

DESIGN MATHEMATICS PROBLEM SOLVING TASKS: STUDENTS RESPONSE

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Abstract

This study aims to develop problem solving problems with a practical Islamic context. The practicality of the questions can be seen from the responses that emerged from the research subject students after working on the developed questions. The question development process uses formative evaluation development steps. The practicality of the questions was obtained through the one-to-one and small group stages involving as many as 22 (twenty two) students from several major cities in Indonesia as well as analysis of student work, questionnaires and interviews. The results of data analysis indicate that practical problem solving problems in Islamic contexts have been obtained and have high validity and reliability so that the questions are feasible to use.

Keywords: Practicality; islamic context; problem solving tasks.

Abstrak

Penelitian ini bertujuan untuk mengembangkan soal pemecahan masalah dengan konteks islami yang praktis. Kepraktisan soal dilihat dari respon yang muncul dari siswa subjek penelitian setelah mengerjakan soal yang dikembangkan. Proses pengembangan soal menggunakan langkah pengembangan formative evaluation. Kepraktisan soal diperoleh melalui tahap one-to-one dan small group yang melibatkan sebanyak 22 (dua puluh dua) siswa dari beberapa kota besar di Indonesia serta analisis terhadap hasil pekerjaan siswa, angket dan wawancara. Hasil analisis data menunjukkan bahwa telah diperoleh soal pemecahan masalah konteks islami yang praktis serta memiliki validitas dan reliabilitas yang tinggi sehingga soal layak digunakan.

Kata kunci: Kepraktisan, konteks Islami, soal pemecahan masalah



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INTRODUCTION

Mathematical skills are part of the life skills that students must have, so learning activities must emphasize the achievement of these skills. Changes in perspective on learning activities must be carried out in constructing conjectures, finding and solving problems (Hendriana, Johanto, & Sumarmo, 2019). NCTM recommends standards for mathematical ability that students must have, one of which is

problem solving ability (Delima, N., 2017). Problem solving is an important part of learning mathematics (Pambudi, Budayasa, & Lukito, 2020), but the problem solving ability of students in Indonesia is still low (Asfar, 2018), (Rahayuningsih & Jayanti, 2018), (Megawati, Hartatiana, & Wardani, 2020). This can be seen from the achievements of Indonesian students in international studies such as the Program for International Student Assessment (PISA). PISA assessment

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aims to assess students' mastery of mathematical knowledge and skills which is held once every 3 years. In 2018 Indonesia remained at the bottom of the ranks. In the field of mathematics, Indonesia received a score of 379 with a ranking of 73 out of 78 PISA participants (Indicators, O. E. C. D., 2019).

The low acquisition of Indonesian students in PISA is due to the characteristics of the test questions in the form of problem solving, while students in Indonesia are less accustomed to solving problem solving problems (Hartatiana, 2014). The 2013 curriculum has emphasized the use of HOTS type questions in mathematics learning. However, the HOTS questions used still do not use contexts that come from phenomena that are close to students' lives (Wardani, 2020). This is in line with the results of observations in fifteen junior high schools spread throughout Indonesia, that most of the evaluation item tests in the mathematics learning process have not used high-level questions with context. In the learning process, most of the practice questions given are still in the form of procedural questions, this shows that students' ability to solve student problem solving needs to be improved. The process of learning mathematics needs to be linked to contextual problems that exist in society and in everyday life (Farida, Hartatiana, & Joemsittiprasert, 2019).

There are many previous studies that develop problem solving problems with various contexts. Such as questions with contexts related to local culture (Dasaprawira, 2021), questions with the context of Pancasila (Amalia, Rusdi, & Kamid, 2021), or even a lot of researchers who have developed PISA model questions. with the context of the

Covid-19 pandemic (Saputri, Turidho, Zulkardi, Darmawijoyo, & Somakim, 2020). However, there are still very few problems with solving the PISA model in a context that contains the life values of the community. These life values can provide useful information for students. Because, when students know the benefits of the questions being worked on, students are more interested in applying the questions in life (Lutfianto & Sari, 2017). Values that have benefits when applied in everyday life are Islamic values (Nihayati, 2017).

