Analysis of Mathematical Problem Solving Ability Viewed by Students Learning Motivation in PBL Learning Model Hijri Calendar Textbooks-Assisted

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A R T I C L E I N F O	Abstract
	This study aims to examine classical mastery, average differences, and differences in proportions between PBL learning assisted by hijri calendar textbooks and PBL learning and describe mathematical problem-solving abilities in terms of students' learning motivation. This research is mixed method. The quantitative research samples were students of class X-8 (experimental group) and X-6 (control group) while in the qualitative research, the research subjects were taken from six students selected from the experimental group. Data collection was carried out by tests, questionnaires, interviews, and documentation. The results showed that (1) the ability to solve mathematical problems in the hijri calendar textbook-assisted PBL model achieved classical mastery, (2) the average mathematical problem-solving ability in the hijri calendar textbook-assisted PBL model was better than PBL learning, (3) the proportion of completeness of mathematical problem solving abilities in the PBL learning model assisted by hijri calendar textbooks is better than PBL learning, (4) a description of mathematical problem solving abilities in terms of students' learning motivation, namely: (a) students with high learning motivation have problem solving abilities very good, (b) students with medium learning motivation have fairly good problem-solving abilities, and (c) students with low learning motivation have poor problem-solving abilities. © 2023 Published by Mathematics Department, Universitas Negeri Semarang

1. Introduction

Mathematics is a universal science that has an important role in developing human thinking power (Mashuri, 2019). According to NCTM (2000), one of the standards of mathematical ability that must be achieved for the development of thinking power is problem-solving. One of the objectives of learning mathematics in the independent curriculum states that the mathematics subject aims to equip students to be able to solve problems which include the ability to understand problems, design mathematical models, complete models or interpret solutions obtained. Minister of National Education Regulation Number 22 of 2006 also states that one of the objectives of having a mathematics subject is for students to have the ability to solve problems which includes the ability to understand problems, design mathematical models, solve problems, and interpret the solutions obtained. Based on some of these sources, it can be seen that problem-solving abilities are important to be mastered by students. The importance of mastering students' problem-solving abilities is explained in Minister of Education and Culture Regulation Number 13 of 2022 which states that one of the strategies for achieving graduate competencies that meet the needs of the world of work is to focus on developing soft skills such as critical thinking skills, communication skills, problem-solving skills, and entrepreneurial skills.

In practice, the problem solving ability of students in Indonesia is still relatively low, this can be seen in the test results Programmer for International Student Assessment (PISA) which was released on December 3, 2019, which stated that the mathematical ability in PISA 2018 decreased when compared to PISA 2015. The PISA results stated that the average score of Indonesia's mathematical ability in 2018 reached 379, while in 2015 the average score of mathematical ability reached 386. The questions contained in PISA were problem-solving types, so the results of this PISA study also provided information that there were still many students who could not answer the problem-solving type math test material. Based on these results, it can be said that the problem-solving skills of students in Indonesia are still relatively low, and this is also the case at senior high school 1 Karanggede. Based on interviews with mathematics teachers at the school stated that students' problem-solving skills still tended to be low in solving math problems. Students only solve problems that are not far from the example questions given by the teacher so when faced with questions of a different type they will have difficulty solving them. The results of daily tests on sequences and series material from 34 class XI students showed that the number of students whose scores reached the minimum completeness criteria was 9 people, while the number of students whose scores had not yet reached the minimum completeness criteria was 25 people. Apart from the results of interviews and test results, a pandemic Covid-19 which has been going on for about two years causes students to be less motivated to learn it has an impact on difficulties in solving math problems. This lack of motivation is what students need to grow back because it will have an impact on the achievement of their learning outcomes.

Learning motivation is a driving factor for successful learning. Lack of motivation to learn mathematics can be overcome by applying a learning model that can increase student activity (Nurliastuti, et al., 2018). One learning model that provides opportunities for students to develop problem-solving skills is Problem-Based Learning (PBL). The PBL model is a learning model that is based on real problems that require authentic solutions and investigations (Trianto, 2007). The application of this PBL model can train students to have critical thinking skills and problem solving skills. Students who are given learning with the PBL model can not only understand the concept but can use it in solving real problems that exist in everyday life. The use of these problems will create more meaningful learning because it involves problems that exist in the student's environment (Amalia & Widodo, 2018). Problems in everyday life that can be developed are problems related to student culture, and this culture can be related to mathematics material. The link between culture and mathematics is referred to as ethnomathematics.

