Systematic Literature Review: Students' Mathematical Problem Solving Ability in View of Self-Efficacy in the PjBL Model with RME Approach Assisted by Scratch

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Abstract

Mathematical problem solving abilities and self-efficacy are fundamental abilities that are very much needed, especially in learning mathematics. But in fact, students' mathematical problem-solving abilities in Indonesia are still low. One effort that can be made to overcome these problems is to apply the Project-Based Learning (PjBL) model with a Realistic Mathematics Education (RME) approach and use Scratch media. This study aims to analyze students' mathematical problem solving abilities in view of self-efficacy in the PjBL model with the RME approach assisted by Scratch. The method used in this research is using the Systematic Literature Review (SLR) method. The results showed that there was an influence on students' problem-solving abilities in view of self-efficacy in the PjBL model with the Scratch-assisted RME approach.

Keywords: Problem Solving, PjBL, RME, Self-Efficacy, Scratch

1. Introduction

Education is never separated from life. One of the sciences in everyday life that plays an important role in education is mathematics. Mathematics has an important role in all aspects of life, so that mathematics is required at every school from elementary to high school. This is an indication that mathematics is important to learn and understand. However, according to (Imaroh et al., 2021) mathematics is still often perceived as a subject that is difficult to understand, boring, abstract, and requires special abilities where not all students can solve math problems. In line with the opinion (Hamimi in Putri & Juandi, 2022) that one of the goals of learning mathematics is to train students' problem solving abilities. In addition, students that have problem solving skills are able to improve decision-making in everyday life.

Problem solving is an initial foundation for studying mathematics. On this basis, problem solving is often referred to as the heart of mathematics and as the core which is the main actor in the mathematics curriculum (Septianingtyas in Adetia & Adirakasiwi, 2022). Problem solving ability is a basic concept that students must have in learning mathematics, learning activities also on implement the knowledge to solve specific problems. Solving problems where the source of the problem comes from students' daily lives will shape students' understanding in learning mathematics (Yetri et al., 2019).

Problem solving ability is students ability to solve mathematical problems by observing the process of find the answers based on problem solving steps. Mathematical problem solving abilities must be possessed by every student because it is important. This is in line with the opinion (Putri & Juandi, 2022) that abilities that can help students make decisions are problem solving skills. However, in reality, the results of students' problem solving abilities in Indonesia have not been satisfactory. Based on the results of the PISA published

by the OECD in 2018, Indonesia got a score of 379 out of the world's average score of 489. This shows that the mathematical ability of students in Indonesia is still far from good. In **Figure 1. 1**, the results of the PISA scores for 2012-2018 are presented.

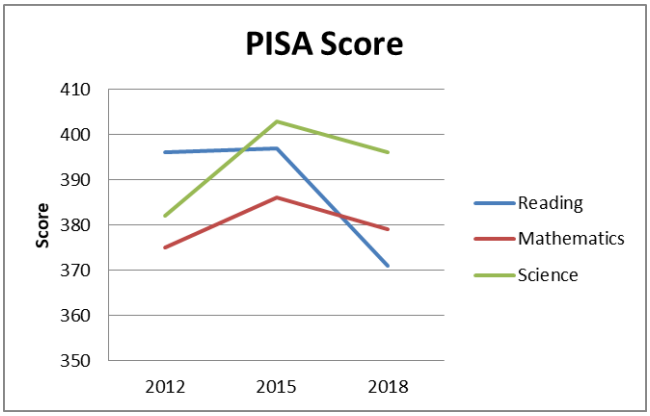

Figure 1. 1 PISA Score Results 2012-2018

(Putri in Disparilla, 2022) states that the level of problem solving ability in non-routine questions is higher than in routine questions, 90% of students are able to solve routine questions well, but for non-routine questions 40% of students still do not use a systematic process in workmanship. Furthermore (Suryani in Disparilla, 2022) said that the problem solving ability of junior high school students in Indonesia is still relatively low. The low learning of mathematics is caused by students memorizing mathematical concepts rather than understanding them. Therefore, the way to develop students' mathematical abilities is to position students as individuals who are active in constructing knowledge through an interactive learning process (Susanti & Nurfitriyanti, 2018).

