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The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

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## Neni Mariana

as a Keynote Speaker

in the 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools (SAMSES) 2020. Universitas Pendidikan Indonesia, 8 October 2020.

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The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

## Book of Abstracts

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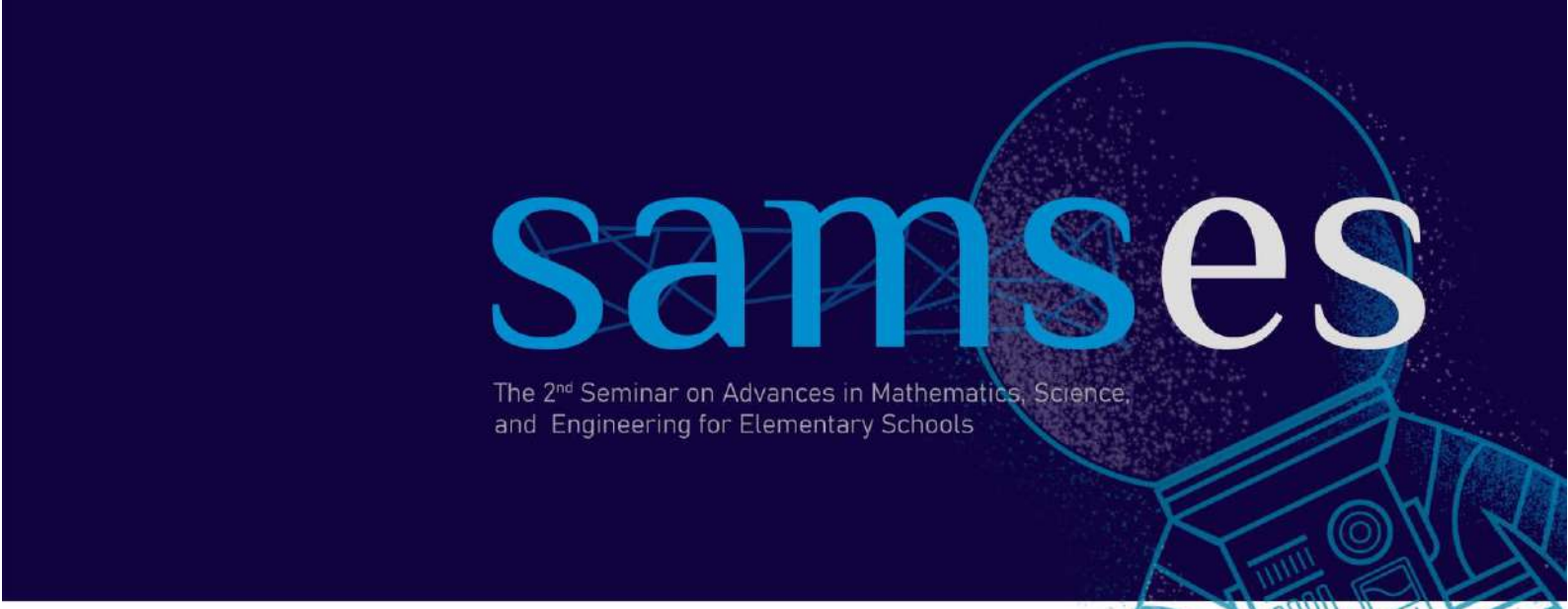