Ethnomathematics is the integration of culture in learning mathematics, namely learning with cultural nuances (Abi, 2016). An example of the application of ethnomathematics in mathematics is the application of puzzles with ethnomathematics nuances through *engklek* games contains mathematical elements such as flat shapes, nets, congruence, reflection, and counting (Suryaningsih & Munahefi, 2021). Other research related to ethnomathematics was conducted by Fitriani, et al. (2019) stated that the Javanese calendar can be applied to ethnomathematics. In this study, it was stated that mathematical concepts are found in Javanese calculations, namely modulo numbers 5 and 7 for marriage activities, and modulo numbers 4 for activities of building a house, moving, circumcision, and guaran. Some of these studies show that culture in society can be associated with mathematical material. A large number of studies on ethnomathematics encourage researchers to use the hijri calendar as a means of developing problem-solving abilities. According to Prasetyo, et al. (2016), the hijri calendar is the calendar used by Muslims, including in determining dates or months related to worship, or other important days. The hijri calendar in this study will be associated with the material of arithmetic sequences and series. The integration of the hijri calendar with mathematics needs to be compiled in the form of a textbook to make it easier for students to learn it. According to Magdalena, et al. (2020), teaching materials are a collection of teaching materials arranged systematically which represent concepts to direct students in achieving competency in learning. hijri calendar textbooks will be used in this study to develop students' problem-solving abilities and applied to the PBL model.

The formulation of the problem in this study is (1) does the mathematical problem-solving ability of students in the PBL model assisted by hijri calendar textbooks achieve classical mastery? (2) is the average mathematical problem-solving ability of students in the PBL model assisted by hijri calendar textbooks better than students in PBL learning? (3) Is the proportion of the completeness of students' mathematical problem-solving abilities in the PBL learning model assisted by hijri calendar textbooks more than students in PBL learning? and (4) How is the description of mathematical problem-solving abilities in terms of students' learning motivation in learning the PBL model assisted by hijri calendar textbooks? While this

study aims to (1) test the classical mastery of the results of students' mathematical problem-solving abilities in the PBL model assisted by hijri calendar textbooks, (2) test the average mathematical problem-solving ability of students in the PBL model assisted by hijri calendar textbooks. better than students in PBL learning, (3) testing the proportion of completeness of students' mathematical problem-solving abilities in the PBL learning model assisted by hijri calendar textbooks more than students in PBL learning, and (4) describing mathematical problem solving abilities in terms of learning motivation students in learning the PBL model assisted by hijri calendar textbook.

2. Methods

This research was a research mix method using a sequential explanatory design where in this design data collection begins with quantitative and then continues with qualitative (Creswell, 2010). The population in this study were class X students at senior high school 1 Karanggede for the 2022/2023 academic year. Quantitative research design using a true experimental design which was shaped Posttest-Only Control Design. In this design, two classes were randomly selected, namely class X-8 as the experimental class to gain learning Problem-Based Learning (PBL) with the help of hijri calendar textbooks, while class X-6 as the control class received regular PBL learning. The subjects in this study were students of class X-8. Data collection methods used are tests, motivational questionnaires, interviews, and documentation. The test method is used to collect data on students' problem-solving abilities after learning with the PBL model. The questionnaire method was used to measure students' learning motivation which was then used to group students according to their problem-solving abilities fulfilled. The interview method was carried out to strengthen in an unstructured way the test results of students' problem-solving abilities in terms of learning motivation.

