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Mathematical Literacy and Curiosity Through Creative Problem Solving Learning Using the PMRI Approach Assisted by Photomath

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Abstract

This study aims to show (1) the quality of Creative Problem Solving learning with PMRI approach assisted by Photomath to improve students' mathematical literacy; (2) test the effect of curiosity on students' mathematical literacy through Creative Problem Solving learning with PMRI approach assisted by Photomath. This research is a type of quantitative research using Quasi Experimental on Pretest-Posttest Control Group Design. The population in this study were VIII grade students of SMPN 02 Kaliwedi, Cirebon Regency. Data analysis on learning quality includes the preparation stage, implementation stage and learning evaluation stage. Quantitative data analysis at the learning evaluation stage includes prerequisite tests consisting of normality test, homogeneity test, mean similarity test, while hypothesis testing consists of one sample average test referring to BTA; classical completeness proportion test; 2 mean difference test; 2 proportion difference test; test for average increase in mathematical literacy; and simple linear regression test. The results proved that (a) learning with CPS model with PMRI approach assisted by Photomath was qualified in improving mathematical literacy; (b) curiosity influenced 73.2% of students' mathematical literacy.

INTRODUCTION

Mathematical literacy is a very important ability to solve life problems related to mathematical concepts. According to Ismail et al., (2024), students in everyday life often encounter problems related to the application of mathematics in both personal and social life. By obtaining good mathematical concepts, it can help students in solving problems, where problem solving is not only in the form of routine problems, it should be solved by mathematical formulas, but more than that, solving everyday life problems related to mathematical concepts. This is because mathematical literacy is described as connecting mathematical material or concepts learned in class with various real-world situations. A person can be said to be mathematically literate if he not only understands mathematical material, but also knows how to use mathematical concepts in everyday life, especially in solving problems (Masjaya & Wardono, 2018). According to Jain & Rogers (2019) the term mathematical literacy was introduced by NCTM (1989) before PISA and mathematical literacy is one of the visions of mathematics education.

But in reality, very few people like or are fond of mathematical literacy. According to Kuswidyanarko et al., (2017) mathematical literacy is one of the abilities to solve mathematical problems in real life that students find most difficult, while according to Madyaratri et al., (2019) many people think that mathematical literacy is the ability to solve mathematical problems that are considered the most difficult and not very easy to master, this is certainly what students have felt. Meanwhile, the mathematics field studied by the Organization for Economic Cooperation and Development (OECD) in the 2015 Programme for International Student Assessment (PISA) study stated that Indonesia ranked 62nd out of 72 PISA participating countries in the field of mathematics (OECD, 2015). Meanwhile, in 2018 Indonesia ranked 73rd out of 79 PISA participating countries in mathematics (OECD, 2018). Furthermore, in 2022 Indonesia ranked 68th out of 80 PISA participating countries in mathematics (OECD, 2022). The results of the United Nation Development Program (UNDP) research in 2020 stated that the Human Development Index (HDI) was ranked 107th out of 189 countries in the world (Adjei, 2015). Meanwhile, the results of the Trends in International Mathematics and Science Study (TIMSS) showed that Indonesian students ranked very low in the ability to: (1) understanding complex information, (2) theory, analysis, and problem solving, (3) use of tools and procedures, and (4) investigation (wardhani, 2011). The low results of the international study show that especially in the skill of understanding the content of reading, the competence of Indonesian students is very low. According to Rahayu et al., (2022), teacher-centered learning causes students not to be motivated to be curious about mathematics subjects, especially in terms of mathematical literacy, because students are not involved independently and creatively in the learning process. Students become passive and only listen to material descriptions, receive, and swallow information just like that from the teacher.

This is because students have low motivation to find out about new knowledge such as mathematical literacy, so students have a tendency to be passive (Yaniawati et al., 2023). This shows a lack of curiosity in learning mathematical literacy, but curiosity is very related to mathematical literacy because it can motivate student learning, increase student participation, improve student problem solving skills, and improve student concept understanding skills. Students' lack of curiosity in learning mathematics will most likely affect their understanding and mastery of materials related to mathematics (Lezhnina & Kismihók, 2022). Student curiosity is one of the most important elements in supporting the success of the teaching and learning process, because curiosity is an attitude and action that always seeks to know more deeply and broadly from something he learns, sees, and hears. Therefore, students' curiosity attitude needs to be developed with a particular learning model, namely the Creative Problem Solving (CPS) model. The Creative Problem Solving (CPS) model is one of the developments of the Problem Solving learning model. The CPS model is a learning model centered on problem-solving skills followed by strengthening creativity. This model is also very important because it can encourage creative thinking and action, stimulate the development and progress of student thinking (Yuberta et al., 2020). By using this learning model, it is hoped that it can generate interest as well as creativity and motivation for students in mathematical literacy, so that students can get the maximum benefits both from the process and the learning outcomes.