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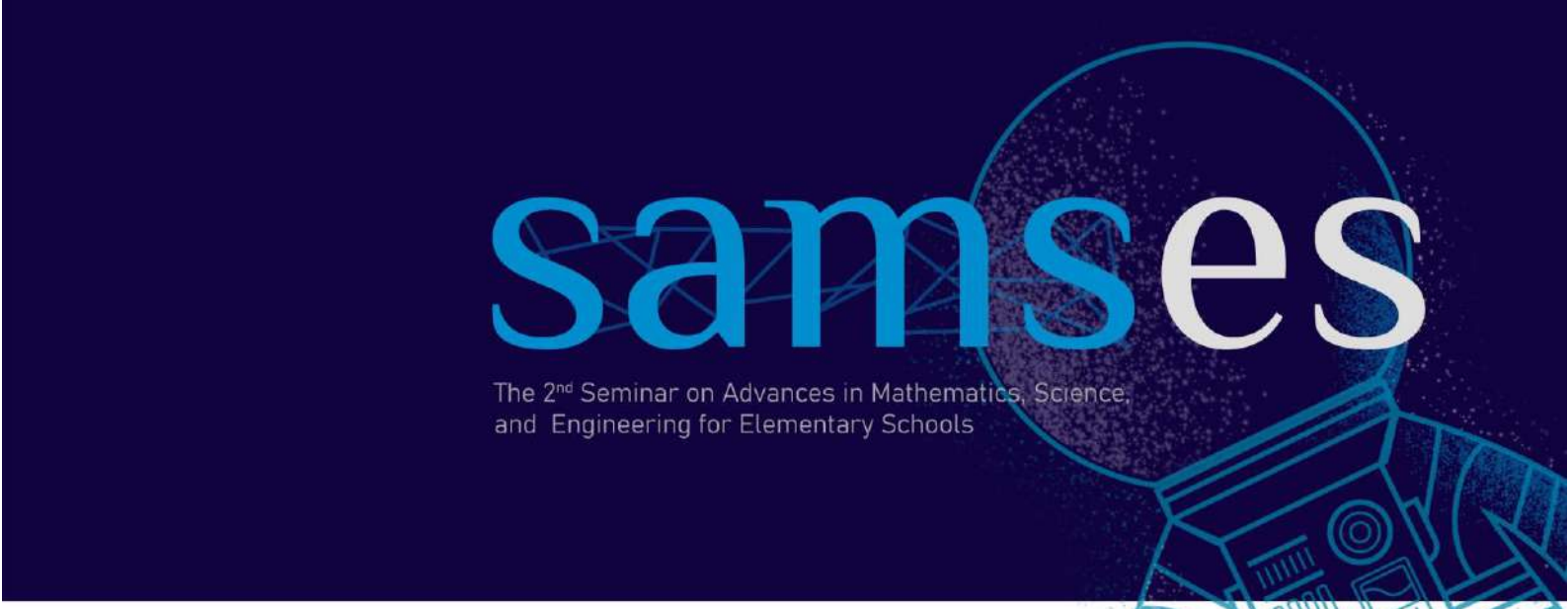


