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Mathematical Literacy in PjBL assisted by E-LKPD in terms of Self Concept

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Abstract. Mathematical literacy and self-concept have become crucial topics in 21st century learning. So that learning innovation and the use of technology need to be carried out to support students' abilities to face the challenges of globalization. The purpose of this study is to describe students' mathematical literacy in terms of self-concept. This study uses a sequential explanatory design. The population in this study was class VIII of one of the junior high schools in Semarang Regency in the 2022/2023 academic year. Subjects in this study were selected using a purposive sampling method based on high, medium and low self-concept categories. Collecting data through test techniques, questionnaire techniques, interviews, and observation. The results showed that the mathematical literacy of students with high self-concept categories was better than students with moderate and low self-concept categories. Students with high self-concept are able to fulfill all indicators of mathematical literacy well; students with moderate self-concepts are able to master the three indicators of literacy but are still unable to apply mathematical concepts, facts, and procedures and represent answers in real-world contexts; students with low self-concept are only able to identify and represent problems mathematically while other indicators have not been fulfilled properly.

Keywords: PjBL; mathematical literacy; self-concept

INTRODUCTION

The challenges of the 21st century have become a crucial topic in the field of education (Maneses et al., 2023; Margeneyer et al., 2022). The basic abilities of reading, writing, and arithmetic alone are not enough to face the challenges of the 21st century, therefore students are required to have deeper skills such as critical thinking skills, problem solving, metacognitive, communication, collaboration, innovation, creation, and literacy (Laprise 2023; Dotson et al., 2022). Based on the Partnership for 21st Century Skill Standards (IP-21CSS) there are at least 4 standards in implementing 21st century learning, namely: 1) 4C (critical thinking, creative thinking, collaboration, and communication); 2) ICT (technology, media, and information literacy); 3) spiritual values; 4) character building (Varas et al., 2023; Atasoy et al., 2023). This is in line with the Indonesian national education system based on Law Number 20 of 2003 that education aims to develop the potential of students to become human beings who have faith, are pious, have noble character, are healthy, knowledgeable, capable, creative, independent, and become citizens of a democratic nation. and be responsible.

Based on the Indonesian education system, mathematics is one of the compulsory subjects taught at all levels of education. This is because mathematics is a very important subject, not only teaching arithmetic and using formulas but also the ability to reason logically and critically to solve problems in everyday life. Mathematics lessons at school aim to create individuals who can understand what they have learned in their environment and at school, create their own meaning, then apply it in everyday life using appropriate representations and models (Canbazoğlu & Tarım, 2020). This is in line with the view of the National Council of Mathematics (NCTM, 2000) that there are at least five basic competencies that students must have in learning mathematics, namely: mathematical problem solving, mathematical communication, mathematical reasoning, mathematical communication, and mathematical representation. The ability to reason and solve problems in everyday life is often known as mathematical literacy.

Mathematical literacy refers to a person's ability to formulate, apply and interpret mathematics in various contexts so that it requires the use of mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena and recognize the role of mathematics in the world (OECD, 2019). Mathematical literacy, expressed as the transfer of mathematical knowledge and skills to real life and mathematical evaluation and interpretation of real life situations, which is a general goal of mathematics education (Clem et al., 2021). With problems regarding mathematical literacy, students are expected to not only solve routine problems, but also solve non-routine problems, mobilize their perceptions of mathematics when faced with situations in

everyday life, use mathematics to produce original solutions in solving problems and combine mathematics with life (Canbazoğlu & Tarım, 2020).

However, the facts show that the mathematical literacy of Indonesian students is still low. This can be seen from the results of the Program for International Students Assessment (PISA) organized by the Organization for Economic Cooperation and Development (OECD). Based on the PISA results, it can be seen that from 2000 to 2018, Indonesia's score was still below the international average, with a ranking that was relatively low compared to other participating countries. In 2018, Indonesia scored 379 with a ranking of 73 out of 79 participating countries. OECD categorizes the average mathematical literacy of Indonesian students as still low, namely at level 2. In this category students can interpret and represent simple problems mathematically but cannot model, compare, and evaluate appropriate problem-solving strategies to deal with complex problems.