In addition, efforts to improve the quality of the learning process are carried out by applying approaches and learning media that optimize brain work and are expected to improve the mathematical literacy of junior high school students, namely the Indonesian Realistic Mathematics Education approach. Indonesian Realistic Mathematics Education (PMRI) is one of the

mathematics learning approaches that is oriented towards mathematizing everyday experiences and applied in everyday life. Indonesian Realistic Mathematics Education (PMRI), on the one hand, is an approach or theory about learning mathematics in schools, which was developed starting in 2000 in Indonesia, on the other hand, PMRI is a movement (not a project) to improve and improve the quality of mathematics education in Indonesia. As an approach or theory, PMRI was originally an adaptation of Realistic Mathematics Education (RME) developed in the Netherlands since around 1970, based on the idea of Freudenthal who said that mathematics is a human activity and its learning (especially for students) begins with problems that can be imagined by students (Lange, 1987).

The most appropriate solution, so that students' abilities in mathematical literacy can grow and develop according to student potential is the Creative Problem Solving (CPS) learning model with the PMRI approach. To support the learning of Creative Problem Solving (CPS) model with PMRI approach in improving mathematical literacy, it is necessary to utilize information and communication technology for learning. Photomath is one of the smart software that can be used as a learning media through mobile phones. The smartphone application can make all students more eager to learn, especially in doing math problems and can be done anywhere and anytime. According to Sibuea et al., (2022) Photomath is an application that can solve math problems by simply pointing the cellphone camera directly into the problem text. This application works very similar to the QR code reader application and can display the solution to math problems on the cellphone screen in seconds.

The novelty in this study is that previous studies only used creative problem solving learning models and Indonesian realistic mathematics education approaches but for this study it has a different research from the previous one, namely that it has applied photomath learning media that helps students in solving mathematics problems, especially mathematical literacy questions in terms of curiosity. In addition, the quality of learning is also important to consider in improving mathematical literacy. Learning quality is something about the learning process that can be carried out as well as possible and produce an innovation in learning. Learning quality can be measured through the preparation stage, implementation stage, and learning evaluation stage (Danielson, 2016). These stages are in line with the research of Wicaksana et al., (2017) that the quality of learning is measured by 3 stages, namely (1) the preparation stage of learning devices and research instruments that have been validated with good categories, (2) the implementation stage of teacher activities and student responses in learning with good categories, and (3) the evaluation stage that has met the criteria.

Based on the description that has been presented, the problem formulations in this study are (1) Is the Creative Problem Solving model with the PMRI approach assisted by Photomath quality in improving students' mathematical iteration? (2) Is there a significant effect on mathematical literacy?

METHODS

Contains This research is a type of quantitative research using Quasi Experimental on Pretest-Posttest Control Group Design. The population in this study were VIII grade students of SMPN 02 Kaliwedi, Cirebon Regency. The samples used in the study were students of class VIII A as the experimental class and students of class VIII C as the control class taken by simple random

sampling technique (Arikunto, 2010). The experimental class will be treated through learning with the CPS model with the PMRI approach assisted by Photomath, while the control class will be treated through learning with the Problem Based Learning model. The data collection technique in the research is using mathematical literacy test and student curiosity questionnaire. The mathematical literacy test instrument will be tested first using validity test, reliability test, difficulty test, and differential power test (Sugiyono, 2021).

The stages of data analysis in the study are through initial data analysis and final data analysis. Initial data analysis is in the form of pretest results of students' mathematical literacy with the aim of measuring the similarity of students' initial abilities in experimental and control classes. Initial data analysis includes normality test, homogeneity test, and mean similarity test. Furthermore, the final data analysis is in the form of student mathematical literacy posttest results with the aim of knowing the results of student mathematical literacy tests after being treated through learning on the CPS model with the PMRI approach assisted by Photomath with the Problem Based Learning model. The final data analysis includes prerequisite tests, namely normality test and homogeneity test, then continued with hypothesis testing, namely (1) The average mathematical literacy of students through learning in the CPS model with the PMRI approach assisted by Photomath has reached the Actual Completion Limit (BTA), (2) The proportion of mathematical literacy of students who have completed the BTA through learning in the CPS model with the PMRI approach assisted with Photomath has reached completeness classical, (3) The average mathematical literacy of students who use the CPS learning model with the PMRI approach assisted by Photomath is higher than the average mathematical literacy of students who use the Problem Based Learning model, (4) The proportion of students who complete BTA in the CPS learning model with the PMRI approach assisted by Photomath is higher than the proportion of students who complete BTA in the Problem Based Learning model, (5) The average increase in mathematical literacy of students who use the CPS learning model with the PMRI approach assisted by Photomath is higher than the average increase in mathematical literacy of students who use Problem Based Learning model, and (6) There is an influence of curiosity on the mathematical literacy of students who use the CPS learning model with the PMRI approach assisted by Photomath (Icam Sutisna, 2020).