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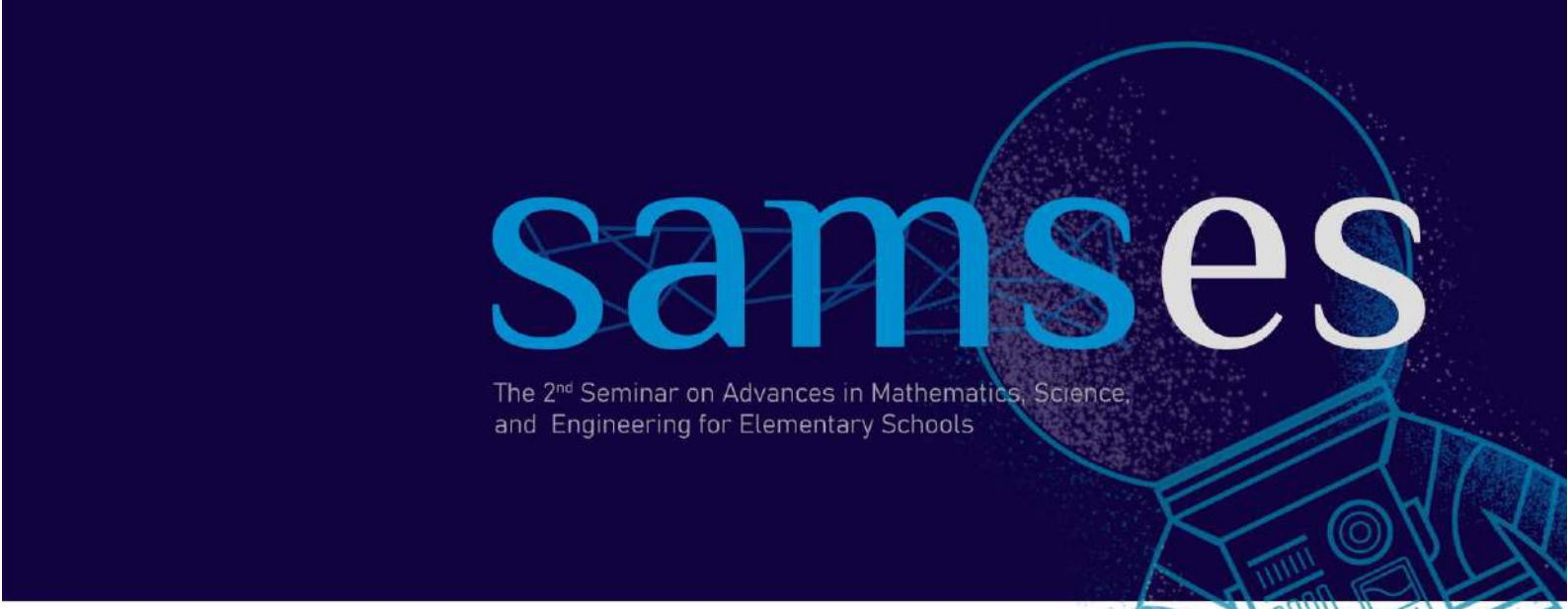


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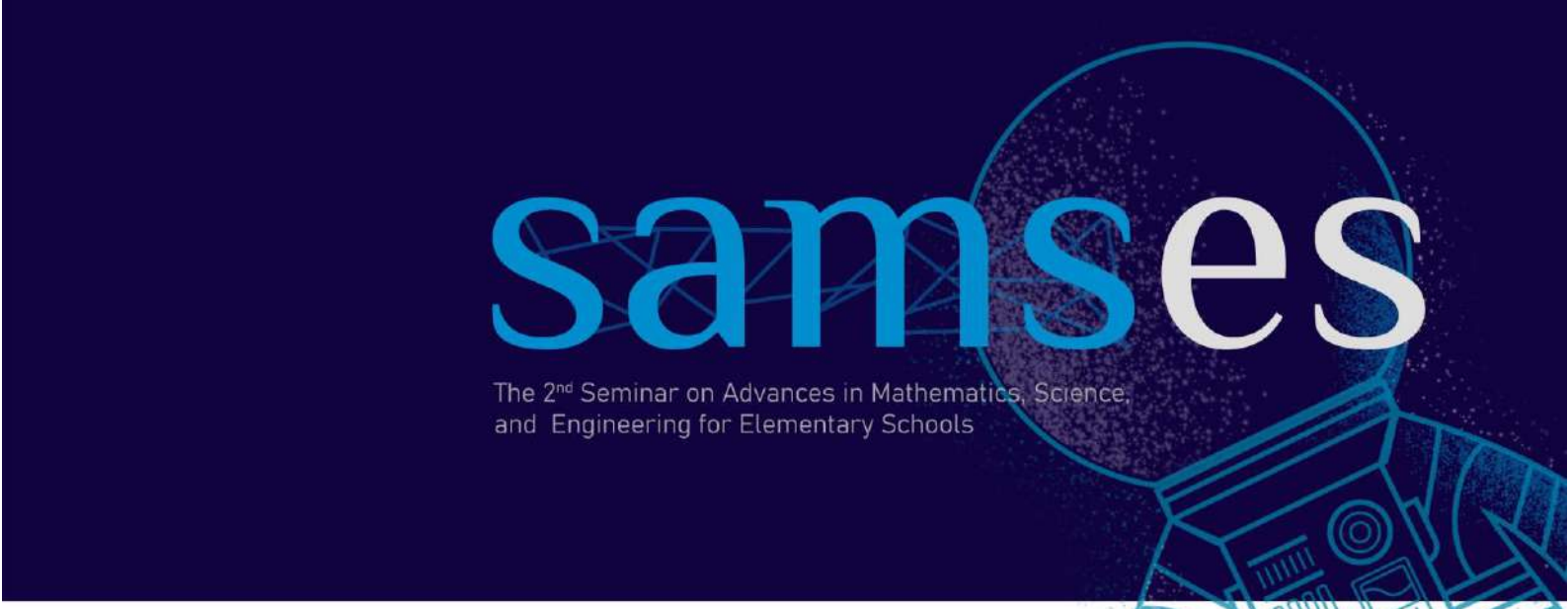