3. Results & Discussions

3.1   Problem-Solving Ability of Students with PBL Model Learning Assisted with Hijri Calendar Textbooks
Problem-Based Learning (PBL) assisted by hijri calendar textbooks provides a learning process using discussion and presentation methods by raising problems in everyday life related to the hijri calendar by using the concepts of arithmetic sequences and series. The lifting of the issue of the hijri calendar is a form of applying ethnomathematics in learning as an effort to provide a new nuance for learning mathematics (Richardo, 2016). These problems were chosen using the PBL model to develop students' problem-solving abilities by way of group discussion activities. This is in line with the opinion of Akinoglu & Tandagon (2007) who states that the advantage of applying the PBL model is that it can develop students' problem-solving abilities. Another opinion was also conveyed by Cahyadi, et al. (2020), namely, ethnomathematics can improve students' mathematical problem-solving abilities in learning mathematics.

Test use Shapiro-Wilk to test the normality of the initial data using the midterm assessment value indicates that there are classes that have a significance value of less than 0.05 so it can be said that the initial data is not normally distributed. The homogeneity test using the initial data obtained a value of $Sig. = 0.984 > 0.05$ so that it can be concluded that the initial data had the same variance. The next test is the average similarity test which is carried out using a non-parametric test, namely the test Mann-Whitney U to find out if the two research classes have the same abilities. The test results obtained a value of $Sig. (2\ tailed) = 0.108 > 0.05$, so it can be concluded that the two research classes had the same abilities. After obtaining the test results, the researcher conducted research by giving treatment to the two research classes. After the final test was carried out, the final data was tested. The first test is the prerequisite test, namely the normality test which shows the significant value of the two classes, namely 0.06 and 0.10 so that the final data meets the normality assumption. The next test is the homogeneity test which obtains a significance value of $0.105 > 0.05$, so it can be concluded that the two study classes have the same variance.

The research was conducted on both research classes to know the differences in problem-solving ability. This difference in ability can be identified by carrying out classical completeness tests, average difference tests, and different proportion tests. The results of the problem solving ability test showed that 23 out of 27

students scored more than or equal to 70. Based on the results of the classical completeness test, it showed that the value of $z_{count} = 1.67 > 1.64 = z_{table}$. These results indicate that students with the PBL learning model assisted by hijri calendar textbooks achieve classical mastery, that is, have a mastery proportion of more than 70%. This classical learning mastery test shows that learning with the PBL model has a relationship with students' problem-solving abilities. The results of research conducted by Widyastuti & Airlanda (2021) show that an effective learning model for improving problem-solving abilities is PBL because it has a very large influence on problem-solving abilities which can stimulate students to be active and accustomed to solving a problem. A similar opinion was also conveyed by Siagan et al. (2019) stated that problem-solving abilities increased after learning was carried out using the PBL model. In addition to this research, classical learning mastery was also shown from the results of research conducted by Fauziyah & Kartono (2017) which stated that the average problem-solving ability test results of students whose learning process applied the PBL model achieved classical learning mastery.

The average difference test between classes treated with PBL learning assisted by textbooks of the hijri calendar and ordinary PBL shows that the value is $t_{count} = 3.7 > t_{table} = 2.01$, so it can be concluded that the average problem-solving ability test results in classes with PBL learning assisted by textbooks with the hijri calendar are better than the class with ordinary PBL learning. The two-proportion difference test shows that the proportion of problem-solving ability test results in classes using PBL model learning assisted by hijri calendar textbooks shows that the value of $z_{count} = 1.04 > z_{table} = 0.67$, so it can be concluded that the proportion of completeness is more than the proportion of mastery of problem-solving ability test results in classes with ordinary PBL learning models. These results are by research conducted by Geni & Hidayah (2017), namely learning with the PBL model with ethnomathematics nuances is effective for increasing problem solving abilities, this is shown from the test results which state that the test results have achieved mastery of classical learning and have a higher average. better than conventional learning. Another study conducted by Abdullah, et al. (2015) states that learning with the PBL model with ethnomathematics nuances is effective for increasing problem-solving skills compared to learning with ordinary PBL models. This is evidenced by the test results which show that the problem-solving abilities of students with the PBL model with ethnomathematics nuances achieve minimum completeness criteria and complete classically, and the problem-solving abilities of students with the PBL learning model with ethnomathematics nuances are better than students with the ordinary PBL model.

