



Trends of problem-solving skills research in journal of mathematics education in Indonesia

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ABSTRAK

Penelitian ini bertujuan untuk menganalisis artikel-artikel yang diterbitkan di jurnal pendidikan matematika Indonesia guna melihat perkembangan penelitian keterampilan pemecahan masalah. Analisis konten adalah metode yang digunakan untuk menganalisis artikel-artikel tersebut. Artikel yang dianalisis merupakan artikel yang terbit pada tahun 2019 hingga 2024, dengan penekanan khusus pada kemampuan pemecahan masalah. Setelah dianalisis, ditemukan adanya penurunan jumlah publikasi yang membahas keterampilan pemecahan masalah selama lima tahun terakhir. Dari artikel-artikel tersebut, desain penelitian yang paling umum digunakan adalah kuantitatif. Selain itu, kelas delapan SMP dan materi 'Geometri' secara konsisten menjadi subjek dan materi yang paling banyak digunakan dalam penelitian ini. Lembar tes dan uji-t merupakan instrumen dan metode analisis data yang paling banyak digunakan oleh para peneliti. Beberapa saran telah diajukan untuk penelitian keterampilan pemecahan masalah di masa depan. Salah satu saran utama adalah meningkatkan variasi metodologi penelitian yang digunakan. Peneliti didorong untuk tidak hanya mengandalkan metode kuantitatif, tetapi juga mengeksplorasi metode kualitatif dan campuran untuk mendapatkan pemahaman yang lebih mendalam tentang bagaimana keterampilan pemecahan masalah dapat dikembangkan secara efektif. Penelitian yang lebih beragam dalam hal subjek, topik, dan metodologi diharapkan dapat memberikan kontribusi yang signifikan dalam meningkatkan kualitas pendidikan matematika di Indonesia, khususnya dalam mengembangkan keterampilan pemecahan masalah siswa.

ABSTRACT

This study aims to analyze articles published in Indonesian mathematics education journals to see the development of problem-solving skills research. Content analysis is the method

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used to analyze these articles. The articles analyzed were articles published in 2019 to 2024, with a special emphasis on problem-solving skills. After being analyzed, it was found that there was a decrease in the number of publications discussing problem-solving skills over the past five years. Of these articles, the most commonly used research design was quantitative. In addition, the eighth grade of junior high school and the material 'Geometry' were consistently the most widely used subjects and materials in this study. Test sheets and t-tests were the instruments and data analysis methods most widely used by researchers. Several suggestions have been put forward for future problem-solving skills research. One of the main suggestions is to increase the variety of research methodologies used. Researchers are encouraged to not only rely on quantitative methods, but also explore qualitative and mixed methods to gain a deeper understanding of how problem-solving skills can be developed effectively. More diverse research in terms of subjects, topics, and methodologies is expected to make a significant contribution to improving the quality of mathematics education in Indonesia, especially in developing students' problem-solving skills.

Content analysis

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1. INTRODUCTION

In general, education covers all experiences that support personal and social growth and is a continuous process that shapes a person's thoughts, feelings, or actions (Dewey, 1986). In line with that, (Driyarkara, 2006) explains that education is an attempt to humanize human beings to make them human integrity so they can fulfill their responsibilities as members of society. In a narrow sense, education consists of a series of experiences planned and structured by an educational institution to a desired learning goal (Tyler, 2013).

According to (Kivunja, 2014), education in the 21st century should focus on the development of skills relevant to the needs of modern society. This includes mastering critical thinking, creativity, communication, and collaborative skills, often called 4C. Further, (Kivunja, 2014) emphasizes the importance of pedagogical innovation that equips students to solve complex

problems, work in teams, and communicate effectively in various contexts. Being aware of this, the educator must ensure that the student has an excellent problem-solving ability.

Problem-solving skills are finding problems, making questions or challenges, making plans or strategies to solve problems, and evaluating outcomes or solutions (Lester, 2013). NCTM (National Council of Teachers of Mathematics) states that problem-solving skills go beyond mathematical knowledge and can be used in real-life situations (NCTM in Ferrini-Mundy, n.d.). According to Kivunja, in the context of education, students can acquire critical, analytical, and creative skills through problem-solving, which are the basis for facing complex challenges in the future (Schoenfeld, 2014).