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**Information:**
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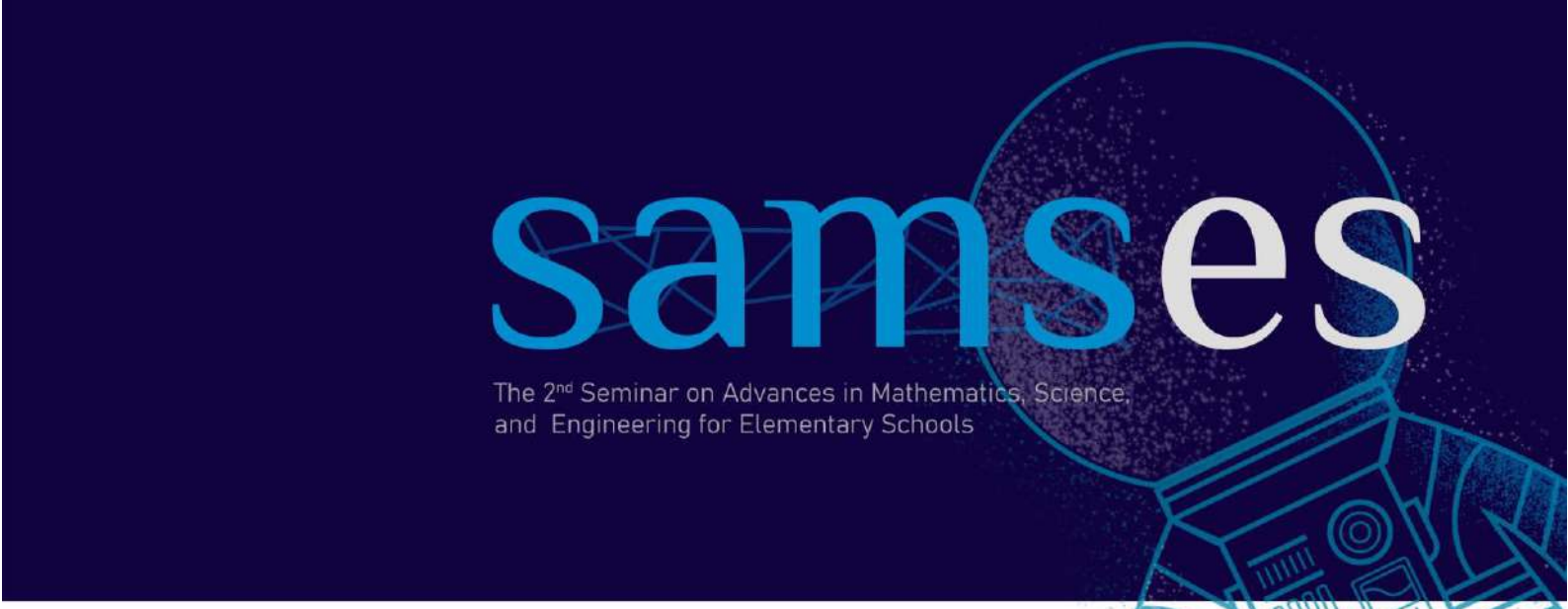