RESULTS

CPS learning with the Photomath-assisted PMRI approach is said to be of quality in increasing mathematical literacy if at stage (1) learning planning, namely the results of validation of the CPS learning tools with the Photomath-assisted PMRI approach, is said to be valid, (2) learning implementation, namely the results of observing the implementation of CPS learning with the Photomath-assisted PMRI approach. Photomath has good criteria, and (3) learning evaluation, namely the CPS model with the PMRI approach assisted by Photomath, is said to be effective.

Measuring the quality of learning at the planning stage is carried out by testing the validity of a learning tool carried out by validators, namely Supervisors and Teachers. The validated learning tools are ATP, Teaching Module, Student Mathematical Literacy Pretest Questions, Student Mathematical Literacy Posttest Questions, LKPD, Student Curiosity Questionnaire, and Interview Sheet. The tools that have been prepared are triangle and quadrilateral material at the class VIII middle school level, even semester of the 2023/2024 academic year. In this research,

there are two models of learning tools used, namely learning tools using the CPS model with the PMRI approach assisted by Photomath and learning tools using the PBL model. The learning tools that have been created are then given to the Supervising Lecturers and Civil Service Teachers for suggestions and input, then revised and validated by the Supervising Lecturers and Civil Service Teachers. Below we will present the overall results of the validation of learning tools and research instruments by validators.

Table 1. Recapitulation Results of Validation Values of Learning Tools and Research Instruments

No.	Device Type	Score			Mean Value	Category
		Validator 1	Validator 2	Validator 3		
1	ATP (KE)	92,0	88,0	98,0	92,67	Very Good
2	ATP (KK)	88,0	86,0	94,0	89,33	Very Good
3	Teaching Module (KE)	90,0	86,25	96,25	90,83	Very Good
4	Teaching Module (KK)	86,25	85,0	91,25	87,5	Very Good
5	*Pretest*	90,0	88,57	91,42	89,99	Very Good
6	*Posttest*	90,0	91,42	98,57	93,33	Very Good
7	Interview Sheet	90,0	90,0	90,0	90,0	Very Good
8	LKPD	93,33	88,88	91,11	91,1	Very Good
9	Curiosity Questionnaire	91,67	93,75	98,3	94,57	Very Good
Mean					91,03	Very Good

Based on the results of the recapitulation of the validation scores for learning tools and research instruments, it was found that the learning tools and research instruments were categorized as very good, so that a conclusion can be drawn at the learning planning stage of quality. Measuring the quality of learning at the learning implementation stage can be measured using the Teacher Activity Observation Sheet on the quality of learning at least meeting the good category. Learning in the experimental class was carried out 6 times. The learning implementation has been adjusted to the steps stated in the Teaching Module which has been created using the CPS model with the PMRI approach assisted by Photomath. Observers will provide an assessment of the implementation of learning using LPAG. Based on the observer's assessment, a score of 96.25 can be obtained, which can be concluded that the teacher's skills in the CPS model with the PMRI approach assisted by Photomath have very good criteria. At the 6th meeting, class VIII A students were asked to provide an assessment of the implementation of learning using the Student Response Sheet. The data obtained by LRS will be analyzed using the average score of each student. The average score obtained was 79. Therefore, it can be shown that the students' response to the implementation of learning using the CPS model with the PMRI approach assisted by Photomath was overall in the good category.

Measuring the quality of learning at the learning evaluation stage can be measured using pretest and posttest. Data analysis in this stage uses initial and final data analysis. The results of the initial data analysis prove that (1) in the normality test, the experimental and control class pretest data show that the data is normally distributed, (2) in the homogeneity test, the experimental and control class pretest data show that both data are homogeneous/the same, (3) in the average similarity test, the pretest data for the experimental class and the control class showed that both data had the same average pretest value. Meanwhile, the results of the final data analysis are