In addition, the affective aspect also plays an important role in one's success in learning. One of these affective aspects is self-efficacy, in which one's belief can increase one's ability to solve mathematical problems. In learning mathematics self-efficacy is required to be developed. (Anshari in Ismit & Lukmana, 2023) explains that problem solving abilities are closely related to students' beliefs in solving problems, because students' efficacy in problem solving will affect student learning outcomes.

Self-efficacy is a person's confidence in their own abilities which influences what they do (Khotimah et al., 2020). Self-efficacy is self-assessment, whether capable of doing good or bad, right or wrong actions. In accordance with the opinion (Uswatun in Rahmawati et al., 2021), it is the result of cognitive processes in the form of decisions, efficacy, or awards about the extent to which students estimate their own abilities in carrying out certain tasks. The low self-efficacy of students affects problem solving abilities because it can make not want to try and give up when get a difficult task (Rahmawati et al., 2021).

Teachers need to design a fun learning process. So the teacher must choose a learning model, learning strategy and learning approach that will be used and influence the learning process. One model that can be used to overcome existing problems is the Project Based Learning (PjBL) model. PjBL model uses activities or projects as media to involve students in teaching knowledge through a discovery process in assignments or projects (Mahendra in Iskandar & Raditya, 2017). PjBL also make easy students to explore, answer issue, be student centered, and construct real results. PjBL doesn’t need a short time, focuses on student to understand a concept by control extensively explorations of an issue and answer that are relevant and implemented in project work. (Nurfitriyanti, 2016).

Learning with a conventional approach makes students tend to be lazy and bored to learn so that the concepts about the subject matter are not really mastered by students. For that we need a learning approach that motivate students to be active, so that they can know the principles about the subject taught by the teacher properly. Then an alternative action can be proposed using the Realistic Mathematics Education (RME) learning approach (Yetri et al., 2019). RME is a learning approach that has the characteristics of using contextual issues, models, results, and students' own construction, learning focuses on students and interactions occur between students and teachers (Susanti & Nurfitriyanti, 2018).

The RME approach is an approach that can help students solve math problems. This approach has advantages, including learning to be quite fun and does not seem stressful for students, most of the material can be understood by students because RME begins by using contextual problems so that it allows students to use previous experience and initial knowledge they have directly, learning directs students to can solve issues informally based on their experience and can train students to be able to express opinions. Mathematics should be linked to truth and it is catch as a person undertaking (Yetri et al., 2019).

The process of learning mathematics using the RME approach is contextual, meaning that the teacher must be able to present a real student environment in the learning process using technology. Technological developments have entered every aspect of people's lives including the education system. The learning process that uses technology has a good impact on the quality of learning. Many studies have proven that the learning process using technology can improve students' learning outcomes. In addition, using technology in learning can make students think creatively, critically, constructively, and students' HOTS (Khalil & Wardana, 2022).

The processes of implementing technology-based learning can be done using digital learning media. It is a means or device operated by teachers to generate it easier to understand learning. Learning media is very important to use in the learning process (Widodo in Khalil & Wardana, 2022). According to (Sundayana in Khalil & Wardana, 2022), media is a tool or the like that can be used as a messenger which is interpreted as subject matter conveyed in a learning activity. Therefore, learning media is very important to use so that students can more easily understand mathematical concepts, especially abstract material.

One of the learning media that can be used is Scratch. Scratch is a programming language that can display animation and sound, so that using scratch an interesting and interactive educational game can be designed (Iskandar & Raditya, 2017). Scratch can also be accessed easily via the internet, and is easy to operate for beginners who want to make a program. Research conducted by (Aulia in Yulianisa & Sudihartinih, 2022) states that using the Scratch application in learning mathematics can increase students' interest in learning.