Project-Based Learning (PjBL) is a popular learning model in developed countries like the United States. PjBL is defined as a learning model that uses projects or activities as media (Carvalho et al., 2022). This is in line with 21st century skills which want learning projects oriented to knowledge, problems, investigation, discovery, and creation to provide opportunities for students to improve learning abilities in this case mathematical literacy (Atasoy et al., 2023). PjBL is considered ideal because it has several advantages, namely: (1) students can work according to their level of ability and strength; (2) encourage social skills and effective communication; (3) critical thinking; and (4) train responsibility and time management (Noski, 2022)

Apart from the right learning model, according to Bayley (2022) the use of technology as a learning medium is also necessary to face the challenges of the 21st century. Technology-based PjBL model innovation is believed to be able to provide more optimal results to achieve learning objectives. This is in line with the opinion of Singh et al (2023) which states that a combination of learning models and the use of technology can increase creativity and innovation in students. The use of technology such as electronic student worksheet (E-LKPD) in the form of student electronic activity sheets can be used to support the implementation of learning. The use of E-LKPD has the advantage of facilitating and shortening the time for the teaching and learning process to be effective, as well as being a learning tool that attracts students' interest because it is equipped with pictures and videos to support students' attention and understanding of learning material (Andriana *et al.*, 2022).

In addition to learning models and media, there are other factors that influence students' mathematical literacy, namely self-concept (Rueda et al., 2023). Self-concept is one of the affective aspects that is the focus of attention in the process of learning mathematics in the world (OECD, 2013). According to Ayodele in Rueda et al. (2023) Mathematical self-concept is defined as a person's way of thinking, feeling, acting, assessing, and evaluating himself related to mathematics. Self-concept becomes an important aspect in the process of learning mathematics to foster a positive attitude in solving math problems.

Based on the description, this study aims to describe students' mathematical literacy in terms of self-concept in PjBL learning assisted by E-LKPD.

METHODS

This study uses a sequential explanatory design, namely the type that uses quantitative methods in the first stage to collect and analyze data, then uses qualitative methods in the second stage to strengthen the results of quantitative research conducted in the first stage. This study consisted of three stages, namely the first stage used quantitative methods, the second stage used qualitative methods, and the third stage was the overall interpretation of the data at the end of the study.

The quantitative research design used was true experimental with a posttest only control design. In this design, there are two groups selected randomly (random sampling) then the first group is given treatment (X) and is called the experimental group, while the other group is not given any treatment and is called the control group. The experimental group is the group that is treated using the PjBL model assisted by the E-LKPD, while the control group is the group that is not given any treatment.

Table 1. Posttest Only Control Design

Group	Treatment	Posttest
Experiment (R)	X	O_1
Control (R)		O_2

(Source: Sugiyono, 2018)

Description:

X: The treatment is in the form of a Project-Based Learning model assisted by E-LKPD

O_1: Posttest scores (final test) after being treated with the Project-Based Learning model assisted by the E-LKPD

O_2: Posttest scores (final test) after no treatment (only using the Project-Based Learning model)

The research design at the qualitative stage in this study focuses on analyzing and describing students' mathematical literacy in the PjBL model assisted by the E-LKPD in terms of self-concept.

RESULTS AND DISCUSSION

Mathematical Literacy in the E-LKPD Assisted PjBL Model

The difference test of two right-sided averages is used in this study with the aim of testing whether the average mathematical literacy in the PjBL model assisted by the E-LKPD is better than the average mathematical literacy in the PjBL model without the assistance of the E-LKPD. Based on the results of the mathematical literacy posttest, the average mathematical literacy in the PjBL model assisted by the E-LKPD was 59.86 with a proportion of 89.65%, while the average mathematical literacy in the PjBL model without the assistance of the E-LKPD was only 31 with the proportion of completeness of 62.06%. Statistical test results using a difference test on the right side of the average obtained the value of $t_{count} = 3.380 > t_{table} = 2.00324$ shows that students who use the PjBL model assisted by E-LKPD obtain an average score of mathematical literacy better than students who use the PjBL model without the assistance of E-LKPD.