The development of students' problem-solving abilities with the use of this hijri calendar textbook is because students are given problems related to daily life related to the hijri calendar. The activeness of students in learning the PBL model assisted by hijri calendar textbooks also increased, this is based on the results of observations of researchers where students have enthusiasm and enthusiasm during learning. The introduction of the hijri calendar and its uniqueness in learning provides motivation and provokes students to be active through question and answer activities. Students take part in learning in an orderly and active manner to discuss in groups. Differences of opinion in each group can also be overcome by carrying out presentations in front of the class. Based on these results, learning with the PBL model assisted by hijri calendar textbooks is good enough to be applicable in developing students' problem-solving abilities.

3.2   *Description of Problem-Solving Ability given Learners' Learning Motivation in Learning the PBL Model Assisted by Hijri Calendar Textbooks.*

The description of mathematical problem-solving abilities in terms of students' learning motivation in model learning *Problem Based Learning* (PBL) assisted by hijri calendar textbooks will be discussed in this section by comparing the results of problem-solving ability tests and the results of interviews in each category of learning motivation. There are three categories of learning motivation, namely the categories of high, medium, and low learning motivation, from these categories two subjects will be selected for each category. The description of problem-solving abilities on learning motivation is based on the results of previous research. Research by Hutajulu, et al. (2019) states that learning motivation has a positive effect on students' problem-solving abilities. Another opinion was also conveyed by Nurliastuti, et al. (2018) stated that the application of PBL with ethnomathematics nuances can increase learning motivation. The description of this problem-solving ability is analyzed by taking into account the four indicators of problem-solving ability, namely identifying the elements that are known, asked, and the adequacy of the required elements, formulating problems or compiling mathematical models, applying strategies to solve various

problems (type or new problems), and explain the results according to the initial problem and use mathematics in a meaningful way.

3.2.1 Problem-solving ability in the category of high learning motivation

Students with high learning motivation can achieve overall learning motivation indicators. This is following research conducted by Nasrah & Muafiah (2020) which states that high learning motivation tends to fulfill all aspects of learning motivation. Students with high learning motivation have excellent problem-solving skills, this is proven by the fulfillment of the four indicators of problem-solving abilities. The results of the recapitulation of achievement indicators of problem-solving ability in students with high learning motivation are shown in Table 1 and Table 2.

Table 1. Results of recapitulation of problem-solving abilities on the subject T_1

Question Items	Problem-Solving Ability Indicators			
	1	2	3	4
1	V	V	V	V
2	V	V	V	V
3	V	V	V	V
4	V	V	V	V

Table 2. Results of recapitulation of problem-solving abilities on the subject T_2

Question Items	Problem-Solving Ability Indicators			
	1	2	3	4
1	V	V	V	V
2	V	V	V	V
3	V	V	V	V
4	V	V	V	V

These results conclude that students with high learning motivation can fulfill all indicators of problem-solving abilities. The indicators identify the elements that are known, asked, and the adequacy of the required elements is fulfilled from the results of tests and interviews with students which shows that students can understand the problem and can write down and mention information that is known and asked in the questions completely and correctly. Fulfillment of indicators for formulating problems or compiling mathematical models is shown from the ability of students to understand the relationship between known and asked information and can make plans or strategies in solving problems using formulas and concepts from the material of arithmetic sequences and series. Fulfillment of the indicators of applying strategies to solve various problems (a type or a new problem) is shown from the ability of students to carry out all the settlement plans and be able to carry out calculations correctly, so that correct results are also obtained. Fulfillment of the indicators explaining the results according to the initial problems and using mathematics in a meaningful way is shown from the ability of students to conclude the final results that have been obtained correctly and being able to solve problems in other ways so that students can compare the results of calculations with results obtained in other ways. This is to the research of Simatupang, et al. (2019) which states that the problem-solving abilities of students with high learning motivation can fulfill the four indicators of problem-solving ability. Hasanah & Firmansyah (2022) stated that students with high motivation have good problem solving skills. The opinion of Nisa, et al. (2020) in his research stated that students with high learning motivation have problem solving abilities that tend to be good and can fulfill the four indicators of problem-solving abilities. The fulfillment of the four indicators in students with high learning motivation is because students who have high learning motivation will always be motivated to try better and if they encounter difficulties they will continue to try. The effort made by students is realized by increasing their study time so that this will have a positive impact on the cognitive abilities of the students themselves. A similar opinion was also conveyed by Wansaga, et al. (2020) who states that there is a significant positive influence between learning motivation and students' cognitive abilities. Research

conducted by Saptono (2016) also states that students who have high learning motivation will make themselves more active and passionate about achieving learning achievements.

