



# META-ANALYSIS PROBLEM BASED LEARNING ON STUDENTS' PROBLEM-SOLVING SKILLS IN HIGHER EDUCATION

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## Keywords

Problem Based Learning;  
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## Abstract

*This study aims to determine the influence of problem-based learning on the problem-solving ability of students in higher education. This type of research is a quantitative research with a meta-analysis approach. The sample of this study comes from the analysis of 12 national and international journals published in 2023-2024. The data source was taken from the Google Scholar, ERIC and Mendeley databases. The sampling technique is direct observation through a journal database. Data analysis is a quantitative analysis with the help of the STATA application. The results of this study show that there is a significant influence of the problem-based learning model on the problem-solving ability of students in higher education with  $ES = 1,014$ ;  $z = 9.013$  with a high effect size category. These findings show that the problem-based learning model is very effective in being applied by lecturers in the learning process in higher education*

## 1. INTRODCUTION

In the era of Revolution 5.0, numeracy skills are not only an important cornerstone in education, but also an essential key to participate effectively in a society that is increasingly dominated by technology and digitalization (Singh et al., 2021; Susanto et al., 2024). Numeracy skills enable individuals to understand and manage rapidly evolving data, solve complex problems, and make decisions based on quantitative analysis. In this context, numeracy is not only limited to basic numeracy skills (Shiyamsyah et al., 2024a), but also includes an understanding of statistics, probability, and mathematical modeling—all of which are vital competencies necessary for navigation in a world that is increasingly dependent on big data and artificial intelligence. The increasing integration of automation systems and artificial

intelligence in daily life requires a society that is not only able to use technology passively, but also understands the basic principles that govern it (Teena et al., 2024).

Strong numeracy skills support this understanding, allowing individuals to interact more critically and innovatively with the technology they use. Thus, effective numeracy education becomes important, not only for the success of the individual in the chosen career, but also for active participation in informed social and economic decision-making. Therefore, approaches such as Problem Based Learning (PBL) that support the development of these skills are becoming increasingly relevant and vital in today's educational curriculum (Rosnelli & Ristiana, 2023).

Numeracy skills play a very important role in everyday life, providing the foundation for a wide range of activities from personal financial management to understanding health and environmental issues (Shiyamsyah et al., 2024). The ability to analyze numbers, create budgets, and understand percentages allows individuals to make informed and thoughtful decisions regarding spending, investment, and use of resources. In addition, in the context of health, numeracy helps people understand drug dosages, read the results of medical tests, and follow effective dietary prescriptions. In environmental settings, numeracy skills enable individuals to interpret data related to climate change, pollution, and energy use, strengthening their empowerment in contributing to sustainability (Astuti et al., 2024).

Furthermore, the mastery of numeracy is an inseparable foundation of success. In the academic world, these skills are essential not only in the study of mathematics, but also in science, technology, and other quantitative fields (Astuti et al., 2024). As time goes on, the need for strong analytical and problem-solving skills is increasing in the job market. In the professional world, numeracy skills allow individuals to perform data analysis, make predictions, and present information in a way that influences strategic decisions. Therefore, proficiency in numeracy not only expands career opportunities but also improves adaptability, making individuals better prepared for various roles in a knowledge-based global economy (Hariadi, 2024; Zulkifli et al., 2022; Utomo et al., 2023).

Students' numeracy skills are a key component in the development of academic and practical intelligence that form the basis for lifelong learning and adaptation in a variety of situations (Atasoy & Güçlü, 2020). This ability includes more than just the basics of arithmetic; it also includes the use of mathematical logic, conceptual understanding, and the ability to apply mathematical concepts in real-world contexts. Students who have good numeracy skills tend to be better able to analyze, reason, and think critically, which are essential skills in almost all areas of study. Mastery of numeracy in the early stages of education helps students in understanding more complex subjects later in life, such as science, engineering, and economics, as well as supporting their confidence in facing quantitative problems in everyday life (Susanto et al., 2024).

Additionally, strong numeracy abilities in students often have a positive impact on overall academic achievement, as these skills are indispensable in standardized assessments and college entrance exams (Dalim et al., 2023). Students with good numeracy skills are usually better at planning, organizing, and completing tasks that require analytical and logical thinking (Widyaningtyas et al., 2023). This not only improves their ability to follow lessons in school,

but also better prepares them for the challenges of work and personal life. Therefore, an education that emphasizes the development of effective numeracy is essential in equipping students with the tools they need to succeed in an increasingly data- and technology-oriented future. Therefore, there is a need for a learning model that can encourage students' numeracy skills, one of which is the problem-based learning model (Dalim et al., 2023).

The Problem Based Learning (PBL) model is a learning model that emphasizes learning through a structured and realistic problem-solving process (Nurwidodo et al., 2023). In PBL, students are faced with real, unstructured problems and they have to work in groups to dig and solve them (Hariadi, 2024; Putra et al., 2023). This process encourages students to develop their ability to search for relevant information, analyze data, and apply the knowledge that has been learned theoretically into practical situations. This approach not only improves the understanding of the concepts of the subject being studied but also fosters other important skills such as collaboration, communication, and critical thinking. PBL is designed to make students more active in learning, changing their position from passive recipients of knowledge to active participants in their learning process (Yuberti et al., 2019).

