

## ANALYSIS OF MATHEMATICAL LITERACY INCREASE AND LEARNING INDEPENDENCE THROUGH PROBLEM-BASED LEARNING

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### *Abstract*

*Mathematical literacy ability is one of the abilities that must be possessed by students to solve problems in the form of word problems that are related to problems in the real world, so that find solutions to mathematical problems requires learning independence. The learning model that can improve mathematical literacy skills is the Problem-Based Learning (PBL) model. The PBL model involves students being active in finding solutions to everyday life problems. This study aims to analyze the increase in mathematical literacy skills and student learning independence through the PBL model. The research method used in this study is a systematic review method, namely identifying, evaluating, and concluding on research results that are similar to a particular research topic. Based on this research, it can be concluded that (1) The PBL model can improve mathematical literacy skills, (2) The PBL model can increase student learning independence.*

**Keywords:** *Mathematical Literacy; Problem-Based Learning; Learning Independence.*

### INTRODUCTION

Mathematical literacy ability is an individual's ability to design, use, and interpret mathematics in various contexts. If students know mathematical concepts that are relevant to everyday life problems, these students have good mathematical literacy skills, so students can solve problems using mathematical concepts (Nurani, Mahfud, Agustin, & Kananda, 2020). In line with Pamungkas & Franita (2019) which states that students who have mathematical literacy skills can infer information, present mathematical problem solving processes, and find solutions to problems.

The achievement of the mathematical literacy skills of Indonesian students is still low, as can be seen from the results of the Program for International Student Assessment (PISA) in 2018 showing that Indonesia is in 73rd position out of 76 participating countries with a score of 379 and the OECD average score is 489. Low mathematical literacy is seen in research conducted by Widiyanti & Hidayati (2021) showing that students' mathematical literacy abilities are still at level 1. From the 4 questions given, the results obtained are that level 1 mathematical literacy skills have a percentage of 62.5%, level 2 is 21.9%, and level 3 9.7%. In line with research conducted by Amelia, Effendi, & Lestari (2021), it stated that the low ability of students' mathematical literacy was caused by the inability of students to interpret problems by 38.09%. The inability of students to apply mathematics to problems is 71.42%. And the inability of students to formulate problems is 71.42%.

In addition to mathematical literacy skills, learning independence is an important aspect that needs to be improved in learning mathematics. Learning independence is the ability of students to determine learning strategies on the basis of their own volition, their

own choices and responsibilities without coercion from other parties. If students have learning independence, students will show readiness in managing good learning situations, be able to find out where the advantages and disadvantages are in learning (Kholifasari, Utami, & Mariyam, 2020). According to Pratiwi, Istirahayu, & Mariana (2022) states that the characteristics of students who have learning independence, namely being able to think critically, creatively and innovatively, are not easily influenced by other people's arguments, do not avoid problems, are able to solve problems by thinking logically, when finding If you have a problem, you will try to solve it independently, diligently, and be responsible for your actions.

Student learning independence still needs to be improved. This is based on the results of research conducted by Zainwal & Aulia (2019), "The level of student learning independence is in the low category, namely, out of 18 participants who were sampled, as many as 85% were in the low category. The high category is 15%. This is in line with research conducted by Febriyanti & Imami (2020) which states that overall the average student learning independence is 28.97%, which is in the low category, with the results of each phase, namely the planning phase of 27.47%, the implementation phase of 33.02 %, and the evaluation phase of 24.80%.

Improving students' mathematical literacy skills and learning independence requires learning strategies by applying appropriate learning models. According to the Ministry of Education and Culture in the 2013 curriculum, the learning process leads students to be active by starting from observing concrete problems, formulating problems, processing information, and forming new knowledge, so that students are able to independently reflect on the problems of everyday life. The learning model that fits these problems is the Problem-Based Learning (PBL) model. Through the PBL model, if students are faced with problems, they are expected to be able to assemble their own knowledge, develop critical thinking skills and problem solving skills, learn independently, and have high self-confidence (Pratiwi & Ramdhani, 2017).

## **LITERATURE REVIEW**

Mathematics is composed of simple mathematical concepts to very complex mathematical concepts. Therefore, it is not only necessary to have the ability to count in mathematics, but also to have mathematical literacy skills to solve mathematical problems related to real life. This is in line with what was expressed by Kis and Astuti (2018, p.38), who said that in the process of learning mathematics, students are not only able to use the ability to count, but students are also able to use the ability to communicate, reason, and think. Other mathematics, all of which are summarized in mathematical literacy abilities. Mathematical literacy ability is a mathematical skill to apply mathematics in various contexts of everyday life. As cited in the PISA draft assessment (OECD, 2021, p.7) Mathematical literacy is defined as an individual's capacity to reason mathematically, formulate, use, and interpret mathematics to solve problems in various real-world contexts. This includes using mathematical concepts, procedures, facts, and tools to describe,

explain, and predict phenomena. This helps a person to recognize the role of mathematics in the world and make the necessary judgments and decisions as citizens.