3.2.2   Problem-solving ability in the category of medium learning motivation

Students with moderate learning motivation have good problem-solving abilities. The ability of students to answer questions according to the indicators of problem-solving ability is in the high and medium categories, this is evidenced by the fulfillment of the four indicators of problem-solving ability. The results of the recapitulation of achievement indicators of problem-solving abilities in students with moderate learning motivation are shown in table 3 and table 4.

Table 3. Results of the recapitulation of problem-solving abilities on the subject S_1

Questions Items	Problem-Solving Ability Indicators			
	1	2	3	4
1	V	V	V	V
2	V	V	V	V
3	V	V	V	V
4	-	V	-	-

Table 4. Results of the recapitulation of problem-solving abilities on the subject S_2

Question Items	Problem-Solving Ability Indicators			
	1	2	3	4
1	V	V	V	V
2	V	V	V	V
3	V	V	V	V
4	V	V	-	-

These results are following research conducted by Fajri, et al. (2021) stated that students with moderate learning motivation can solve mathematical problems in the high and medium categories and can answer problems using indicators of problem-solving abilities. The study also stated that students' ability to answer questions using indicators of problem-solving ability was quite good, but students still experienced difficulties in solving problems and could only fulfill a few indicators of problem solving ability. The opinion of Hasanah & Firmansyah (2022) states that students with moderate motivation have high and medium problem-solving abilities, this is due to differences in achievement indicators of learning motivation and this will result in differences in fulfillment of problem-solving ability indicators. This relationship can be seen in the learning outcomes (Sudibyo, et al., 2016). The greatest learning motivation for students is found in fulfilling aspects of students' interest and attention to subjects, while the lowest learning motivation of students is found in aspects of students' responsibilities in carrying out assignments (Vani, 2016). This research proves that the fulfillment of learning motivation indicators affects the fulfillment of problem-solving ability indicators. Differences in the achievement of indicators of learning motivation in students with moderate learning motivation are found in the two indicators of learning motivation, namely the existence of encouragement and needs in learning and the presence of a conducive learning environment that allows students to learn better.

The results showed that students with moderate learning motivation tended to be able to solve questions using indicators of problem-solving ability, but in one last question, students had difficulties in applying strategies to solve problems and difficulties in explaining results according to the initial problems and using mathematics meaningfully for not being able to complete the calculation correctly. The indicators identify the elements that are known, asked, and the adequacy of the elements needed can be fulfilled properly which is shown by students who can write down and mention information that is known and asked correctly so that students can be said to be able to understand the problem well. Fulfillment of the indicators of formulating problems and compiling mathematical models is also shown by students who can choose the right solution formula and can apply the information they know and ask for the formula. The fulfillment of the first and second indicators was quite well fulfilled by the students, but in the third and fourth indicators,

the students had difficulty implementing them this happened to students when they found questions that were quite complicated and applied the two concepts of sequences and arithmetic series simultaneously. Indicators of applying strategies to solve various problems (a type or a new problem) can be fulfilled from the results of work and interviews that write down and explain the process of calculating and applying all information that is known and asked to solve problems using the correct formula and this can be done by students at problems that use only one solution concept. The indicators explain the results according to the initial problems and using mathematics meaningfully can be fulfilled properly. This is shown by students who can conclude the final results that have been obtained correctly and can solve problems in other ways. Difficulties will be felt by students if the problem requires two applications of concepts at once from arithmetic sequences and series, this is due to difficulties in doing the correct calculations that will have an impact on the inability of students to explain the results according to the initial problems and use mathematics meaningfully. These results are following the research of Fajri, et al. (2021) which states that students with medium learning motivation can choose the right solution strategy but are not careful in the calculations so they get wrong results, besides that students with medium learning motivation are unable to answer indicator questions explaining and verifying answers correctly

3.2.3 Problem-solving ability in the category of low learning motivation

Students with low learning motivation have poor problem-solving skills. This is evidenced by only fulfilling several indicators of problem-solving ability on problems that require one concept of completion, whereas on problems that require two concepts of solving simultaneously, students cannot fulfill all indicators of problem-solving ability. The results of the achievement indicator recapitulation of problem-solving ability in students with low learning motivation are shown in table 5 and table 6.