Islamic values in this case can be in the form of worship values, monotheistic values and moral values. Islamic values can also be integrated into mathematics learning ((Salafudin, 2015), (Ulpah & Novikasari, 2020)). This provides an opportunity for students to be more motivated related to behavior and good deeds that are usually done in everyday life. This is also in line with the objectives of the 2013 Curriculum, which is to prepare Indonesian people to have the ability to live as individuals and citizens of faith, productive, creative, innovative, and affective and able to contribute to the life of society, nation, state and noble civilization (Komara, 2017). Based on the background that has been previously disclosed, it is necessary to develop practical problem solving questions in an Islamic context for junior high school students.

METHOD

This research is a development research which consists of two stages, namely preliminary and prototyping with a formative evaluation flow consisting of self-evaluation, expert review, one to one, small group and field test (Nieveen & Folmer, 2013). It aims to describe the practicality of

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problem solving in an Islamic context obtained in the one to one and small group stages. At the preliminary stage, research preparation begins by determining the place and subject of research, examining the Islamic context that can be applied in question development, and reviewing some literature related to research. This research involved schools in five islands in Indonesia, namely Java, Sumatra, Nusa Tenggara, Kalimantan and Sulawesi. The selection of these five islands took into account the large number of regions in Indonesia, so that five large islands were taken and the research subjects in the one-to-one stage were selected from 5 (five) schools in five cities with two people from each city, while the research subjects were at the small group stage selected from 6 (six) schools involving 12 (twelve) students. Data obtained through questionnaires, interviews and documentation. Questionnaires and interviews were conducted after students were given problem solving questions in an Islamic context, while documentation was in the form of student work results. The data were analyzed descriptively qualitatively based on the results of students' answers and their comments on the questionnaire and conducting interviews and quantitatively through item analysis. The practicality of the questions in this study will be explored more deeply through responses of the students involved as research subjects.

RESULT AND DISCUSS

The practicality of problem solving was observed through two stages in the formative evaluation, namely the one-to-one and small group stages. In the one-to-one stage, the first prototype was tested on 10 students in

five different cities. The one-to-one process began by sending question files and interview sheets to the math teachers of each school via email. Then the teacher distributed the tasks to the selected students. At this stage, the teacher acted as a facilitator who supervises and helps students who have difficulty understanding and working on questions.

The one-to-one implementation procedure was that students were given questions that are developed consisting of 8 questions to be worked on for 60 minutes. After completed the tasks, students were given questionnaires and interview sheets consisting of questions about the questions they have worked on. Next, the teacher interviewed students to confirm the answers to the questionnaire. The one-to-one stage focused on the practicality of the questions which include clarity, ease of use, and student interest in the questions given. The results of student comments and suggestions obtained from filling out questionnaires and interviews were used to revise the first prototype. The comments and suggestions from students (s1, s2, s3, s4, s5) are summarized in Table 1.

Table 1. Student comments on the one-to-one stage

No	Comments	Subjects
1	I've never solved a problem in this context before, so it felt confused and difficult.	S1, S2, S3, S4, S5
2	These tasks provide new information and knowledge about Islamic values and hadiths.	S1, S2, S3, S4, S5
3	There are several questions whose Islamic value is less visible, such as numbers 1, 4 and 5	S1, S3, S4

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No	Comments	Subjects
4	he sentences in the questions are too long and difficult to understand, as in problems numbers 2 and 3.	S1, S2, S3, S4, S5
5	The information in questions 3 and 6 is lacking, so it cannot be answered.	S3
6	The picture in question number 6 is less supportive in answering questions	S1, S2, S3, S4, S5
7	Problem number 8 contains a lack of information	S1, S2, S3, S4, S5
8	In question number 8, the description of the increase in the number of pages is not clear and detailed	S1, S2, S5

The five students gave various responses regarding the eight problem-solving questions. Most of the student responses focused on the context of Islamic values contained in the questions as shown in Table 1. Based on comments and suggestions from students, the tasks developed were revised and it can be seen in Table 2.

Table 2. Revised decisions of tasks developed based on student comments / suggestions in the one-to-one stage

Number of Tasks	Revised Decisions
1, 2, 3, 5	The sentence will be clarified.
6, 8	Added sentences to the picture so that students pay attention to the picture.
1, 4	The context on the problem is improved by bringing out Islamic values.
8	Added information 1 juz totaling 10 pages.

