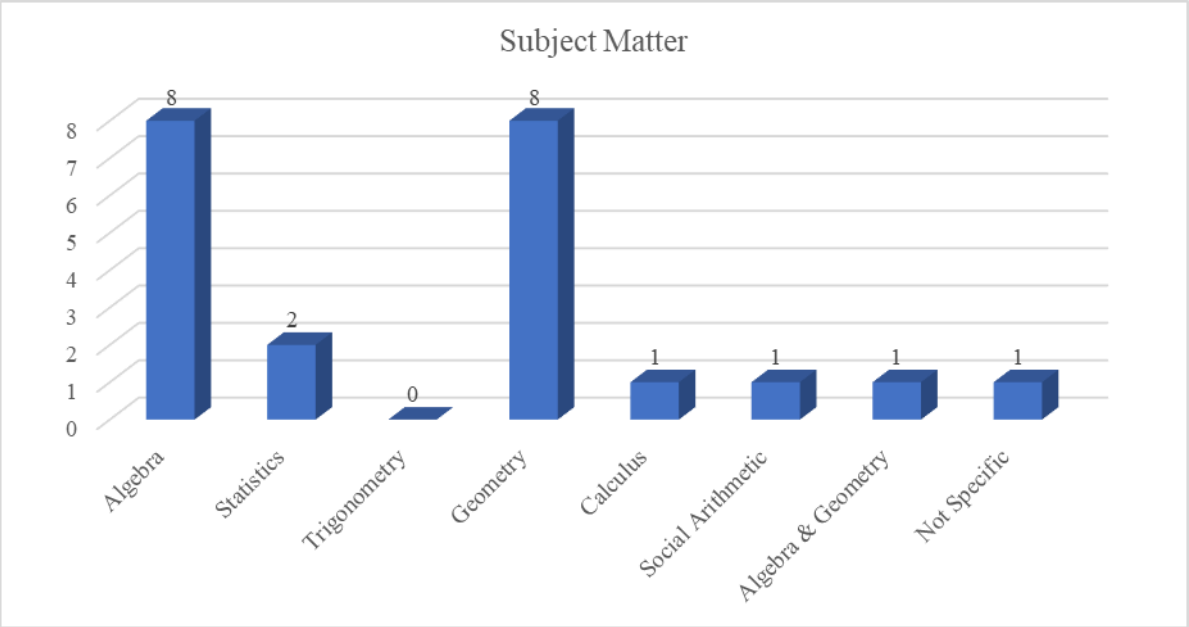

Figure 7. Subject Matter

In figure 7, the majority of research tests related to algebra and geometry with 8 articles each. Whereas for other materials it is still rarely done, especially on trigonometry material, there are no published articles. Therefore, the researcher recommends that there is a need for research on trigonometry material related to mathematical representation abilities based on self-efficacy so that teachers can determine the right methods and strategies for the learning process in class related to trigonometry material.

Self-efficacy refers to belief in one's own ability to succeed in achieving something. According to Bandura, self-efficacy is an academic term that refers to how capable a person is of assessing himself in certain situations about "I can do it" or "I can't do it" (Hamilton & Ghatala, 1994). Self-efficacy becomes an individual assessment of a person's ability to organize and carry out activities that lead to the achievement of certain goals (Bandura, 1997). Students' belief in their abilities contributes to the success of expressing their ideas to solve a problem (Lunenburg, 2011). Each student's self-efficacy can influence efforts to achieve certain results, as well as student behavior in completing their assignments.

Mathematical representation ability based on high self-efficacy.

According to research by Sahendra et al. (2018), students who have relatively high self-efficacy use multiple representations, namely models and mathematical sketches. Students who have high self-efficacy have relatively good mathematical representation abilities (Apriliyani et al., 2022; Setyawati et al., 2020). This is in accordance with Pratiwi

et al. (2019) who found that the performance of students' mathematical representation abilities with high self-efficacy was 89% and the research results of Andini et al. (2021) who found that the average test score of students with high mathematical representation abilities was 85.75 and was in the high self-efficacy category. Self-efficacy gives confidence in one's ability to solve a problem. Thus, students with high self-efficacy believe in their ability to use more than one representation to solve a mathematical problem.