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# In-service teachers' perception on implementing realistic mathematics education approach in their best practices

# In-service teachers' perception on implementing realistic mathematics education approach in their best practices

**N Mariana[1,*], S A Sholihah[1], R Riski[2], I Rahmawati[1], W Wiryanto[1], D Indrawati[1] and B Budiyono[1]**

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**Abstract**. This paper aims to portray elementary teachers' perception of implementing the Realistic Mathematics Education (RME) approach in their best practice after training in a series of RME workshops. The perceptions captured in the study include (1) teachers' confidence in understanding RME and its implementation in their best practices; (2) RME criteria, which teachers found most challenging during the planning and the implementation. The subject of this study is 296 elementary teachers who have attended the training. The workshop series provided RME materials, simulation during the workshop, implementation in teachers' best practices, and the workshop to discuss their experience. There are two findings in this study. Firstly, most teachers have a better understanding of RME characteristics. However, most teacher believe that the RME approach can be applied most mathematical topics. They felt confident in implementing the RME approach in their best practices. Secondly, teachers found that the most challenging when planned the RME lesson was finding suitable media related to mathematics topics. Moreover, during the implementation, teachers found it most challenging to lead students to formal mathematics. These results suggest that the most impactful workshop is better, followed by best practices and participants' reflection afterward.

## 1. Introduction

One of the mathematics education problems in Indonesia is the teachers use conventional learning such as explaining and solving mathematics problems based on the previously given formula, while students simply copy their teacher's solution and strategy and remain passive [1]. Teachers need to increase knowledge competencies to teach mathematics learning especially in primary school. If teachers cannot be able to develop the initial mathematics ability of students in primary school level, that will affect students' daily life and career in the future [2]. Therefore, mathematics teachers in elementary school need to bring contextual learning in the class with an approach such as Realistic Mathematics Education (RME).

RME initially comes from the Netherlands and a Freudenthal's fundamental idea to theorize "mathematics as a human activity" [3]. Realistic Mathematics Education (RME) is an approach in teaching children mathematics, in which the teacher designs series of mathematical activities as an educational task [4]. Within the task, the teacher sets learning goals including mathematical goals and social norm goals. Treffers [5] mentions that the goals set base on pedagogical theories and are written in detail mathematics instructions. In the classroom, the principles of RME are that students should be active to revitalize mathematical concept and the learning process must be interactive.

According to Treffers [6], there are three principles of RME which are guided reinvention and progressive mathematizing, didactical phenomenology, and self-developed models. Guided reinvention comes from the philosophy of the emergence of mathematics concepts developed gradually. Freudenthal believed that by nature mathematics is progressively rediscovery [7]. Then, mathematics in the classroom can be moved progressively too, from informal students' knowledge to formal mathematics. Phenomenon surrounding the children as contextual mathematics problems can be explored during the lesson. It is called didactical phenomenology. After the phenomenology exploration, children need to develop model of the situation to the model for solving the problem shown as self-developed models. In order to implement these three principles of RME, the role of teachers is essential to guide students throughout the learning process in each principle.

The process of guided reinvention and progressive mathematizing in the classroom lead by the teacher by posing guiding questions. As a consequence, the teacher should be able to arrange questions during planning the lesson to help students finding the concept. Moreover, during the lesson the teacher can ask the guided questions to help them finding the correct answer without blaming even though students' answers are out of the teacher's expectation. In short, the teacher should be able to refrain from giving the correct answers directly to lead students to move to formal mathematics.

Meanwhile, the didactical phenomenology requires teachers to find relevant contextual situation suitable for children. By the contextual situation, they create contextual mathematical problem to start the learning. Then, teachers need to think about mathematical modelling and design a continues series of mathematics activities. To help students move from *model of* to *model for* [8], teachers determine suitable media for the series of activities. Gravemeijer [9] called this as the emergent models which may foster the movement from informal to formal mathematics.