Scratch is a programming language designed to introduce computer programming concepts in a simple way that anyone from any background can understand. The concept of scratch programming is visualized in the form of program blocks like putting together a puzzle. This makes it easier for children to learn programming without having to be preoccupied with the complexities of writing syntax in common programming languages. One of the math concepts that can be taught with Scratch is geometry, such as the concept of flat shapes. The combination of image and sound concepts can support a story or game idea that you want to convey. This is what makes scratch can be used as an interactive learning medium through games to understand mathematical concepts. (Iskandar & Raditya, 2017).

Based on the background described above, the researcher formulated the problem, namely "How to increase students' mathematical problem solving abilities in view of self-efficacy in

the PjBL model with the RME approach Assisted by Scratch?". This study aims to analyze students' mathematical problem solving abilities in view of self-efficacy in the PjBL model with the RME approach by Scratch. This research is expected to be useful for educators in determining appropriate learning models, learning approaches, and learning media to improve students' mathematical problem solving abilities.

2. Method

This study is used the Systematic Literature Review (SLR) method. It is a study method for collecting and evaluating study results linked to topics that will become research topics (Lame in Putri & Juandi, 2022). SLR recognizes, analysis, assess, and explains all obtainable study. Investigator review and pick out journals in a organized way, that in every process follow predetermined steps (Triandini et al., 2019). SLR research aims to identify, examine, and make conclusions from all research results related to the research topic. The purpose of this literature study is to get a conceptual framework that can help solve the problem being researched in order to disclose concepts that are relevant to the case to explore further.

In this SLR research stage there are 5 stages, the first is formulating the issue (research question). Write a formulation of the problem that will be discussed in depth. This question is construct according the want of the theme to be chosen by the author. The Research Question (RQ) includes (RQ1) What are the research objectives and methods used; (RQ2) What level is selected in the article regarding students' mathematical problem solving abilities in view of self-efficacy in the PjBL model with the RME approach assisted by Scratch in 2016-2023?; (RQ3) How does the influence of students' mathematical problem solving abilities in view of self-efficacy in the PjBL model with the RME approach assisted by Scratch?

The second stage is to search for literature, after formulating the topic and formulation of the problem to be raised or researched, the next stage is to search for relevant articles or journals or what is known as the search process. Sources of data are in the shape of national and international articles. The study literature search process is carried out by accessing data on Google Scholar. A search was conducted on the database using the keywords "mathematical problem solving ability", *"self-efficacy"*, *"Project Based Learning"*, *"Realistic Mathematics Education Approach"*, and *"Scratch"*. Next, namely the third stage, determination of inclusion and exclusion criteria is carried out to determine the feasibility of the literature to be used in SLR research or not. Articles that meet the inclusion criteria will be included in the research phase. **Table 2. 1** below describes the inclusion and exclusion criteria used in this study.

Table 2. 1 Inclusion and Exclusion Criteria

Inclusion	Exclusion
National or international articles that are relevant to students' mathematical problem solving abilities in view of self-efficacy in the PjBL model with the RME approach Assisted by Scratch.	National or international articles that are not relevant to students' mathematical problem solving abilities in view of self-efficacy in the PjBL model with the RME approach Assisted by Scratch.
National or international articles in	National or international articles that do

accordance with the title and research topic.	not accordance with the title and research topic.
Articles and journals published in 2016-2023 are used as a reference for discussion.	Articles and journals published before 2016 are used as a reference for discussion.
The language used is Indonesian or English.	The language used is other than Indonesian or English.

Furthermore, in the fourth stage, namely, selecting the results of the literature from articles that meet the criteria. The fifth stage is making research conclusions, where researchers understand the search results that have been summarized. At this stage, the authors make research conclusions, namely brief statements about the results of the descriptive analysis derived from facts or logical relationships and contain answers to the statements submitted in the problem formulation section.