The results of the study showed that the average mathematical literacy with the PjBL model assisted by E-LKPD was better than the PjBL model without E-LKPD because the PjBL model assisted by E-LKPD was designed as an interactive activity sheet that can increase motivation and learning independence of students. This is because E-LKPD is not monotonous in the form of written text only but also provides links to learning videos from various sources as learning references, and is equipped with interactive practice questions. This is different from the PjBL model without E-LKPD assistance where the usual PjBL model only uses paper-based manual LKPD which is only in the form of written text. This certainly makes students bored and lazy in doing practice questions because the form is too monotonous. That is the reason why the average mathematical literacy in the PjBL model can be better than the PjBL model without E-LKPD assistance.

This is in line with the Connectivism theory of George Siemens and Stephen Downes in (Tham et al., 2021) which states that in the era of information technology where communication devices have been interconnected in a global network, knowledge can be distributed through information networks and can be stored in digital format. The results of this study are also in line with the results of previous research from Goss (2022) which states that the combination of learning models and the use of technology can improve student learning outcomes.

The Effect of Self-concept on Mathematical Literacy in the E-LKPD Assisted PBL Model

Based on the simple linear regression test, the regression equation $\hat{Y} = -70.372 + 2.118X$ is obtained. Then a further linear regression test was carried out to obtain the value $sig = 0{,}000 <\propto= 0.05$ which means that there is a positive influence between self-concept on mathematical literacy with the coefficient of determination R^2 obtained is 0.792. This shows that 79.2% of mathematical literacy is influenced by mathematical self-concept, meaning that students who have high self-concept will most likely have high mathematical literacy as well. This is because students who have high self-concepts have good views and expectations of the mathematical abilities they want to achieve so they have strong motivation and willingness to learn and practice, while the remaining 20.8% are influenced by other factors which consist of various possibilities. such as students' initial abilities, understanding of the material, implementation of learning and other factors. Students with low initial ability but have high self-concept, it is possible to have good mathematical literacy. This can happen if students have a strong interest, will, and confidence to realize their hopes in learning mathematics.

The results of this study are in line with Fitts' theory which states that self-concept has a strong influence on one's behavior. This is also supported by Carl Rogers' theory which divides self-concept into positive and negative self-concepts, where a person with a positive self-concept will feel valuable, confident and able to meet their expectations, whereas someone with a negative self-concept will lack the interest in competing and experience problems easily. worry. The results of this study are also in line with previous

studies, namely the research of Rueda et al, (2023) which states that self-concept has an effect on mathematical literacy, in this study the influence of self-concept on mathematical literacy is 70.3%, while the other 29.7% is influenced by other variables. This is also in line with the results of Toh & Watt (2022) which states that self-concept has a positive effect on high-level abilities

Mathematical Literacy in the E-LKPD Assisted PjBL Model in terms of Self-concept

The indicators of mathematical literacy based on the seven basic abilities assessed in PISA have been revealed by the OECD (2019), namely: (1) communication; (2) mathematizing; (3) representation; (4) reasoning and argument; (5) devising strategies for solving problem; (using symbolic, formal, and technical language and operations; and (7) using mathematics tools).

Based on these indicators, researchers developed several indicators of mathematical literacy used in this study, namely: (1) identifying the mathematical aspects of the problem; (2) represent the existing situation in the problem mathematically; (3) designing and implementing strategies to solve problems; (4) apply facts, concepts, mathematical procedures when solving problems; and (5) interpreting mathematical answers in real-world contexts. The mathematical literacy test questions consist of 5 questions where each question meets all the mathematical literacy indicators used. In this study, the mathematical literacy in terms of self-concept is grouped into three categories, namely high, medium, and low.

Mathematics Literacy of Students in High Self-concept Category (S-1)

In general, students with a high self-concept category are able to: (1) identify mathematical aspects by listing what is known and asked in questions number 1 to 5; (2) represent the problem mathematically by making a precise mathematical model for questions number 1 to 4, while number 5 still has a few errors because it is inconsistent in exemplifying and incomplete in making a mathematical model; (3) design and implement problem-solving strategies using elimination and substitution methods on questions number 1 to 4, while number 5 is able to design problem-solving strategies but have not implemented strategies with the right methods; (4) use the steps to solve the problem correctly on questions number 1 to 4, while number 5 still does not use the correct mathematical concepts and procedures; (5) interpret mathematical answers in real-world contexts by writing conclusions correctly on each question.