The roles of teachers in implementing three principles of RME needs to train in the series of workshop. Since RME has been adopted in Indonesia in 2001 and now it has been two decades of its dissemination [10], many workshops for Indonesian teachers have been done. Many research has been conducted as well to examine how far Indonesian teachers' ability in the implementation. A study conducted by Yilmaz [11] examines the competencies of prospective elementary teachers in posing contextual problems with open-ended questions suitable to RME. Another attempt of study on preservice teachers shows that a model of Campus-School (CS) in which teacher students get trained of RME approach on campus and implement it at school enabled teacher students to enhance their pedagogical ability in mathematics teaching. Moreover, there was a study on in-service teachers' ability in using social norms within RME approach after series of workshops [12]. However, there is no study yet examining in-service teachers' perception of RME and portraying their understanding and struggles in implementing RME after series of workshops.

Therefore, in general, this paper aims to elementary teachers' perception of implementing the Realistic Mathematics Education (RME) approach in their best practice after training in a series of RME workshops. The perceptions captured in the study (1) include teacher's confidence in understanding RME and its implementation in their best practices; and (2) RME criteria which teachers found most challenging during the planning and the implementation. The workshop series provided RME materials, simulation during the workshop, teachers implementing in their best practice, and the workshop to discuss their experiences.

## 2. Methods

We conducted a series of workshops for Surabaya elementary teachers. The workshops were held in respective three weeks. One-week workshop provided examples of RME implementation. We let the participants designed and implemented the lessons with RME approach in the second week. Then, we met again in the third week to discuss their best practices and conducted a reflective survey. We randomly selected one teacher as the workshop participants to be the sample of this study. The subject of this study was 296 elementary school teachers attending the workshop series and following the implementation of RME in their best practices.

On the last day of the workshops, we distributed a questionnaire through a Google Form link to gather the survey data. Two sets of questions were respectively created to excavate teachers' confidents in understanding concepts of RME and its implementation in their best practices and to perform teachers' most challenging criteria of RME during the lesson planning and its implementation. The first set of questions are: (1) which statements below are you understand as the characteristics of RME? (2) How confident are you in implementing all RME characteristics during the best practices?, (3) Do you think all mathematical concepts can be taught using an RME approach?, (4) Is the RME approach suitable for thematic curriculum in elementary school?. The first question requires multiple answers, with all answers provided right. Meanwhile other questions in this first set require only one answer. The second set of questions are: (1) During your lesson planning, which parts of RME criteria you found challenging to accommodate? and (2) During the implementation, which RME criteria you face difficult to capture in your lesson?

The data was presented using graphs and diagrams. Then, we qualitatively analyzed the data by interpreting it descriptively to discuss the coherency of the findings with existing theories and other previous research. We described the data based on the following topics regarding the aims of the research:

- Teachers' confidence in understanding RME and its implementation in their best practices, and
- RME criteria which teachers found most challenging during the planning and the implementation.

## 3. Results and discussion

### *3.1. Teachers' confidence in understanding RME and its implementation in their best practices*

As mentioned in the method section, in order to excavate teachers' confidents in understanding RME and its implementation in their best practices we posted multiple answers with all provided right answers. The finding shows only 120 of 296 participants responded to all right answers and others leave some unchosen. It means that less than a half of teacher participants have a better understanding on RME concepts.

Whilst asking how confident they are in implementing all characteristics of RME in their best practices, we used Likert scale from 1 to 4 to represent respectively the mostly unsure to mostly sure of the confident. The results were captured in the following bar chart.