3. Result and Discussion

The results are in the form of summary and analysis of articles from research that has been done before. By applying the inclusion criteria, 22 articles were obtained that were relevant to the keywords that had been determined. After that, the articles were further categorized based on study characteristics. The diversity based on study characteristics is presented in **Table 3. 1.**

Table 3. 1 Number of Studies Based on Criteria

Characteristics Study	Criteria	Frequency
Year of Publication	2016	1
	2017	3
	2018	2
	2019	2
	2020	2
	2021	3
	2022	8
	2023	1
Educational level	ES	3
	JHS	14
	SHS	4
Research methods	Qualitative	3
	Quantitative	11
	Mix Method	1
	Research and Development	5
	Systematic Literature Review	2
Purpose	The effect of self-efficacy on problem solving abilities	8
	The effect of RME on problem solving abilities	2

	The effect of self-efficacy and RME on problem solving abilities	3
	The effect of PjBL on problem solving abilities	4
	The effect of Scratch on problem solving abilities	5

From the articles obtained, the total of articles presented every year is dissimilar. In Figure 2 the following diagram presents the distribution of relevant studies from 2016 to 2023.

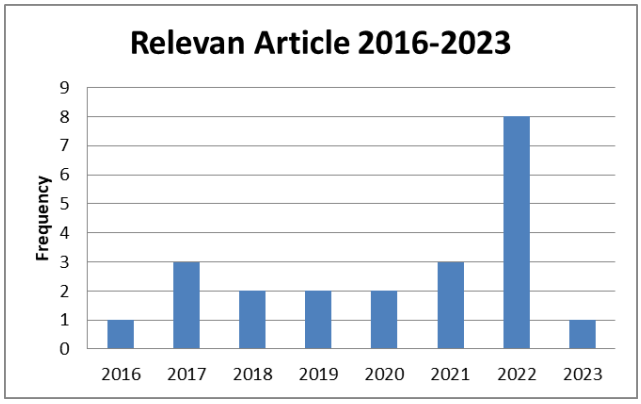

Figure 3. 1 Studies by Publication Year

Based on **Figure 3. 1**, it can be seen that the number of publications that occur has increased and decreased every year. The number of research publications, there are 8 relevant articles. **(RQ1) What are the purposes and research methods used in the article regarding students' mathematical problem solving abilities in view of self-efficacy in the PjBL model with the RME approach assisted by Scratch in 2016-2023?**

In **Figure 3. 2** below, it shows that study found in 2016-2023 has dissimilar research purposes. There are 5 research purposes established from 22 articles. It can be over that study in 2016-2023 tends to focus on the effect of self-efficacy on problem solving abilities with a percentage of 36%. While the research purpose on the effect of RME on mathematical problem solving ability shows a percentage of 9%.

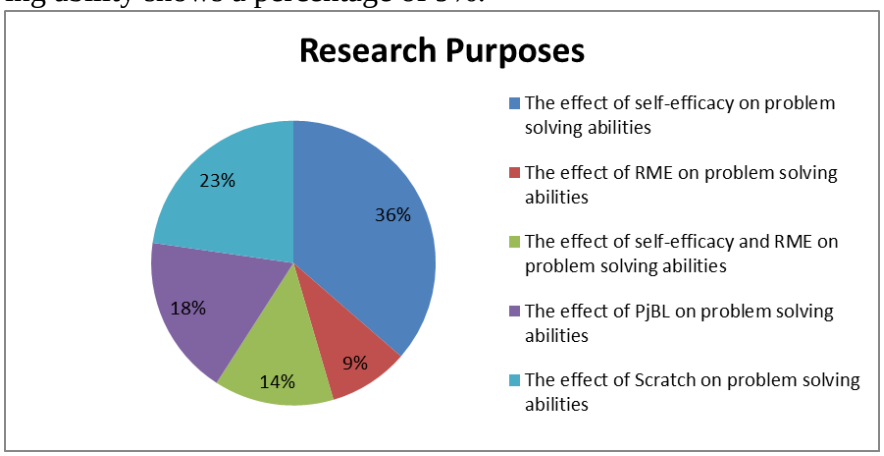

Figure 3. 2 Research Proposes

Figure 3. 3 below shows that of the 22 articles, there are 5 research methods used in the 2016-2023 research. Quantitative research with a percentage of 50% indicates that this research method tends to be more extensively used. Itcan be concluded that study in 2016-