The results are in line with the statement of Amri & Widada (2019) that students who have a good or positive self-concept allow the students to be easier in constructing mathematical ideas in themselves. This is because the good or positive self-concept of students makes them tend to always think positively so that they do not give up easily and do not easily despair and always try to find solutions by realizing the mathematical ideas in their minds into real problems. Thus it can be said that the better or more positive the self-concept of students, the better the students' mathematical literacy skills.

Students' Mathematical Literacy in Medium Self-concept Category (S-2, S-3, S-4)

In general, students in the medium self-concept category (S-2) are able to: (1) identify mathematical aspects by listing what is known and asked in questions number 1 to 5; (2) being able to represent the problem mathematically by making an appropriate mathematical model for questions number 1 to 3, while numbers 4 and 5 are still not able to make an appropriate mathematical model; (3) being able to design and implement a problem solving strategy using the elimination and substitution method on questions number 1 to 3, while numbers 4 and 5 have not been able to design a problem solving strategy to be used; (4) able to correctly use the steps to solve the problem correctly only in questions number 2 and 3, in question number 1 it is still incomplete and there are several errors related to the systematics of writing numbers and the form of mathematical equations, while numbers 4 and 5 have not been able to do the steps -problem solving calculation steps; (5) being able to interpret mathematical answers in real-world contexts by writing conclusions correctly in questions number 2 and 3, in question number 1 they have not been able to draw conclusions correctly, while in questions numbers 4 and 5 they have not been able to write any conclusions.

The medium self-concept category in the S-3 subject generally has almost the same mathematical literacy as the S-2 subject, namely being able to: (1) identify mathematical aspects by listing what is known and asked in questions number 1 to 5; (2) being able to represent the problem mathematically by making an appropriate mathematical model for questions number 1 to 3, while numbers 4 and 5 are still not able to make an appropriate mathematical model; (3) being able

to design and implement a problem solving strategy using the elimination and substitution method on questions number 1 to 3, while numbers 4 and 5 have not been able to design a problem solving strategy to be used; (4) being able to use the correct problem solving calculation steps only on questions number 1 and 3, number 2 still has many errors, while numbers 4 and 5 have not been able to carry out the problem solving calculation steps; (5) being able to interpret mathematical answers in real-world contexts by writing conclusions correctly only in numbers 1 and 3, while numbers 2, 4 and 5 have not been able to write answers correctly.

The medium self-concept category for S-4 subjects is generally able to: (1) identify mathematical aspects by listing what is known and asked in questions number 1 to 5; (2) being able to represent the problem mathematically by making the correct mathematical model for questions number 1 to 4, but in number 2 there were still a few errors in making the mathematical model, while numbers 4 and 5 were still not able to make the appropriate mathematical model; (3) able to design and implement a problem-solving strategy using the elimination and substitution method in questions number 1 to 4, while number 5 has not been able to design a problem-solving strategy to be used; (4) able to correctly use the steps for calculating problem solving in questions number 1 to 4, while number 5 has not been able to carry out the steps for calculating problem solving; (5) being able to interpret mathematical answers in real-world contexts by writing conclusions correctly only in numbers 2 and 3, while numbers 1, 4 and 5 have not been able to write answers correctly. In the moderate self-concept category, S-4 subjects tend to have better mathematical literacy compared to S-2 and S-3 subjects, this is because during the learning process S-4 subjects tend to be more active in asking questions, and dare to give answers in front of class. In addition, when viewed from the results of activities using the E-LKPD, S-4 subjects had better enthusiasm and willingness to learn than S-2 and S-3 subjects because they always submitted activities to E-LKPD earlier than S-2 and S-3 subjects.

These results are in line with research of Ding (2016) which revealed that a person's positive perception (self-concept) of mathematics is positively linearly related to the achievement of mathematical literacy that he/she has achieved. A positive attitude towards what he/she has learned encourages high learning motivation. Likewise, there is a tendency for someone who has high self-confidence in their abilities, then the achievement of mathematical literacy tends to be high too.