Table 5. The results of the recapitulation of problem-solving abilities on the subject R_1

Questions Items	Problem-Solving Ability Indicators			
	1	2	3	4
1	V	V	V	-
2	V	V	V	-
3	V	-	-	-
4	-	-	-	-

Table 6. The results of the recapitulation of problem-solving abilities on the subject R_2

Question Items	Problem-Solving Ability Indicators			
	1	2	3	4
1	V	V	V	V
2	V	-	-	-
3	V	-	-	-
4	-	-	-	-

These results are following the research of Fajri, et al. (2021) which states that students with low learning motivation cannot explain the results and do not re-examine the results of their answers. A similar opinion was also conveyed by Netriwati (2016) stating that students with low problem-solving abilities were unable to explain the calculation process and were unable to write down or mention ways to check the answers they had obtained. This shows that students tend not to be able to fulfill all indicators of problem-solving ability. Hasanah & Firmansyah (2022) also conveyed a similar opinion, that is students with low motivation have low problem-solving abilities and cannot meet the problem-solving ability indicators. This study also states that students cannot master the questions which has an impact on incompleteness in working on the questions this occurs because there is no desire and confidence in themselves to be able to solve the questions so students will easily give up if they encounter difficulties in working on them.

Fulfillment of indicators of problem-solving abilities in students with low learning motivation tends to be able to fulfill indicators of identifying elements that are known, asked, and the adequacy of the elements

needed, this can be seen from the results of work and interviews of students who can write down and mention information what is known and correctly asked. The indicators of formulating problems and compiling mathematical models cannot be fulfilled properly, because students are not careful in understanding the problem which results in errors in choosing formulas and their application in questions. Fulfillment of the indicators of applying strategies to solve various problems (a type or a new problem) cannot be fulfilled properly, this is because students experience difficulties in doing calculations and this results in errors in obtaining results. The similarity of abilities in students with low motivation is shown from the achievement of students who can only fulfill one indicator of problem-solving ability on problems that require one concept of completion and cannot fulfill all indicators on problems that require the application of two concepts at once. Differences in the achievement of problem-solving abilities in students with low learning motivation can be seen from the fulfillment of the indicators, some students can fulfill three indicators and some students can only fulfill one indicator of problem-solving abilities. In general, students with low learning motivation are caused because students lack the desire and desire to succeed and lack the drive and need to learn. conducive learning environment to enable students to learn better and this indicator contain a sense of comfort and pleasure in the learning atmosphere in class. This is what causes students to have different abilities in achieving problem-solving ability indicators.

4. Conclusion

Based on the results of the research and discussion that has been described, it can be concluded that (1) the mathematical problem-solving abilities of students in the PBL model assisted by hijri calendar textbooks achieve classical mastery, (2) the average mathematical problem-solving ability of students in the book assisted PBL model learning the hijri calendar is better than students in PBL learning, (3) the proportion of students' mathematical problem-solving ability mastery in the PBL learning model assisted by hijri calendar textbooks. is more than students in PBL learning, (4) the description of mathematical problem-solving abilities is reviewed from the learning motivation of students in learning the PBL model assisted by textbooks of the hijri calendar, namely: (a) students with high learning motivation tend to have very good problem-solving abilities, this is shown by fulfilling the four problem solving indicators and being able to answer all questions correctly, (b) students with medium learning motivation tend to have fairly good problem-solving abilities, this is shown from fulfilling all indicators on problems that require two solving concepts and can only fulfill two indicators on problems requiring two solving concepts, and (c) students with low learning motivation tend to have poor problem-solving skills, this is shown from the fulfillment of one indicator on a problem that requires one concept of completion and cannot meet the indicator on a problem that requires two concepts of solution.

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