divided into two, namely prerequisite tests and hypothesis tests. For the prerequisite test results in the final data analysis, namely (1) the normality test results show that the posttest scores for the experimental class and control class are normally distributed, and (2) the homogeneity test results show that the posttest scores for the experimental class and control class are homogeneous/the same. Next, to test the hypothesis in the final data analysis, namely (1) the average test of 1 sample referring to BTA shows that the results of t = 11.57 > t table = 1.721 with a significance level of 5% and dk = (n-1) = 22 – 1 = 21, such that H_0 is rejected and H_1 is accepted, which means that the average final test of students' mathematical literacy through the Creative Problem Solving model with the PMRI approach assisted by Photomath has reached an average BTA with a BTA value of 63.5; (2) the classical completion proportion test shows that the results of z count = 2.72 > z table = 0.4967 with z_(0.5-α) obtained from the standard normal distribution with probability (0.5 - α) and α=5 %, such that H_0 is rejected and H_1 is accepted. So, the proportion of students who complete learning in classes that use the Creative Problem Solving model with the PMRI approach assisted by Photomath is more than classical completion based on BTA; (3) the test of the difference between 2 means shows that the result of t = 2.617 > t table = 1.675, with t_(1-0.05) obtained from the t distribution list at dk = (n_1+n_2-2) and probability (1 - α) with α = 5%, such that H_0 is rejected. So the average mathematical literacy of students in the Creative Problem Solving model using the PMRI approach assisted by Photomath is higher than the average mathematical literacy in the Problem Based Learning model; (4) The test of the difference between 2 proportions shows that the results of z count = 3.33 > z table = 0.4996 with a significance level of α = 5%, such that H_0 is rejected and H_1 is accepted. So the proportion of completeness of the mathematical literacy test results of students taught using the Creative Problem Solving learning model with the Photomath-assisted PMRI approach is higher than the proportion of completeness of the mathematical literacy test results of students taught using the Problem Based Learning learning model; (5) The average increase test shows that the results of t = 6.296 > t table = 1.675 with t_(1-0.05) obtained from the t distribution list at dk = (n_1+n_2-2), probability (1 - α) and the significance level α = 5% then H_0 is rejected and H_1 is accepted. So, the average increase in students' mathematical literacy test results through the Creative Problem Solving model with the Photomath-assisted PMRI approach is higher than the average increase in mathematics literacy test results using the Problem Based Learning model.

In this research, hypothesis 6 is included, namely to analyze curiosity which has a significant effect on students' mathematical literacy. For hypothesis 6, use a simple linear regression test, with curiosity as variable .05, then H_0 is rejected using the regression testing criteria, namely sig value < 5% = 0.05, then H_0 is rejected, meaning that there is a linear relationship between the curiosity variable and students' mathematical literacy scores; (2) The regression significance test shows that the output results from SPSS version 20 obtained a calculated f value = 54.539 > f table = 4.531 with dk in the numerator = 1 and dk in the denominator = (22-2) with a significance level of α = 5%, so H_0 is rejected. So the regression direction coefficient means; (3) The coefficient of determination test shows that the results obtained are R Square or R^2 = 0.732 = 73.2%, meaning that this value shows that variations in the mathematical literacy variable (y) can be explained or explained by the process skills variable (x) of 73. 2%. In other words, variable x influences variable y by 73.2% and there is still 26.8% of variable y which is influenced or can be explained by variables other than student curiosity.

DISCUSSION

The observer prepared the learning process by compiling learning tools and research instruments for class VIII SMPN 02 Kaliwedi, Cirebon Regency. This assessment refers to the preparation stage according to Wijayanto & Retnaningsih (2019). All learning tools have been validated and obtained an average score of 91.03%, so they fall into the very good category. Based on the validation results on the ATP which has been developed in accordance with learning activities, namely including the CPS model learning syntax with the PMRI approach assisted by Photomath, it obtained an average score of 92.67%, so that the ATP meets the very good category. The results of the validation of the teaching module using the CPS model using the PMRI approach assisted by Photomath obtained an average score of 90.83%, so that the teaching module meets the very good category. The teaching module that has been created is a development of ATP with steps in learning activities adapted to the CPS model with the PMRI approach assisted by Photomath. The validation results for the LKPD obtained an average score of 91.1%, so that it was included in the very good category. The LKPD is in accordance with the learning material. The validation results from the pretest test questions got a score of 89.99% and the posttest test questions got a score of 93.33%, so they fall into the very good category. This trial of pretest and posttest questions aims to analyze the pretest and posttest questions on mathematical literacy, whether they meet the requirements or not in testing validity, reliability, the level of difficulty of each question, and the differentiability of each question. After the mathematical literacy questions have met the requirements, questions can be selected to be used for the pretest and posttest. The validation results of the questionnaire instrument got an average score of 94.57% and the interview guide got an average score of 90.0%. The student curiosity questionnaire is used to prove that the student has low, medium and high curiosity criteria. Next, an interview guide was used to ask questions regarding the process and results of working on mathematical literacy questions for several students sampled for interviews.