According to research results (Safrudin et al., 2021), self-efficacy has a positive effect on mathematical representation abilities of 27.4%. Research which results that students with high self-efficacy are also followed positively on their mathematical representation abilities in 10 articles is research by Apriliyani et al. (2022), Nurbayan & Basuki (2022), Widya & Manoy (2022), Andini et al. (2021), Hanifah et al. (2021), Said et al. (2021), Setyawati et al. (2020), Pratiwi et al. (2019), Sahendra et al. (2018), and Sopiany & Dewi (2017). There is only one article that shows that high self-efficacy is not always accompanied by high students' mathematical representation abilities (Susanti et al. 2020). Thus, students with high self-efficacy also dominantly have high mathematical representation abilities as well.

Students' mathematical representation abilities in view of moderate self-efficacy.

Students with moderate levels of self-efficacy experience difficulties when solving questions. In this case, the student's answers are inaccurate and incomplete regarding the information contained in the problem. Students with moderate self-efficacy achieve 66% mathematical representation ability (Pratiwi et al., 2019). The research results are in accordance with research results which state that the average test result for students' mathematical representation ability with moderate self-efficacy is 75.14 and fulfills all indicators of mathematical representation ability but is not optimal (Andini et al., 2021). Students with moderate self-efficacy have sufficient self-confidence to use adequate representations so that several problems arise when solving a mathematical problem.

Students who complete the two dimensions of self-efficacy, both the dimensions of generality and strength as well as strength and level, only fulfill one indicator of mathematical representation ability as a problem-solving facility by utilizing visual representations in the form of diagrams (Azkiah & Sundayana, 2022). Students with a moderate level of self-efficacy have good mathematical representation abilities, this can be seen in the way students work on problems systematically, but the final results are not precise because they are not thorough (Hanifah et al., 2021). Students with moderate levels

of self-efficacy also show moderate levels of mathematical representation ability (Susanti et al., 2020; Setyawati et al., 2020, Pratiwi et al., 2019). Thus, students' mathematical representation abilities with self-efficacy are experiencing several problems such as difficulty solving problems, inaccurate calculations, and dominantly having moderate mathematical representation abilities.

Students' mathematical representation abilities based on low self-efficacy.

Students with low self-efficacy tend to use only one representation ability indicator or apply a single representation (Sahendra et al., 2018; Andini et al., 2021; Widya & Manoy, 2022). The mathematical representation ability of students with low self-efficacy does not utilize written verbal to solve mathematical problems. (Said et al., 2021). All students who have low self-efficacy also have low mathematical representation abilities. (Setyawati et al., 2020; Susanti et al., 2020; Pratiwi et al., 2019). Students with very low self-efficacy have poor mathematical representation abilities, this is due to students' lack of understanding of the basic concepts of the material and students are not sure to start each step of completion.

Students have difficulty understanding the meaning of questions and are unable to solve problems, as experienced by students with low self-efficacy. The performance of students with low self-efficacy has the achievement of their representation abilities in the low and very low categories. Students with low self-efficacy have a mathematical representation ability performance of 54%. (Pratiwi et al., 2019). Students with low self-efficacy have an average low mathematical representation test score of 40.83. (Andini et al., 2021). Thus, students with low self-efficacy abilities have limitations in their mathematical representations such as relatively involving a single representation, difficulty understanding the meaning of the questions, and inadequate understanding of material concepts.

Based on the research results above, self-efficacy has a dominant role in students' mathematical representation abilities to support students in solving a problem. Scholars and academics can focus on various ways to increase student self-efficacy. To increase self-efficacy and mathematical representation abilities, teachers can use appropriate learning methods/approaches/strategies. According to the 7 quantitative studies identified in this SLR, all of them are experimental research (Saputri & Kamsurya, 2020; Sinaga et al., 2018; Lusiana & Setyaningsih, 2018; Supandi et al., 2018; Sowanto & Kusumah, 2018; Fadilla et al. ., 2017; Dewanto, 2008). All of these experimental researches were carried out to test a model/method/approach/learning strategy for self-efficacy and mathematical

representation abilities. Descriptions of learning methods/strategies on students' mathematical representation abilities and self-efficacy are shown in table 1.