Furthermore, based on the revision decision, the following questions are given before and after revision. This condition can be seen in Table 3

Table 3 Examples of questions before and after revision

No	Before	After
1	Zainab is a generous person. She always distributed food, money and clothes to the poor people around her. Zainab had a basket of grapes and dates which she would share. 1/5 of them are grapes. The average weight of the sprig of grapes is 250 grams while the average weight of dates is 100 grams. Write down the information you get from the question. Then, calculate how much fruit Zainab has.	Almsgiving is one of the pious deeds ordered by Allah SWT. Where people who give charity will get countless rewards from Allah SWT. Based on this, Zainab often distributed food to the poor around her residence. This time Zainab wanted to distribute fruits. Of the total fruit he brought, 1/5 was grapes, and the rest were dates. The average weight of a single grape is 250 grams while the average weight of a single date is 100 grams. Write down the information you get from the question. Then, calculate how much fruit Zainab has.
2	Aisyah is a student who likes to share food without expecting anything in return from others. Aisyah only hopes for a reward from Allah SWT for her kindness. One day he made a cake to be distributed to his neighbors. The cakes Aisyah makes are 60 layer cakes, 75 chocolate agar and 90 donuts which will be served on several plates. How did Aisyah distribute the cakes evenly into several plates without any cakes left?	Islam teaches us to care for each other. During the Covid19 pandemic like this, Aisyah distributed groceries to several motorcycle taxi drivers who were affected by Covid19. Aisyah provides 62 kg of sugar, 77 liters of cooking oil and 93 kg of flour which will be packed using cardboard boxes. What is the minimum number of boxes used by Aisyah to distribute the three staples in the same amount on one box? Are there any basic necessities left? Explain.

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After revising the questions as shown in table 3, the next step was to do a small group test. There was a slight difference from one-to-one. In the small group, after completing the questions, students are asked to fill out a questionnaire and interview sheets regarding each question on the Google form link. The answer from subjects (s1 until s12) about the questions are presented in Table 4.

Table 4. Students' comments on the small group stage

No	Comments	Subjects
1	Mathematical problems with Islamic stories like this are very rarely encountered at school, so it's very interesting.	S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12
2	The Islamic context is certainly very interesting because it is so close to our daily lives that it is very easy for us to practice it in our daily life.	S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12
3	Because it is rarely given in mathematics learning at school, some questions are difficult to solve.	S1, S2, S3, S5, S8, S9
4	The sentence of the question is understood, but confused when answering, especially questions that require reasons for the answer.	S1, S3, S6, S8, S11
5	The questions are too difficult because there is no information such as numbers, which makes it confusing to answer.	S1, S3, S6, S8, S9
6	There was a wrong writing of the name in question number 5, which made it confused.	S1, S3, S5, S6, S7, S8, S9, S11, S12
7	The picture in the problem is clear.	S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12
8	These questions add new insights and knowledge because this type of question is rarely found in school mathematics learning.	S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12

After analyzing the students' answers at the small group stage, it was seen that the scores showed fluctuating, while all students involved were included in the high math ability. This indicated that not all students with high mathematical abilities could solve problem solving tasks with integrated Islamic values well. This is because students with high mathematical abilities are more accustomed to working on procedural. So that, when working on prototype 2 questions, students got difficulties. Students' difficulties can be seen in Table 4.

On the questionnaire and interview sheets, students stated that the sentences of the questions were well understood, the pictures on the questions were clear, and the context of Islamic values was easy to understand. So that the reason there are some students who could not solve some questions was not due to the incorrect structure of the questions, but students admitted that the understanding of mathematical concepts was a constraint, their understanding of mathematical concepts was in low category. In addition, students rarely did math problems in the form of non-routine problem solving, which students rarely encountered in solving procedures as well as questions that were integrated with the context of Islamic values, this makes students feel more difficult. Thus, based on the results of the researcher's analysis, the students' constraints in solving the problem did not originate from the structure of the problem, it could be concluded that the problem solving problems of mathematics in an Islamic context were declared practical.

In addition, this research conducted item analysis to test the validity and reliability of the items. Item

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analysis was carried out using Microsoft Excel software. Test the validity of the items using the Karl Pearson product moment correlation, and for the reliability of the items used Cronbach-Alpha. From the results of the item analysis, it was found that the questions were valid and reliable.