Learning independence is an attitude within oneself that can affect students' learning outcomes in mathematics. Basically, independent learning is a concept in which a learner is empowered to learn independently. People who are independent in learning can make their own choices responsibly. This is in accordance with the opinion of Adman, et al, (2016) (Fironika, et al, 2020, p.709). They believe that students can be said to be independent if they can be responsible for what they do, learn without the help of others, learn on their own, and believe in their own choice.

The learning model is Problem Based Learning (PBL). Namely, learning is oriented towards solving various problems, especially those related to the application of subject matter in real life. While students are doing problem solving activities, the teacher acts as a tutor who will help them define what they don't know and what they need to know to understand and or solve problems. (Newbledan in Gintings, 2010: 210). Through problem-based learning (Problem Based learning), the learning process does not stop just because students have found answers. But it also trains students to find alternative solutions and reflect on the results of their work. This can encourage students to think critically and creatively in solving math problems (Anggiana, 2019).

## **METHOD**

This research uses Systematic Literature Review (SLR) research, which is a method for identifying, evaluating, and interpreting research results that are relevant to the research questions, topics, or events that are of concern (Kitchenham, 2004). This study aims to be systematic about the research results so that the existing facts as policy decisions become more comprehensive and balanced.

Based on the SLR stages, the researchers collected articles that had the keywords mathematical literacy ability, independent learning, and PBL models. Data collection was carried out by documenting articles obtained based on a literature review. There were 20 articles that were indexed to at least SINTA 5 with keywords relevant to research through Google Scholar with the help of the Mendeley Reference Manager. From various articles, the researcher selected 6 relevant articles, then the article data was presented in a table containing the author's name, year of publication, journal name, and research results.

## **RESULTS AND DISCUSSION**

Based on the search results for articles indexed by Google Scholar that are relevant to the research theme, they are then put together and screened regarding whether the study is the same or not. The research data was then analyzed and made a summary of the documented articles related to the PBL model. The results of the data analysis can be seen in Table 1.

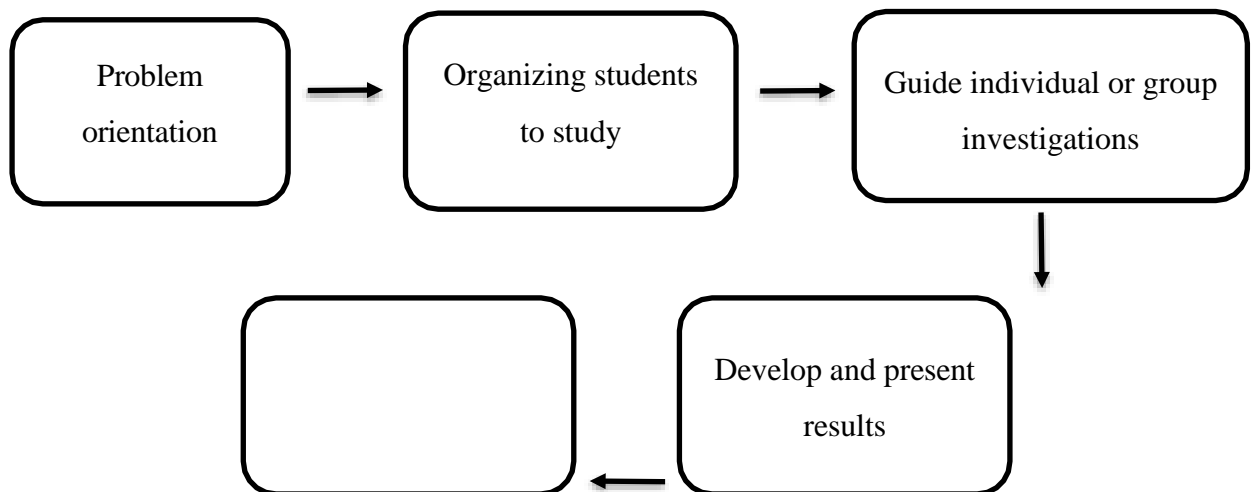
Table 1. Articles Related to Increasing Mathematical Literacy Ability and Independent Learning Through the PBL Model

