Pre-Service Mathematics Teachers’ Perception on Realistic Mathematics Education

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Abstract. Realistic Mathematics Education (RME) has a long story of application around the world. Experts believe that it is a prominent approach in teaching and learning mathematics. However, there is a need to analyse whether it is still suitable to use in the classroom teaching in preparing students to survive in the 21st century era. Therefore, the aim of this study is to describe pre-service mathematics teachers’ perception about RME. This study is a descriptive research using survey method. The data were collected through questionnaire. The collected data was analysed by using percentage technique. The result shows that there is positive perception of pre-service mathematics teachers in this study towards the use of RME in classroom teaching.

1. Introduction
For a long time period, teaching mathematics realistically has become a trending topic of discussion among educational experts. The initial idea of what we call now Realistic Mathematics Education (RME) come from Hans Freudenthal, a Dutch mathematician, and his colleague in 1970s. From RME point of view, mathematics is seen as a human activity which mean that it should be close to the real life context, has connection with students’ experience and relevant to community. Within RME approach students are supported in discovering some novel mathematical phenomenon through the activity of mathematization. This is in accordance with the basic characteristic and principles of RME. RME approach has five characteristics, namely the use of context, the use of models, the use of students’ own construction and production, interactivity, and intertwinement. In addition, RME has three core principles proposed by Freudenthal that are guided reinvention and progressive mathematization, didactical phenomenology, and self-developed models.

Guided reinvention and progressive mathematization will allow students to make sense of the mathematical concept they gain during the learning process since they are facilitated to use their own production and have a reflective discussion together with the other students. Through mathematizing, which mean the activity of organizing subject matter to make it more mathematical, students experience being a mathematician hence the concept they reinvented will more settle in their minds. Through this activity they can elaborate their initial knowledge and teacher can bridge it to the formal mathematics concept. Furthermore, in term of didactical phenomenology, Freudenthal stated that it will help teacher to know about students' starting point before they involving in a mathematics
lesson\textsuperscript{[11]}. This imply that teachers should take students' initial knowledge into account in designing a lesson in order to help students to shift smoothly from their existing knowledge to the new concept that they will achieve\textsuperscript{[12]}. Moreover, students are encouraged to use model that emerge during the learning processes. The use of models is beneficial in connecting between the informal situation, mathematics context and a formal concept of mathematics that is the intended goal of the lesson\textsuperscript{[13]}. Furthermore, some evidence of the advantages of using RME approach in the mathematics learning can be summarize in the following. To begin with, RME approach can increase students' achievement and their attitudes towards mathematics\textsuperscript{[14]}. RME approach also facilitate students to develop their creative and critical thinking. For example, the principle of activity that considers the need to rediscover a mathematical concept. This principle requires students to learn mathematics through experiencing by themselves\textsuperscript{[15], [16]}. Moreover, RME approach also support students in developing their mathematical communication skills. The mathematical communication skills of students can be measured through the ability of students to model problems in the form of pictures and diagrams, in making mathematical models or mathematical symbols, in problem solving process, and in explaining ideas, situations, and mathematical relations, in writing, with real objects, pictures, graphs, and algebra\textsuperscript{[17]}. Based on the above explanation, it is important for mathematics teachers to master the basic principles and characteristic of RME approach along with the skill on implementing it in the classroom\textsuperscript{[18]}. It is also important to prepare it for the pre-service mathematics teacher who still study in the college. In addition, in the preparation process the perception of the pre-service teachers towards RME approach should also consider by the lecturer. This is important as the identification of the lecturer in improving learning design of the related course in the teacher education program especially in mathematics education study program. Therefore, this study aimed to describe the preservice mathematics perception on RME.

2. Method
The present study is a descriptive research. The data collected through an online questionnaire. The participants of this study are 36 students of mathematics education study program in Universitas Negeri Padang who took Mathematics Instruction Strategy Course in the academic year of 2019/2020. Then, the collected data was analyzed by using percentage technique.

3. Result and discussion
This part consists the description of data collected through the questionnaire on this study. The authors present it in three major points as the following. The points will tell us about the participants respond on whether they ever heard about RME before taking the Mathematics Instruction Strategy along with the sources, their perception on basic understanding of RME, their perception on what level of education is suitable for using RME approach and their prediction of what kind of obstacles that they will deal with when implement RME approach in the classroom teaching later on.

3.1. Source for getting information about RME
The first statement given to the participants was about whether they already knew the term RME before taking the course of Mathematics instruction strategy. The aim of the author is to find out whether the term RME is familiar or not among the participants of this study who will become mathematics teachers later on. Further, for the participants who answer “Yes” on the first statement, they should tell about the source of information from whom or from what media they got information about the term RME before the course. The results are presented in Figure 1 and Figure 2 as the following.
Based on Figure 1, the proportion of the participants who answer “Yes” is 56%. This implies that RME term is quite familiar for about a half of the participants. Furthermore, it is interesting to see that there are various sources used by the participants in getting information about RME approach (Figure 2). The highest percentage is information from articles followed by online web sources and from books which are 39%, 29% and 18% respectively. These results suggest that most of the participants of this study obtained information about RME by reading through these sources themselves. This shows that they have a good literacy awareness.