Previous research by (Rosnelli & Ristiana, 2023; Zulyusri et al., 2023) who explored the effectiveness of the Problem Based Learning (PBL) model in the context of numeracy learning has provided important insights into the advantages of this approach in the Society 5.0 era. A number of studies reveal that PBL, with a focus on problem-based learning, is very effective in improving students' understanding of mathematics (Santosa et al., 2022; (Nurtamam et al., 2023). This is mainly because PBL invites students to actively interact with learning materials, encouraging self-discovery and practical application of mathematical concepts (Hariyadi et al., 2023a). The study shows that through PBL, students not only acquire better numeracy knowledge but also develop the ability to apply that knowledge in real-life situations, a skill that is highly valued in a society dominated by technology and data such as Society 5.0. Therefore, this study aims to determine the effectiveness of the problem-based learning model to improve students' numeracy skills in the 5.0 society era.

## 2. RESEARCH METHODS

This research is a type of meta-analysis research. Meta-analysis research is a type of research that analyzes primary research data statistically to get a conclusion (Tamur and Junadi, 2020; Oktarina et al., 2021; Ichsan et al., 2023). This study aims to determine the effectiveness of the problem-based learning model to improve students' numeracy skills in the 5.0 society era. The data of this study comes from the analysis of 10 reputable national and international journals published in 2023-2024. The data collection technique in the study is direct observation through a journal database. The eligibility criteria are that the research must be relevant, the research must be indexed by SINTA, Scopus or Web of science, the research must be an experimental method or quasi-experiment, the research has complete data to calculate the effect size value and the research sample must > 30 students. The data analysis in this study is statistical analysis with the help of the SATA application. Furthermore, the effect size value criteria in this study are sourced from the effect size criteria (Borenstein et al., 2007) which can be seen in Table 1.

**Table 1.** Effect Size Value Criteria

Effect Size	Kriteria
$0.0 \leq ES \leq 0.2$	Low
$0.2 \leq ES \leq 0.8$	Medium
$ES \geq 0.8$	High

### 3. RESULT AND DISCUSSION

From the results of searching for data sources, 10 studies were obtained that had met the predetermined inclusion criteria. Furthermore, the research data is calculated the effect size value which can be seen in Table 2.

**Table 2.** Criteria for Effect Size Value 12 Research

Journal Code	Years	Effect Size	Criteria
PL1	2024	0.82	High
PL2	2024	1.52	High
PL3	2024	0.87	High
PL4	2023	0.72	High
PL5	2023	0.66	Medium
PL6	2024	1.07	High
PL7	2024	1.24	High
PL8	2023	0.90	High
PL9	2024	0.62	Medium
PL10	2024	0.51	Medium
<b>Average effect size</b>		<b>0.893</b>	<b>High</b>

Based on table 2, the effect size values of the 10 studies ranged from 0.51 to 1.24. Furthermore, according to the effect size value criteria of Borenstein et al., 2007, 3 studies with medium effect size values and 7 studies with high effect size values were obtained. Furthermore, the average effect size value of 0.893 in the high effect size category. These findings conclude that the problem-based learning model has a significant influence on students' numeracy skills. The problem-based learning model encourages students to be actively involved in their learning through the exploration of real problems that must be solved in groups (Nurmasari et al., 2023). This approach not only challenges students to use their numeracy skills in relevant contexts, but also improves their understanding of how to apply mathematics in real-life situations. This intrinsically strengthens the relationship between theory and practice, an indispensable aspect in today's technology-based society. (Sheng et al., 2020. ; Hariyadi et al., 2023b).

Furthermore, PBL students learn to develop critical and analytical thinking skills. In dealing with complex problems, students are required to identify, analyze, and evaluate data and formulate logic-based solutions. This ability is very important because numeracy is not only related to numbers, but also to the ability to think logically and make decisions based on data (Ajmal & Hussain, n.d.). Therefore, PBL not only improves numeracy skills but also prepares students to face workplace challenges that often require analysis and solutions to complex problems. Problem based learning (PBL) PBL also contributes to the development of collaborative skills. In the era of Society 5.0 which emphasizes teamwork and collaboration across disciplines, the ability to work together with others in solving problems is a highly valued skill. Through PBL, students learn to communicate effectively, negotiate, and collaborate in teams, all of which are essential components of numeracy skills in both professional and personal contexts (Yuberti et al., 2019). Technological adaptation in PBL in the Society 5.0 era provides opportunities for students to use digital tools in solving numeracy problems. The use of mathematics software, online learning platforms, and digital collaboration tools not only enriches the learning process but also helps students prepare for the digital world of work. It underscores the importance of integrating technology in mathematics education, in accordance with the needs of modern society (Hudson et al., 2021; Lestari et al., 2024); Nurtamam et al., 2023; Putra et al., 2023).

Learning through PBL problem-based learning helps to overcome motivation problems in learning mathematics, which is often seen as a difficult and uninteresting subject by many students. By placing students in an active role as problem solvers, PBL makes math learning more relevant and engaging (Liline et al., 2024; Dalim et al., 2023). This increases student engagement and learning motivation, which is an important factor in academic success in numeracy. PBL in the context of numeracy shows that this approach can significantly improve student learning outcomes. Compared to traditional methods, students who take PBL often show greater improvement in standardized tests and performance assessments (Nurwidodo et al., 2023). The consistency of these positive results shows that PBL is not only beneficial in improving numeracy skills but also as a learning method yang efektif secara umum dalam pendidikan modern.

#### **4. CONCLUSION**

From the results of this study, it can be concluded that the problem-based learning model has a significant influence on students' numeracy ability with an average effect size of 0.982 (high effect size category). These findings show that the problem-based learning model is very suitable for schools to apply in improving students' numeracy skills.

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