The overall quality of learning implementation in the CPS model with the PMRI approach assisted by Photomath can run well, this can be seen from the Teacher Activity Observation Sheet. Based on LPAG, it is known that the learning syntax that teachers must implement is that it fulfills all components, so that when an evaluation is carried out on the implementation of learning, it can be stated that the implementation of the learning carried out by the teacher meets the CPS model learning syntax using the PMRI approach assisted by Photomath. The results of the calculations in the LPAG have been assessed by teachers at the school when implementing the CPS model using the PMRI approach assisted by Photomath, with an average score of 96.25%, which is included in the very good criteria. When looking at the LPAG results that have been assessed by the tutors in the CPS model with the PMRI approach assisted by Photomath, the criteria are very good. Finally, students can participate in learning activities very well. In this case, in accordance with Wardono (2015) that the teacher's role in implementing learning strategies can have a positive impact on the quality of learning.

In the quality of learning evaluation, learning through the CPS model with the Photomath-assisted PMRI approach will be explained, which consists of: (1) the average mathematical literacy using the CPS model with the Photomath-assisted PMRI approach reaching the actual completion limit (BTA), (2) the proportion the mathematical literacy of students who use the CPS model with the Photomath-assisted PMRI approach exceeds classical mastery based on BTA, (3) the average mathematical literacy that uses the CPS model with the Photomath-assisted PMRI approach is

better than the average mathematical literacy that uses the Problem Based Learning model , (4) the proportion of students who completed BTA for students who used the CPS model with the PMRI approach assisted by Photomath was higher than the proportion of students who completed BTA for students who used the Problem Based Learning model, (5) the average increase in students' mathematical literacy with model learning CPS using the Photomath-assisted PMRI approach is higher than the average increase in students' mathematical literacy using the Problem Based Learning model, (6) there is a significant influence between students' curiosity on students' mathematical literacy through the CPS model using the Photomath-assisted PMRI approach (Danielson, 2016).

The quality of learning is measured quantitatively by giving an initial mathematical literacy test, a final mathematical literacy test, and a student curiosity questionnaire. This assessment includes a learning evaluation stage based on Wijayanto & Retnaningsih (2019). The initial mathematics literacy test and the final mathematics test were carried out on 2 samples, namely the experimental class which applied the CPS model with the PMRI approach assisted by Photomath and the control class which applied the Problem Based Learning model. Meanwhile, the questionnaire was only used by the experimental class which implemented the CPS model with the PMRI approach assisted by Photomath.

In a simple regression analysis between the curiosity variable and the mathematical literacy variable, there is an influence of curiosity on students' mathematical literacy, if seen from the results of the influence test that has been carried out, it is found to be 73.2%. In this case, it means that student curiosity has an influence of 73.2% on the increase or decrease in mathematical literacy and the remaining 26.8% is caused by other factors, such as learning independence, learning motivation, self-confidence, etc. Based on research according to Vintere et al., (2024) states that a child shows curiosity when the child reacts positively to his environment by exploring or manipulating new or unique things.

CONCLUSIONS

Based on the results and discussion, learning using the CPS model with the PMRI approach assisted by Photomath is of high quality and can improve students' mathematical literacy through 3 assessment stages, namely (1) learning preparation stage, including learning tools and research instruments that have been validated by experts and have met the minimum criteria. good, (2) the learning implementation stage, including the results of observations of the implementation of learning by the teacher and the results of student responses to learning that obtain minimum good criteria, (3) the learning evaluation stage includes: (a) average mathematical literacy in learning using the CPS model with the Photomath-assisted PMRI approach has reached the determined Actual Completion Limit of 63.5, (b) the proportion of students' mathematical literacy completeness in learning using the CPS model with the Photomath-assisted PMRI approach is more than classical completeness based on BTA, (c) the average literacy mathematics in learning using the CPS model with the Photomath-assisted PMRI approach is higher than the average mathematical literacy in learning with the Problem Based Learning model, (d) the proportion of students who use the CPS model using the Photomath-assisted PMRI approach is higher than the proportion completeness of mathematical literacy of students who use learning using the Problem Based Learning model, (e) the average increase in mathematical literacy of students who use the

CPS model with the PMRI approach assisted by Photomath is higher than the average increase in mathematical literacy of students who use the Problem Based Learning model, and (f) there is a significant influence of curiosity on students' mathematical literacy of 73.2%.

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