3.2. Basic understanding on RME
In this part the authors tend to get information on participants’ understanding of RME approach after they followed the course (Figure 3).

Based on Figure 3, it can be seen that all of the participants give positive responses to the statement about their understanding on philosophy and characteristic of RME approach. This is important for the participants as they will become mathematics teachers who will apply the RME approach in teaching. Further, after they responded to the above statement, the authors wanted to know the participants' opinions about RME and its effect on students' higher order thinking skills (HOTS) and meaningful learning as can be seen in Figure 4 and Figure 5.

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Figure 1. Participants’ responses on whether they ever heard about RME before the course
Figure 2. Sources in getting information about RME

Figure 3. Participants’ responses on their understanding about philosophy and characteristic of RME

Figure 4. Participants’ responses on whether RME can support students in developing their higher order thinking skill
Figure 5. Participants’ responses on whether RME approach will help teacher in designing meaningful learning
Based on Figure 4 and 5, all participants give positive agreement to the statements. The author also asked the reasons for their response. In term of students’ higher order thinking skills most of the participants stated that RME can support students in developing HOTS because in learning the teacher provides flexibility for students to explore the given context and generate models that can be used in rediscovering the mathematical concepts being studied. Then, in term of meaningful learning participants said that the use of real-world contexts as a starting point in learning could make the learning more meaningful for students. In addition, in the RME approach the focus of the learning is the students and it involves problem-solving processes that range from informal mathematics to more formal mathematics.

Furthermore, participants were asked to respond to the statement that the RME approach is suitable to be applied in mathematics learning in order to prepare students for the 4.0 industrial revolution (IR 4.0). The result is shown in Figure 6 below.

![Figure 6. Participants’ responses on whether RME approach is suitable to be implemented in mathematics classroom in order to prepare students to deal with Industrial revolution 4.0](image-url)

From Figure 6 we can see that most of the participants, about 95% in total, expressed positive agreement towards the statement. Several reasons were put forward by the participants regarding their responses. Most of those who answered agree and strongly agree, the reason is that through the RME approach students are guided to develop creative and critical thinking skills together with problem-solving skills which are life skills needed in the era of the IR 4.0. These skills are needed to survive in the era of IR 4.0, where a major role in the aspect of life is the use of artificial intelligence and smart robot technology [19]–[21]. Whereas, those who responded disagree, their reasons are because the IR 4.0 main characteristics are the integration of cyber technology and also the use of the internet network, so according to them it was not suitable with the RME characteristic which made the real situation as a context for learning. In fact, that is not entirely true. The fact is that the real-world context referred to in RME is not limited to real objects around students. Expert says that the intended "reality" can also be something real and imaginable in students' minds [11].

3.3. Implementation of RME and potential obstacles on its implementation

In this section, participants were asked to provide their opinion on which level of education is suitable for implementing the RME approach. They can choose more than one. The results at this point are presented in Figure 7 below.

The bar chart in Figure 7 shows that all levels of education are considered suitable for implementing RME in mathematics learning. The primary school level was chosen by 33 out of 36 participants followed by junior and senior high school levels (31) and higher education levels (29). This result shows participants point of views that RME approach can be used from elementary school until higher level of education. This in line with several researches conducted by experts on implementing RME in various level of education [22]–[28].
The last part of the questionnaire in this study asked about the opinions of participants about the possible obstacles faced by the teacher in implementing mathematics learning using the RME approach. Five predictions were given in the questionnaire and the participants can choose more than one or add more predictions. The result was summarized in Figure 8.

From Figure 8, it clearly seen that the top three possible obstacles to be faced are described in the following. The first is related to the limitation of teachers' ability in designing a powerful context that will be used in learning. The second is related to the limitation of time allocation when implementing RME in class. And the third is the limited availability of instructional media that can support the success of RME based learning.

Considering the above description, it is important for teachers to be prepared in anticipation of those potential obstacles by equipping them as early as possible. This is in line with the expert opinion which states that before implementing RME, teachers need to be prepared in advance [18].

4. Conclusion
To sum up, the result shows that there is positive perception of pre-service mathematics teachers in this study towards the use of RME in classroom teaching. Majority of the participants agree that RME approach can help students in developing their HOTS and prepare them in dealing with IR 4.0. In addition, it is also summarized from this study that some of the possible difficulties that may arise in
using the RME approach are the difficulty in designing a strong context and also the limited time and media for implementing the learning.

Furthermore, the next study required is about how to prepare the pre-service teachers in conducting lesson by using RME approach. This is important so that later on they can use it in the real classroom teaching.

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