Table 1. Learning Methods/Strategies against Mathematical Representation Ability and Self-Efficacy

Researcher	Learning Model / Methods/Strategy	Research Results
(Dewanto, 2008)	Problem-Based Learning	Experimental research. Students in the PBL class have better self-efficacy and multiple mathematical representation abilities than conventional classes.
(Lusiana & Setyaningsih, 2018)	Problem-Based Learning with the Think Talk Write strategy	Experimental research. The students' self-efficacy and mathematical representation abilities in the class implementing PBL with the TTW strategy were better than students in the class implementing direct learning.
(Supandi et al., 2018)	Think Talk Write Strategy	Experimental research. In the TTW strategy, many students are enthusiastic in learning mathematics, actively ask questions, are competitive in answering questions, so they can improve their mathematical representation skills.
(Azwar et al., 2017)	Contextual Teaching and Learning Based on Aceh's Cultural Context (CTL-BKBA)	R&D research. Learning tools for the CTL-BKBA model on sequences and series material effectively develop mathematical representation abilities. Meanwhile, increasing self-efficacy is less effective.
(Fadilla et al., 2017)	Guided Discovery Learning Model	Experimental research. Guided discovery learning is not effective on students' mathematical representation abilities and self-efficacy
(Nadia et al., 2017)	Inductive Discovery Learning (IDL)	Mixed-method research. In IDL learning, mathematical representation abilities are good.
(Sinaga et al., 2018)	Cooperative learning model type TPS (Think Pair Share) with Autograph	Experimental research. TPS with Autograph type cooperative learning has a significant effect on self-efficacy and students' mathematical representation abilities.
(Sowanto & Kusumah, 2018)	Situation-Based Learning Assisted by Geometer's SketchPad	Experimental research. In the GSP-assisted SBL learning, students' mathematical representation abilities increased significantly compared to the regular method. Whereas for self-efficacy there is no significant difference.
(Saputri & Kamsurya, 2020)	Core Learning Model (Connecting-Organizing-Reflecting-Extending)	Experimental research. Both the Core learning model and the Core learning with an open-ended approach can improve

Researcher	Learning Model / Methods/Strategy	Research Results
	with an Open-ended Approach	students' self-efficacy and mathematical representation abilities.
(Safrudin et al., 2021)	Online Learning through Flipped Classrooms.	Mixed-method research. After online learning with flipped classrooms, the average students' mathematical representation ability increased.

Based on table 1, there is a learning model that is less effective for students' self-efficacy and mathematical representation abilities, namely the guided discovery learning model. However, in the guided discovery learning class, the increase in self-efficacy and students' mathematical representation abilities was greater than that of students with conventional learning (Fadilla et al., 2017). Therefore, teachers can apply effective learning models as in table 1 to increase students' self-efficacy and students' mathematical representation skills so that they can encourage solving a problem well. Researchers recommend teachers and other researchers apply or further research on Problem-Based Learning and Think Talk Write strategies. When students learn to use the Think Talk Write strategy, students actively ask and respond to questions and answers competitively, which can increase their self-efficacy and mathematical representation abilities.

CONCLUSION

Based on the results of the analysis of 22 articles using the SLR method, it can be concluded that students with dominant high self-efficacy also show high mathematical representation abilities. Students' mathematical representation abilities with self-efficacy are experiencing several problems such as difficulty solving questions, inaccurate calculations, and dominantly showing moderate mathematical representation abilities. Students with low self-efficacy have limitations in their mathematical representations such as the majority involving a single representation, difficulty understanding the meaning of the problem, and inadequate understanding of material concepts. Based on the research results above, self-efficacy plays an important role in students' mathematical representation abilities, which support students in solving a problem.

In addition, more research outside Java should be carried out, bearing in mind that students from other cities in Indonesia also have an urgency to become useful research subjects to fill research gaps in students' mathematical representation abilities and self-efficacy, especially in the regions of Sulawesi and Papua. In addition, research related to the ability of mathematical representation in terms of self-efficacy needs to be carried out

in elementary schools considering that there has not been any research conducted in elementary schools, especially since mathematical representation is important for children aged 7-12 years. This is because the child is in the concrete operational phase of development. In that phase, children use concrete thinking to solve problems. Mathematical representations will help students to externalize mathematical concepts into concrete. Then, trigonometry material also needs to be studied considering that there has not been any research conducted on this material.

The implication of this finding is that self-efficacy can be applied in learning models with the aim of increasing students' mathematical representation skills so that they can map student academic achievement. This research can also help teachers to find the best method, model, or strategy for students in order to develop students' self-efficacy and mathematical representation abilities. Therefore, it is important for scholars and academics to continue to focus on various ways to increase student self-efficacy. The author recommends teachers and other researchers apply or further research on Problem-Based Learning and Think Talk Write strategies regarding self-efficacy and mathematical representation abilities.

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