Researcher and Year	Journal Name	Research result
Pamungkas & Franita (2019)	JP3M (Jurnal Penelitian Pendidikan dan Pengajaran Matematika)	The results showed that there was an increase in mathematical literacy skills after using the PBL model. The achievement of mathematical literacy skills obtained an average pretest score of 3.25 and a posttest average score of 7.45
Agustin, junarti, & Mayasari (2022)	J'THOMS (Journal of Technology Mathematics and Social Science)	The results showed that $thitung = 2.0533 > ttabel = 2.0017$ so that there is an influence of the PBL model on mathematical literacy skills on statistical subjects and can achieve learning mastery
Nurlaela & Imami (2022)	Jurnal Ilmiah Dikdaya	Based on the results of the study, it was shown that the application of the PBL model could improve mathematical literacy skills with the average obtained by students increasing, namely the pretest of 52.50 and the posttest of 74.00.
Melissa (2016)	Jurnal Ilmiah Edukasi Matematika (JIEM)	The increase in the independence of learning mathematics with the PBL approach can be seen from the increase in the percentage of students who have learning independence in the very high category at the initial condition of 9%, cycle I of 27%, and cycle II of 41%. Learning mathematics using the PBL approach will train students to be more independent in learning, because learning is done with group discussions to solve problems and construct knowledge.
Silviani (2018)	Jurnal Pendidikan Matematika : Judika Education	Based on the results of the questionnaire data, 80.24% indicated a positive response (SS and S) to the 15 statement items. This means that students have

Kurniyawati, Mahmudi, Wahyuningrum (2019)	Jurnal Riset Pendidikan Matematika	independent learning during the learning process. Learning using the PBL learning model with the ability of student learning independence was obtained at 76.18% in the good category. This means that there is an increase in the ability of students' learning independence included in the good category by using the PBL model.
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The Problem-Based Learning (PBL) model is a learning model that can improve students' mathematical literacy skills. This is caused by the steps of the PBL model, namely identifying problems, studying independently, investigating, exchanging information, and assessments can facilitate students in improving their mathematical literacy skills (Pamungkas & Franita, 2019). The PBL model is designed so that students study authentically to find solutions to contextual problems. Through the PBL model, students must analyze and define problems, develop assumptions and make predictions, collect and analyze information, conduct experiments, and draw conclusions (Madyaratri, Wardono, & Prasetyo, 2019). The stages of the PBL model are shown in Figure 1.

**Figure 1. Stages of the PBL Model**



Pratiwi & Ramdhani, (2017), "Students' mathematical literacy skills can be improved using the PBL model because: (1) giving problems to students can familiarize students with applying appropriate problem-solving strategies so they can answer the problems given, (2) presentation of questions adapted to the context that exists in everyday life, so that students can imagine what and how to solve the problems given, (3) the PBL learning model starts with the orientation of students towards problems, then solves these problems by detecting, searching for and finding the main causes of problems, then design and

implement a solution and finally reflect on the investigation carried out". This is in accordance with the indicators of mathematical literacy ability. As for the research conducted by Indah, Mania, & Nursalam (2016) argued that the PBL model helps students process ready-made information and compile knowledge about the real world and can involve students actively in solving real problems, so that it causes learning motivation, increases curiosity and the ability of mathematical literacy has increased. So, the PBL model can be used as an alternative to improve students' mathematical literacy skills.

According to Melissa (2016), through PBL, students are presented with a problem, so that students are able to analyze problems, find information, process information, and draw conclusions. Thus, the PBL model will train students to learn independently because learning is done with group discussions to solve problems and construct knowledge. In line with the research results of Kurniyawati, Mahmudi, & Wahyuningrum (2019), "In addition, investigating, looking at relationships, using books or learning resources is a sub-aspect of personal attributes which is one aspect of learning independence. This causes PBL to be more effective in increasing student learning independence." This shows that the PBL model will form students who are independent in learning, because the PBL model is implemented by forming groups to find solutions to problems and construct knowledge.

## CLOSING

### Conclusion

Based on the results of the analysis conducted by researchers, the PBL model can be an alternative learning model to improve students' mathematical literacy skills and independent learning. The stages of the PBL model consist of students orienting to problems, organizing students for learning, guiding individual and group investigations, developing and presenting work, as well as analyzing and evaluating problem-solving processes. The stages of the PBL model have links with indicators of mathematical literacy ability and learning independence. Namely, with the PBL model, students will get used to solving problems so that students are able to improve their mathematical literacy skills and learn independence in analyzing, processing, and drawing conclusions about mathematical problems.

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