Schoenfeld (2014) showed that mathematical problem-solving skills are the ability to find, analyze, and solve mathematics problems using understanding mathematic concepts and logical thinking skills. It also involves a systematic and creative thinking process for an effective solution strategy. Furthermore, (Polya, 2014) argues that problem-solving must include actions or measures that must be followed systematically to find a suitable solution. In his book "How to Solve It: A New Aspect of Mathematical Method", he explains that such steps consist of: (1) understanding problems, meaning analyzing problems, finding data, and understanding demands; (2) planning solutions, i.e., making strategies or plans to solve problems; (3) implementing solutions, meaning implementing plans by performing appropriate procedures; and (4) re-checking, carried out to evaluate solutions made by reviewing the steps taken and ensuring that the solution meets the problem criteria adequately.

Recognizing the importance of mathematical problem-solving skills for students, it is necessary to dig information continuously to see the development of such problem-solving skills in the educational world. This statement is supported by Susanti's (2017) view that to improve the quality of mathematics education, especially in Indonesia, research on mathematical problem-

solving skills is crucial to be done because problem-solving skills are one of the essential skills to have students face the challenges of the 21st century.

In Indonesia, several researchers have conducted studies on student problem-solving skills in the context of mathematics education. According to (Susanti, 2017), mathematical problem-solving research in Indonesia often discusses the effectiveness of different learning approaches, such as Realistic Mathematics Education (RME) and Problem-Based Learning. (PBL). A study by (Saprizal, 2018) tested how practical RME approaches improve students' ability to solve mathematical problems. In addition to testing with specific learning methods or approaches, research on mathematics problem-solving skills is often linked to other parameters. However, only some have reviewed all the information related to mathematical problem-solving research in one study report.

The research aims to gather data on various studies dealing with mathematical problem-solving capabilities in Indonesia by analyzing the content of scientific journals published in mathematics education in Indonesia over the last five years, from May 2019 to May 2024. As for the things that are being tracked, such as how problem-solving skills research evolves from year to year, how the design of the research problem-solving skills is used, what topics are most commonly used to see student problem-solving abilities, what data analysis methods are used, and so on.

This research differs from previous ones in terms of mathematical problem-solving capabilities in a few ways. First, all the papers studied are accredited to the Science and Technology Index (SINTA), published from 2019 to 2024. Second, the research will investigate several papers with troubleshooting capability as the primary focus. Some parameters are also used to analyze content.

2. METHOD

Research Design

The principle of content analysis is used in this study, which focuses on the results of various studies published in the scientific journal *Mathematical Education in Indonesia*. The research method used is adapted from the methods used by Nur et al. (2021), namely: (1) identify and evaluate Indonesian mathematical education research; (2) identify significant focus and trends in mathematics education research in Indonesia; and (3) provide advice for future research.

Data Source

Data was collected from content analysis on mathematics education articles. SINTA (<https://sinta.kemdikbud.go.id/>) is a platform to measure the progress of science and technology designed and developed by Indonesia's Ministry of Education and Culture (Kemendikbud). There are a total of 104 journals of mathematical education in the SINTA database, ranging from accredited SINTA 2 to SINTA 6. Out of the total of such journalism, the journal-accredited SINTA 2 is ranked in the top five. Using the keyword problem-solving skills found 50 articles in five selected journals. However, of these articles, only 24 directly investigate the ability to solve mathematical problems. The article analyzed in this study has been published online since 2019. All these articles have been analyzed in this study.

Research Instrument

The guidelines or instruments used in this study are shown in Table 1 below. To analyze the content of the journal as well as the selected article, there are seven main components to be considered, namely: (1) the number of publications per year; (2) the type of research; (3) the subject of the research; (4) the chosen mathematical topic; (5) the treatment; (6) the research instrument; and (7) the data analysis techniques used. Specifically, components (2), (3), (6), and (7) will be further analyzed according to Table 1, adapted from the (Susetyarini & Fauzi, 2020) research instrument. In addition, the component (2) consists of two subcomponents: (2a) the type of research in general and (2b) the kind of quantitative research.

