The quality of learning materials through mathematics realistic to improve students' mathematical communication ability in the elementary school

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Abstract. Learning mathematics aims to help students in solving daily-life problems. Therefore, students require mathematical communication ability. In fact, the mathematical communication ability of students in Indonesia is low. Mathematical communication ability can be enhanced by applying realistic mathematics in which students are engaged to be active in learning using real problems. Islamic context can be used as a real context for Acehnese student embracing Islamic culture. The learning materials incorporated with Islamic context is currently limited in mathematics learning. Thus, it is necessary to develop learning materials using realistic mathematics incorporating Islamic nuances to improve students’ communication ability. This study is the research and development, only focused on the validity and practicality of the learning materials. The participant was Grade 5 students at the integrated Islamic elementary school, in Aceh Besar, Indonesia. The products of this study were a lesson plan, a student worksheet, and a communication test. The results showed the average score of the lesson plan, worksheet and test were 3.7, 3.6, and 3.8 respectively. It means learning materials is fulfill valid criteria. The average score of the implementation process is 3.5. It means learning materials was fulfill practical criteria. The further research can use the learning materials to test their effectiveness.

1. Introduction
Mathematics is all around us however we are not aware that we are performing mathematical operations. In fact, many students are trained to perform mathematical calculations rather than mathematical thinking [1]. In solving a mathematics problem, students must have the mathematical ability [2] and to communicate ideas of mathematics clearly [3]. However, the results of the assessment by the Program for International Student Assessment (PISA), a study focused on literacy reading, mathematics, and science in 2015, showed that Indonesia was ranked 65 out of 69 the participating countries. Mathematical communication is needed in solving PISA problems as a realistic problem [4]. Therefore, the teacher needs to design learning materials that links mathematics with real problems to improve student communication, one of which is by applying a Realistic Mathematics Education (RME) approach.

Freudenthal as a founder of RME said mathematics is a human activity in solving problems that are close to students’ experiences [5]. Realistic in RME is about something real in the students’ mind, it was not just about real word problems but also about the fantasy problems or formal problems as lons
as common sense for students [6,7]. It is necessary to study mathematics about students' culture, especially the students in the province of Aceh.

As stated in Qanun no 18 of 2001 that the province of Aceh should conduct education by incorporating the Acehnese peculiarities and following the Islamic Shari'a. One of the solutions is by developing realistic mathematics learning materials that include Islamic values, a mathematics learning based on the contextual of Islamic values derived from Al-Quran and Hadith. In fact, realistic Islamic mathematics learning materials are not yet available. The implementation of Islamic nuances education in Aceh has not been implemented optimally, the integration of Islam is still limited to certain Islamic principles such as separating the seats between male and female students, praying and reciting the Qur'an before commencing lessons and giving advice [8].

Therefore, the development of mathematics learning materials using a realistic mathematical approach that is in line with the Islamic values needs to be done. The research question of this study is "how is the process and result of the development of valid and practical learning materials of Realistic mathematics with Islamic nuances to improve mathematical communication ability of students in the Elementary School?"

2. Method

This research can be categorized as one type of research and development. Research and development is the research producing products. The products are the learning materials. The subjects of the study were Grade 5 students of Islamic integrated primary school in Aceh Besar, Indonesia. Development procedures following the design of [9], namely: a preliminary Investigation Stage, Prototyping Stage, and Assessment Stage.

Stages of development of learning are as follows:

- Preliminary Investigation Stage. This stage aims to obtain data about school curriculum, learning materials and learning resources, learning materials that were used, and the situation.
- Prototyping Stage. At this stage, the learning device is designed with an Islamic realistic mathematical approach by optimizing student activeness. Activities at this stage include the design of the lesson plan, the student worksheet, and the test. The design result is called prototype 1. The expert will assess prototype 1 at the assessment stage. The next stage is (1) validating and (2) practicing.
- Assessment Stage. The Quality of learning materials is based on the [10] criterion, which is valid and practical. Validity can be seen from the data based on the expert assessment and recommendations. Realistic mathematical learning materials in Islamic nuances on the lesson regarding speed is said to be valid if the average value of learning materials validity should at least be 3. Practicality is assessed by some practitioners. The data can be obtained by finding the average score of teacher's practical questionnaire and the percentage of the tool's implementation. The steps are adopted from [11], learning materials are said to be practical if at least the criteria for the implementation of learning materials and the practicality test of teachers obtained are 3. If the score is less than the specified criteria, they must be re-tested.