Mathematics Literacy of Students in Low Self-concept Category (S-5)

In general, students with low self-concept categories are able to: (1) identify mathematical aspects by listing what is known and asked in questions number 1 to 5; (2) being able to represent the problem mathematically by making an appropriate mathematical model for questions number 1 to 3, while numbers 4 and 5 are still not able to make an appropriate mathematical model; (3) being able to design and implement a problem solving strategy using the elimination and substitution method in question number 1, whereas in numbers 2, 3, 4 and 5 they have not been able to design a problem solving strategy to be used. Students with low self-concept categories have not been able to meet the 4th and 5th indicators of mathematical literacy, namely students have not been able to apply mathematical concepts, facts and procedures in solving problems, and have not been able to change mathematical forms into real contexts. This can be proven by the inability of students to write down answers related to the steps for calculating the problem and drawing conclusions on each item given.

The less than optimal results in students with low self-concept categories are because the success of students in learning mathematics in class will be greatly influenced by their self-concept, including how they control their emotional intelligence. Students with bad or negative self-concepts will affect their behavior, which will tend to be bad or negative and increasingly difficult to achieve success (Mutiara et al., 2019).

Based on the results of the analysis that has been done, in general students with high self-concept categories have better mathematical literacy than students with medium or low self-concept categories. This happens because students with high self-concept categories can answer questions carefully and completely, where accuracy is obtained because of persistence and high enthusiasm in practicing solving problems related to literacy questions so that the experience and ability to answer questions carefully and completely is complete. become a good habit that is instilled in students. Completeness and accuracy can be seen from the answers of students who are able to formulate problems mathematically, use concepts, facts, procedures, and reasoning and can

interpret, apply, and evaluate mathematical outcomes. Even though there are still a few errors, in general the percentage of errors is less than the errors of students with medium and low self-concept. In addition, students with high self-concept are able to realize their abilities and shortcomings and have the desire to improve them, thus students can improve their mathematical literacy skills so that they are more optimal. This is inversely proportional to students with low or negative self-concept who tend to feel afraid and pessimistic. Students feel that math literacy questions are difficult so that they give up on working on them. This is in line with Permatahati et al. (2019) which states that a student who has a bad or negative self-concept will tend to have bad or negative behavior and will find it increasingly difficult to achieve success. Conversely, students who have a good or positive self-concept will tend to have good or positive behavior as well, making it easier to achieve success.

The results of this study are in accordance with Rogers' theory which states that a person who has a positive self-concept tends to be able to be him/herself and tries to meet their own and other people's expectations, whereas a person with a negative self-concept looks down on him/herself and has less interest in competing and maintaining distance in the surroundings. This research is also in line with previous research by (Eweida et al., 2023; Vassilakos et al., 2023) that students with a positive self-concept tend to be able to carry out tasks optimistically and be wise with the opinions of others, while students with a negative self-concept tend to be hesitant in giving answers and are easily influenced by their friend's answer. In addition, (Şengönül, 2022; Fleischmann et al., 2023) which states that students with high self-concept have better mathematical representation abilities than students in the medium self-concept category, as well as students with medium self-concept have better mathematical representation abilities than students with low self-concept. This is also in accordance with the research of Tong et al, (2021) which states that the mathematical communication skills of students with high self-concept are better than students with medium and low self-concept. Both of these studies were assessed according to this research because the ability to represent and communicate mathematics is a basic component in mathematical literacy.

CONCLUSION

Based on the results and discussion above, it can be concluded that there is an influence of self-concept on students' mathematical literacy in the PjBL model assisted by the E-LKPD. Learning using the PjBL model assisted by E-LKPD is proven to be able to improve mathematical literacy skills, this is evidenced by the difference in the average value of students' mathematical literacy when participating in PjBL learning assisted by E-LKPD and without E-LKPD. In addition, students with a high self-concept category are able to fulfill all the indicators of mathematical literacy used, students in the medium self-concept category are able to fulfill three indicators, meanwhile students in the low self-concept category are only able to fulfill two indicators.

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