Table 1. aspects and Categories used for Content Analysis in Research

Aspects	Categories	
Types of research (2a)	A.1-RnD	A.3-Qualitative Research
	A.2-CAR	A.4-Quantitative Research
Types of quantitative research (2b)	B.1-Observation Studies (OS)	B.5-True Experimental Designs (TED)
	B.2-Correlational Research (CR)	B.6-Quasi-Experimental Designs (QED)
	B.3-Survey Research (SR)	B.7-Ex Post Facto Designs (EPFD)
	B.4-Pre-Experimental Designs (PED)	
Research Subject	C.1-VII Grade JHS students	C.7-Undergraduate students
	C.2-VIII Grade JHS students	C.8-Postgraduate students
	C.3-IX Grade JHS students	C.9-JHS teacher
	C.4-X Grade SHS students	C.10-SHS teacher
	C.5-XI Grade SHS students	C.11-lecturer
	C.6-XII Grade SHS students	
Data collection instruments	D.1-questionnaire sheet	D.4-interview sheet
	D.2-observation sheet	D.5-unidentified
	D.3-test sheet	
Data analysis methods	E.1-mean	E.6-ANCOVA
	E.2-percentage	E.7-Correlation
	E.3-N-gain	E.8-Unidentified
	E.4-t-test	E.9-Others
	E.5-ANOVA	

Data Analysis

Each article is placed in a specific category based on a particular characteristic that meets Table 1. This decision is based on information in the abstract sections, methods, and discussions. Subsequently, the data collected and analyzed is displayed in the form of bar charts.

3. RESULT AND DISCUSSION

Number of Publications

The number of articles published shows how often research is carried out over a given period. Referring to the diagram in Figure 1, an article that examines mathematical problem-solving capabilities has existed since 2019. The number of publications increased significantly from 2019 to 2020. Unfortunately, from 2020 to 2024, publications have been declining. This indicates a declining trend in publications dealing with mathematical problem-solving skills.

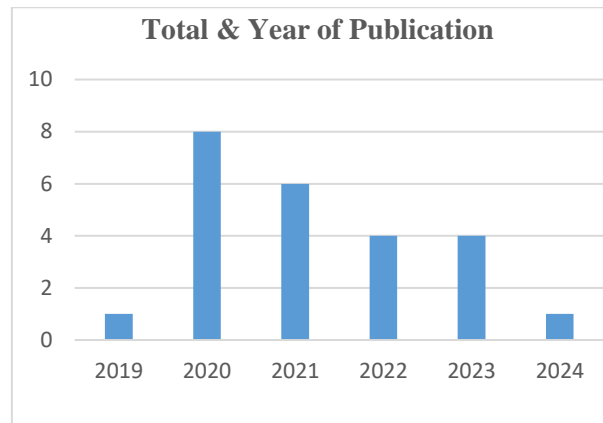


Figure 1. The declining trend in the number of educational research focused on problem-solving capabilities in Indonesia in the last five years.

In general, most research is rejected because researchers are aware of a common problem around them. One of the most common problems today concerns the ability to solve mathematical problems of Indonesian students, who are still considered low. Therefore, this research is considered the most effective.

Type of Research

The focus of research is determined by the type and design of research. Figure 2 shows that researchers most often use quantitative research methods to study students' ability to solve mathematical problems. This is consistent with previous research findings that show that researchers in mathematics education prefer the kind of research quantitatively rather than qualitatively. According to Sanjaya (2015), this is due to the belief that quantitative methods are more objective. However, it does not mean that qualitative research is a fan-only one. Because if you look at Figure 2, the type of quality research is still more compared to RnD research. This aligns with what Shakouri (2014) showed: quality research has proven to increase.

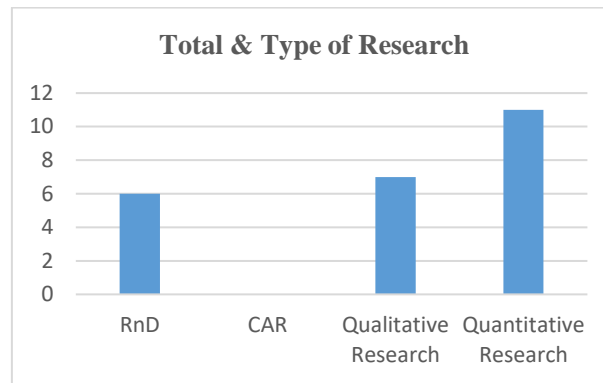


Figure 2. Distribution of research with a major focus on problem-solving capabilities in Indonesia over the last five years.