3. Result and discussion

The development of this learning materials follows the development model described in the previous section, which follows the steps (1) preliminary stage, (2) prototype stage, (3) assessment stage. The development results of each stage are as follows:

3.1 The result of Preliminary stage

The results of the preliminary investigation are as follows:

- A realistic approach can be used to seek out Islamic societies because of mathematical learning with a realistic approach giving students the opportunity to be actively involved physically and mentally in constructing knowledge linked to the students' real-life experiences.
• Supporting theories of learning are a constructivist theory, discovery learning theory, Piaget learning theory, and Vygotsky theory.
• Theories about Islamic values such as respecting the opinions of friends when expressing views, responsibilities, discipline, and honest.
• Islamic values derived from Al-Qur'an and Al-Hadith related to the topic of Speed such as Surah Al-Isra 'Verse 1 "Isra' Mi'raj" events about the speed of light experienced by the Prophet as a miracle and the nature of the obligatory and impossible for God.
• The preliminary condition of Grade 5 at the integrated Islamic elementary school, Aceh Besar, Indonesia as a field test has been studied in a group, but students were not used to learning mathematics with the realistic approach. The classroom setting school involved supports the realistic approach as the class consisted of 20-25 students. The Topic of speed, distance and time were taught in Grade 5 Elementry School, and usually, teachers found difficulties to teach this topic to the students. Accordingly, a preliminary idea was obtained to develop a mathematics learning tool that can increase student learning interest, that was developed by incorporating problems close to the daily life of students and inserting Islamic values.

3.2 The result of Prototyping Stage
At this stage, realistic mathematics learning materials of Islamic nuances was designed. The results obtained were designing the characteristics of realistic mathematics learning of Islamic nuances: (1) starting the learning the contextual problems in accordance with Islamic religious values, (2) giving the students an opportunity to model the problem informally with the strategies they understand, (3) Conducting the learning in groups to develop interactions among learners, (4) linking the subject matter with other materials as a unity.

While the learning materials developed were (a) Lesson Plan, (b) Student Worksheet and (c) Test. one of which is presented in Figure 1:

![Student Worksheet](image)

**Activity 1**
Read and observe the hadith about the good of the Friday prayers below!
From Abu Huraira, Prophet Mohammed sallallaahu'alaihi wasallam said "If come Friday, then the angels stand at the doors of the mosque, then they write the people who come early as early. People who come early are assumed to sacrifice a camel. the one who comes after it is supposed to be the one who sacrificed a cow. and who afterwards sacrificed a goat. after that like sacrifice a chicken. then after that like the person who sacrificed the egg. Then, after the priest ascended to the pulpit, the angels closed their charity logbook and sat listening to the lecture." (Ahmad in Musnad No. 10164)

**Figure 1.** The Student Worksheet of Islamic Realistic Math Learning Materials.
Figure 1 is the result of the student worksheet design. The content was adapted from the hadith of the virtue of the Friday prayer and complete with pictures to make it easier for students to understand the text. The indicator to be achieved is the ability of students to understand the reading in the picture. Then, students can write more abstract mathematical symbols.