Some of the student's work results can be seen in Figure 1. This question contains indicators of the ability to understand fraction and average material problems. In this indicator, students are expected to be able to write down the information obtained from the questions and solve the problems based on the information obtained from the questions.

a. Tuliskan informasi apa yang terdapat pada soal.

$x = \frac{1}{5}z$	$x = \text{Jumlah anggur}$
$y = \frac{4}{5}z$	$y = \text{Jumlah kurma}$
	$z = \text{Jumlah total}$

Berat x / buah = 250 g
 Berat y / buah = 100 g
 Dit: Berat buah keseluruhan?

b. Tuliskan penyelesaian soal di atas.

$$\begin{aligned} \text{Berat keseluruhan} &= 250x + 100y \\ &= 250\left(\frac{1}{5}z\right) + 100\left(\frac{4}{5}z\right) \\ &= 50z + 80z \\ &= 130z \text{ gram} \end{aligned}$$

Jadi, berat totalnya sama dengan 130 x jumlah total

Figure 1. Student's Correct Answers to Question Number 1

In this case, students are expected to be able to write down information about the number of dates using the concept of fractions. Students are required to apply the concept of addition and subtraction, so that they are able to write down the weight of the requested dates from the information obtained. Furthermore, to obtain the total weight of fruit owned by Zainab, students are required to make an appropriate mathematical model. In this stage students use the information and arrange it into a mathematical model

and make equations for the right one. From the equations that have been made students can apply the concept of multiplication and addition in algebraic forms. It can be seen in Figure 1 that students can correctly conclude the number of dates which are students from the number of grapes, which is 4/5 parts. Furthermore, students carefully determine the number of each fruit by multiplying the average fruit weight by the ratio of the number of fruits. Thus students have met the ability to understand the problem. As many as 85% of students can answer this question correctly.

The Islamic context that exists in this problem is giving alms in everyday life. With a context that is familiar to students, it could make students interested. This could be seen in the students' answers to the questionnaire, as many as 98% of students stated that the context used in the questions was interesting. From the results of the interviews, it was also revealed that the context used was interesting because it was close to the students' daily lives. In addition, knowledge will be meaningful for students if the learning process involves problems with a context, one of which is the context of everyday life (Bito, 2016).

On the other hand, there were still some students who were wrong in answering question number 1. This was not because the students did not understand the meaning of the problem or it was not because the students did not understand the mathematical concepts in the problem. The real reason from this situation can be seen from the solution. The students answered incorrectly because they were not careful in calculating. The student's answer can be seen in Figure 2.

Tugas MI
B. buah anggur $\frac{1}{5}$ sisanya (cuma) $\frac{9}{5}$
 $= \frac{1}{5} \times 250 \text{ gram} + \frac{9}{5} \times 100 \text{ gram}$
 $= 50 + 180 \text{ gram}$
 $= 180 \text{ gram}$

Figure 2. Student's Wrong Answers to Question Number 1

Based on the results of the interview, it was found that the mistakes made by students were caused by students not checking again after solving the questions, in problem solving theory looking back is an important stage in the problem solving process (Vakilian, 2013). In addition, the importance of utilizing old experiences to form new knowledge, in this case making analogies and linking old experiences to similar cases faced, this seems that students are not used to doing, applying concepts that have been understood to new types of problems.

Through the development of mathematical problem solving tasks in Islamic contexts can provide students with new learning experiences. Because by inserting religious values, especially in this case Islamic values, it can motivate students to carry out these Islamic values in their daily lives. (Richardo, R., 2020). In addition, problem solving tasks with interesting contexts can also increase students' motivation in solving problems.

CONCLUSSION AND SUGGEST

The questions developed met the practical criteria which were analyzed through work results, student comments, as well as questionnaires and interviews at the one to one and small

group stages. Based on questionnaires and interviews, students stated that the sentences were well understood, the pictures in the questions were clear, and the context of Islamic values was easy to understand. From the analysis of the validity of the items, it was obtained that all the questions were valid and had high reliability. The teacher can use problem solving problems in an Islamic context to develop mathematical thinking skills and to raise awareness to behave well for students.

Positive responses from students in this study can be used as the basic for next research. Questionnaires can be developed more deeply and equipped with interviews more comprehensive. Data can be enriched to draw conclusions by increase the number of subjects with integrated context

Islamic values. Other researchers can develop problems by integrating other Islamic values such as the value of aqidah, morals, muamalat, sharia in mathematics problems.

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