Figure 2 shows that CAR has not been done in the last five years for this type of research. Therefore, this could be an opportunity for the next researcher to consider using the kind of research CAR to create a novelty in research mathematical problem-solving capabilities.

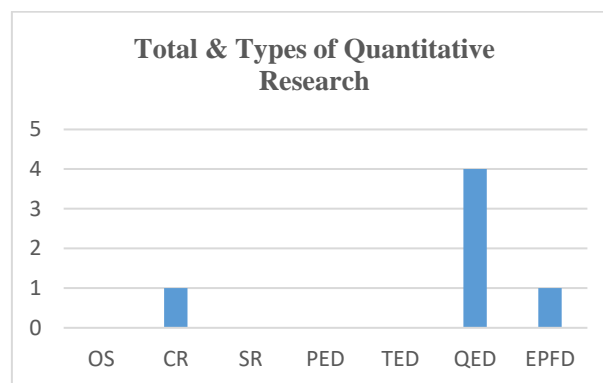


Figure 3. Distribution of quantitative research with a major focus on problem-solving capabilities in Indonesia over the last five years.

Figure 3 shows that the type of Quasi-Experimental Design (QED) research is more in demand than other types of quantitative research. It is in line with what Gopalan et al (2020) have argued that QEDs are becoming increasingly popular because of their ability to build causal relationships while dealing with the ethical and practical limitations of experiments that take place in the real world. Moreover, Gopalan et al(2020) explained that this method increases the validity of findings related to interventions and educational policies, which makes it very appropriate and beneficial to understanding and improving educational practices and outcomes. For other types of quantitative research can be an opportunity for researchers to undertake research into new mathematical problem-solving capabilities.

Research Subjects

Based on information about the type of research, quasi-experimental designs are the most frequently chosen by researchers. This suggests that research generally seeks to compare the best instructional designs to encourage students to be able to solve problems well. As shown in Figure 4, primary high school students are the most selected research subjects. Then followed by high school students, undergraduates and high school teachers. Previous research has also shown that high school students are often chosen to study mathematical problem-solving skills. According to Amalia & Sulistyorini (2022) this is because high school students are at a critical stage of cognitive development that is important to understand more complex mathematical concepts and requires better critical thinking and problem-solving skills.

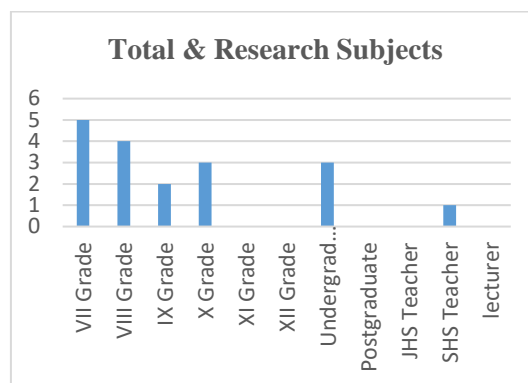


Figure 4. Distribution of research subjects with a major focus on problem-solving in Indonesia over the last five years

Mathematics Topics Selected when Conducting Studies

According to Amalia and Sulistyorini (2022), mathematics is the science that studies magnitude, structure, space, and change. It can also be defined as studying patterns and relations using numbers and symbols. In education, mathematics helps students solve problems in various fields, such as science, technology, and economics.

The mathematics subjects taught at the school are varied. For example, according to the 2013 curriculum, the High School mathematics subjects cover several topics such as social arithmetic, lines and angles, squares and triangles, number patterns, functions, line equations,

Pythagoras theorems of chance, and so on. Generally speaking, researchers raise a topic to examine problem-solving ability in solving issues with the topic.