3.3 The result of Assessment Stage

3.3.1 Validation Results
In this step, experts validated prototype 1. Prototype 1 was assessed by four experts, including of two lecturers who taught mathematics education and two mathematics teachers of Grade 5. The result of the analysis is presented in Table 1.

| Component | Result analysis | Before Revision | Decision | After Revision |
|-----------|----------------|----------------|----------|----------------|
| Lesson Plan | Average is 3.7 | The learning objectives in lesson plan 3 Learners cannot solve the problem relating to the distance | Can be used with minor revision | The learning objectives in LIP 3 Learners can solve the problem relating to the units of distance (hm, dam, and dm) |
| Students worksheet | Average is 3.6 | Students worksheet 3 activity 2 Hints about the question no 2 in the filling table is less clear. | Can be used with minor revision | Students worksheet 3 activity 2 Hints about the question no 2 in the table filling become: Table 1: Fill in the following table according to the note. Table 2: Fill in the following table by adding 2 lengths according to table 1 Table 3: Fill in the following table by subtracting 2 lengths based on with Table 1. |
| Test | Average is 3.8 | Figure in figure 1 is too small | Can be used with minor revision | Figure in figure 1 was enlarged |

The table above shows that prototype 1 can be used with minor revision. One of the revisions made to the student worksheet. The preparation of student worksheet must meet various requirements, including the didactic requirements, construction requirements and technical requirements [12]. Therefore, based on the suggestion of the expert, the student worksheet 3 was revised. Revisions are made related to the instruction of the sentence in the table in the student worksheet 3, and this was conducted so that students can easily understand the instruction of the activities. The result of the revision of prototype 1 is called prototype 2. Prototype 2 will be tested for its practicality.

3.4 Results of practicality
The practical test is done by small group and field test. Small group test was administered on five students at the integrated Islamic elementary school. Based on the results of small group test, the following information is obtained.

- Many students asked questions on the student worksheet 3 activity 1 no 2 that is "Change the meter in 300.00.000 m as you know!". The command sentence is refined to "change the unit meter at 300,000,000 m according to the other distance unit (minimum 2)!
- The figure in the student worksheet 1 number 4 and the table at the activity 2 number 3 was too small. The revision was made with the figure and table enlarged.

From a small group test, we can conclude that prototype 2 did not change much, only a few revisions were made to improve the language in students worksheet 3. Using simple and short sentences, it will make it easier for learners to capture what is hinted in student worksheet [12]. Prototype 2 that has been validated and tested for the legibility then revised following the advice of the expert and the results of a limited test. The result of the revision of prototype 2 is called prototype 3.

The prototype 3 was then tested on a field test. The test was held on 9-13 April 2018 in Grade 5 at the integrated Islamic elementary school, Aceh Besar. The test was conducted to obtain data about the implementation of learning.

### Table 2. Observation results of learning materials implementation.

| Learning Class       | Observer 1 | Observer 2 |
|----------------------|------------|------------|
| Learning on the first day | 3.4        | 3.4        |
| Learning on the second day | 3.6        | 3.7        |
| Learning on the third day | 3.8        | 3.8        |
| Learning on the Fourth   | 3.8        | 3.7        |
| Learning on the fifth    | 4          | 4          |

Table 2 shows that observers assessed the implementation of learning materials is running well. In the first teaching and learning process, the observer gave a rating of 3.4. This result was relatively lower than the next day. According to observers, on the first day, the teacher had not mastered the class, so that the teacher-centered learning was dominant. Teachers gave many explanations about the hadiths contained. The impact was short learning time. On the second day, the average score observer 1 rated 3.6 and observer 2 rated 3.7 indicating that the learning process is better.

### 4. Conclusion

Realistic mathematical learning materials with Islamic nuances can be used to improve students' mathematical communication skills in the elementary schools. This is based on the learning process development process mentioned earlier, obtained by valid learning materials with the average of the validity of the lesson plan, students worksheet and test are of 3.7; 3.6; and 3.8. These learning materials are also practical; it can be seen from the implementation of learning with the average of 3.5 meaning that the implementation of learning in the good category. It is expected that these learning materials can be developed not only on the topics of measurement, distance, time and speed only but also on other topics and their effectiveness can also be tested.

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