2023 tends with quantitative research. While the mixed method research method and Systematic Literature Review (SLR) can still be developed further.

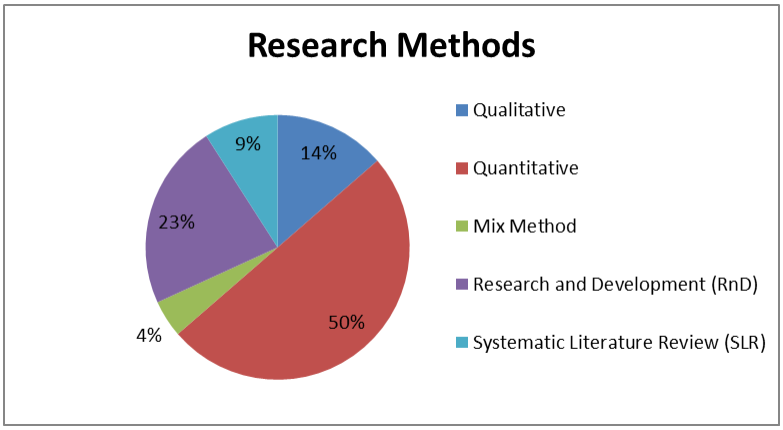

Figure 3. 3 Research Method

(RQ2) What level is chosen in the article regarding students' mathematical problem solving abilities in view of self-efficacy in the PjBL model with the RME approach assisted by Scratch in 2016-2023?

Relevant articles used as data in this study were conducted from elementary to high school levels with detailed distribution in **Figure 3. 4**.

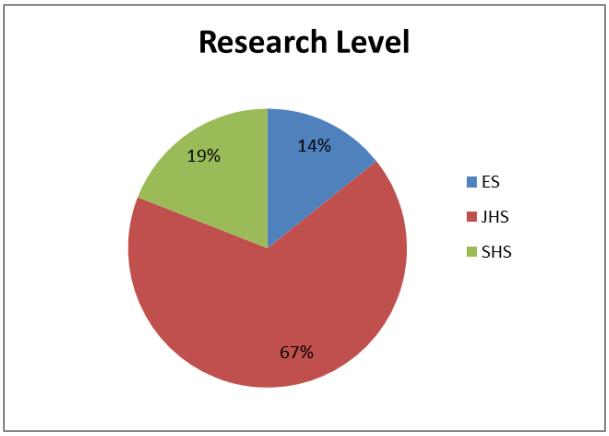

Figure 3. 4 Research Level

From **Figure 3. 4** it can be seen that students' mathematical problem solving abilities in view of self-efficacy in the PjBL model with the Scratch-assisted RME approach were the most studied at the JHS level with 14 studies, while for the high school level there were 4 studies and at least the elementary level with 3 studies because it is necessary for JHS students to have these abilities. From the results above, we can see that research on college students is still rarely studied. This can be a reference for further research to examine at the tertiary level.

(RQ3) How does the effect of students' mathematical problem solving abilities in view of self-efficacy in the PjBL model with the RME approach assisted by Scratch in 2016-2023?

From the 22 articles that have been reviewed, several research results have been obtained previously. Research by (Disparrilla & Afriansyah, 2022); (Ismit & Lukmana, 2023); (Khotimah et al., 2020); (Imaroh et al., 2021); (Adetia & Adirakasiwi, 2022); (Rahmawati et al., 2021); (Putri & Juandi, 2022) shows that there is a good link or relationship between mathematical problem solving abilities and self-efficacy. The relation is that when students' self-efficacy is high, students' mathematical problem-solving abilities are also high, and vice versa.