Table 2. The most frequently chosen mathematical topic in research with a major focus on problem-solving skills in Indonesia in the last five years

Topics	Number of articles
Triangle	2
Geometry	5
Pythagoras Theorem	2
Algebra	3

Table 2 above shows the four most selected materials for research. Geometry is the most chosen mathematical topic, followed by algebraic matter, triangles, and Pythagoras theorem. One of the research papers on geometry explains that the reason for selecting geometries to test problem-solving abilities is because one of the materials is closely related to students' daily lives. Then, in addition to the four topics above, other topics studied were rows and rows, assemblies, split, and others up to integral calculus at the undergraduate level. Therefore, topics not mentioned in Table 2 can be an excellent opportunity for future researchers to investigate students' mathematical problem-solving abilities.

Treatments

Giving treatment aims to test a researcher's hypothesis or determine how critical a particular condition is to a specific parameter. Table 3 shows that the most widely used treatment for mathematical problem-solving skills is the problem-based learning model, as many articles follow the use of digital modules/books and learning with the STEM approach of each article. According to Rezio et al. (2022), problem-based learning is widely used to test problem-solving skills because problem-based learning is significant in improving student problem-solving skills.

Table 3. Three of the most popular types of treatment

Treatments	Number of articles
Problem-based learning	4
Module/e-book	2
Learning with STEM approach	2

Data Collection Instruments

Researchers need instruments to help them collect data while doing research. Students' ability to solve mathematical problems can be measured with many instruments, even with instruments that previous researchers have made. One of the most commonly used research instruments is the question test.

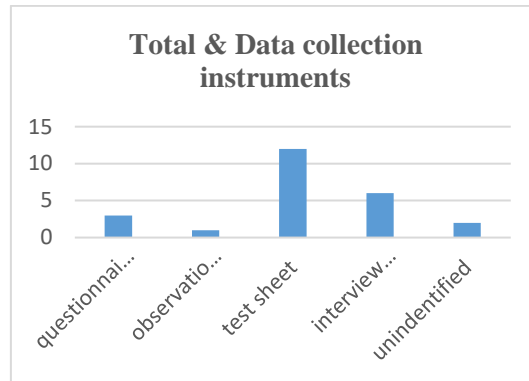


Figure 5. Distribution of selective instruments for data collection in research with a major focus on problem-solving capabilities in Indonesia over the last five years

Data Analysis Methods

The accuracy of data analysis selection will determine the degree of validity of the research carried out. Based on Figure 6, six of the 24 studies used a t-test as a method of data analysis. Next are the percentage and n-gain. Therefore, for analysis methods that are still little selected, there can be an opportunity for further research.

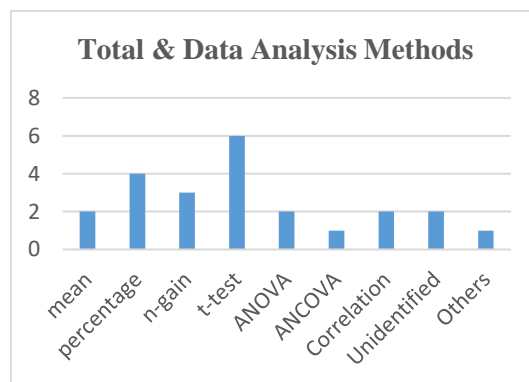


Figure 6. Distribution of selection of data analysis methods in research with a major focus on problem-solving capabilities in Indonesia in the last five years

4. CONCLUSION

This study analyzed articles highlighting problem-solving skills and published in journals of mathematical education across Indonesia from 2019 to 2024. The analysis shows a declining trend in the number of publications focusing on problem-solving capabilities over the past five years. Among the publications analyzed, quantitative research is the most dominant. In addition, eighth-grade students in junior high school are most often chosen as research subjects, while geometry is the subject of most discussion. Problem-based learning (PBL) is the most widely used method, while test sheets and t-tests are the most commonly used instruments for data collection and analysis.

Based on this study's findings, several recommendations have been formulated for further research. First, the declining publication trend represents a great opportunity for researchers in mathematics education to do more research on future problem-solving capabilities. Second, the frequency of qualitative research needs to be increased to investigate the development of problem-solving capability. Third, R&D research aimed at developing instructional products should be targeted to improve the ability to solve problems of students who are still low. Fourthly, researchers must provide transparent information about their research instruments, including their validity and reliability. Finally, it is recommended that researchers choose the test most suitable for the hypothesis and design of the research in carrying out any research.

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