The researcher concluded that it is very principal to have high self-efficacy, especially in solving mathematical problems. There is an effect of self-efficacy on mathematical problem-solving abilities because it can make students more confident and capable in solving mathematical problems without any doubts that make students feel unsure and cause them to be unable to totally solve mathematical problems. Having high self-efficacy can make students more persistent in trying to solve math problems without having a great sense of difficulty in solving math problems.

In addition, there is an impact of implementing the PjBL model on mathematical problem solving abilities. The ability educate using the PjBL model is greater than that taught using the expository learning model. Students' problem-solving abilities become better after learning with the PjBL model. (Nurfitriyanti, 2016); (Sasmita et al., 2021); (Rahmazatullaili et al., 2017); (Safithri et al., 2021). The problems used in PjBL learning are in the form of contextual problems that can train or develop students' ability to think creatively by exploring and presenting mathematical ideas, as well as identifying and solving given problems.

According to research conducted by (Khoiriyah, 2018); (Yetri et al., 2019); (Susanti, 2017); (Susanti & Nurfitriyanti, 2018), students' mathematical problem solving skills are better after using the RME approach. This study has revealed that the RME approach has a positive impact on problem solving abilities. This is because students are often trained in conveying information or reasons during learning activities, according to the syntax in the RME learning model which make these students know the benefits of mathematics. (Susanti & Nurfitriyanti, 2018).

On the other hand, researchers also found that there was a relationship between self-efficacy and mathematical problem solving abilities. The results of student self-efficacy research in the experimental class showed that before and after the treatment there was progress. Before being given the treatment the students lacked confidence, this was seen when the teacher gave pretests, many students cheated and were unsure of their own answers. After being given treatment, students felt confident about their answers because the representations made had directed students to solve the questions correctly. Therefore, the RME approach has an effect on student self-efficacy. (Yetri et al., 2019); (Susanti, 2017); (Sopyan & Marlina, 2019).

ICT-based learning media using scratch software can be designed interactively so that students are motivated to learn singly and are easy to use anywhere. Mathematics learning media uses valid and effective scratch applications to improve HOTS of students which are valid and practical to use (Khalil & Wardana, 2022); (Rani & Wintarti, 2022); (Fatimatuz Zahro Octavia & Kartika Yulianti, 2022); (Yulianisa & Sudihartinih, 2022); (Iskandar & Raditya, 2017). In addition, it was found that the application of scratch learning media using the PjBL model could improve problem solving abilities. It can be concluded that there is an influence on students' mathematical problem solving abilities in terms of self-efficacy in the PjBL model with the Scratch-assisted RME approach.

4. Conclusion

Based on the results and discussion of 22 articles published in 2016-2023, it can be seen that research related to problem solving abilities in view of self-efficacy has been the most widely researched. The major part was conducted using quantitative methods at the junior high school level because at this level the ability to solve mathematical problems really needs to be improved. According the results and trends obtained, there is an effect on students' mathematical problem solving abilities in view of self-efficacy in the PjBL model with the RME approach assisted by Scratch. In addition, there are differences in the problem solving abilities of students who have high, medium, and low self-efficacy taught by the PjBL model and the RME approach assisted by Scratch. Therefore, it can be concluded that each component is effective in increasing students' problem solving abilities.

Overall the application of the PjBL model with the RME approach assisted by Scratch is effective in helping teachers and students improve their mathematical problem-solving skills from a self-efficacy perspective. Based on the findings in this study, it is highly recommended that teachers use this method in learning mathematics. It is hoped that this research can become a basis for further exploring the application of the PjBL learning model, the RME approach, and Scratch media to improve students' problem solving abilities from a self-efficacy perspective.

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