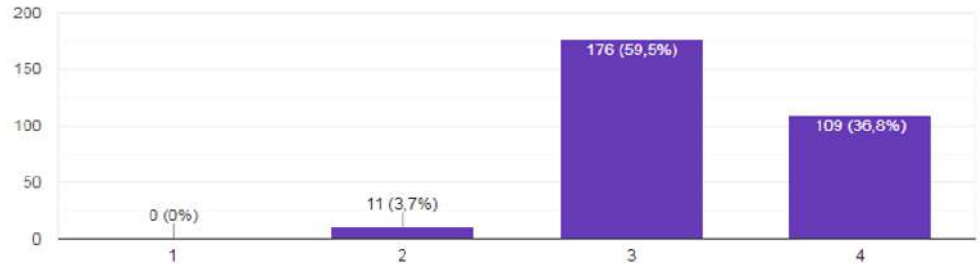


**Figure 1.** Teachers' confidence to implement RME.

The bar chart from Figure 1 shows no teachers felt very unsure and only 3.7% of teachers felt unsure that they have implemented all RME characteristics during their best practices, whereas others are confident enough to say yes they do implement all the RME characteristics. In other words, most teachers felt confident during the implementation that they have done RME approach in their mathematics class and following all its criteria.

The data demonstrates that after the workshops less than a half of the participants have a better understanding on RME characteristics. However, more than a half of them believe that most mathematical topics can be taught by the RME approach and feel confident that they have implemented RME approach in their best practices. The RME characteristics that already given in this workshop are;

(1) real world context, (2) guided discovery, (3) a shift from informal mathematics to formal mathematics, (4) start from realistic problems, (5) use modelling, (6) created a fun learning. This theory is suggest by Clements (3) that main characteristics of RME include the development of model which lets the transformation happen from contextual to formal mathematics, the application of meaningful context, the interaction between teacher and students, the perception of mathematics as an integrated subject, and the reaction of mathematics concepts by the students. The most teachers understanding about RME characteristics is to create a fun learning.

The one of purpose RME is to change mathematics learning into meaningful and more fun for students by developing them into problems within context [8]. RME starts to take problems from around the society of the students. Then the teachers will help the students solve the contextual issues. This problem-solving activity is believed to give positive impact to students' cognitive achievement especially in their ability for understanding mathematics [13]. Dealing with contextual problems is the best way to teach mathematics.

Other findings portray how many teachers reckon all mathematical concepts can be taught using RME as an approach and the approach is suitable within a thematic curriculum in elementary school. The results were shown in these respectively two pie charts in Figure 2 and Figure 3.

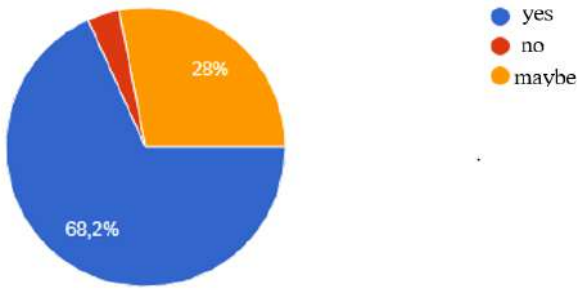


**Figure 2.** Teachers respond about coherent between RME and mathematics concept.

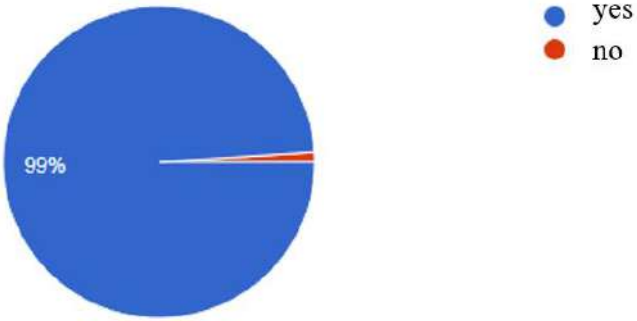


**Figure 3.** Teachers respond about coherent between RME and thematic curriculum.

*3.2. RME criteria which teachers found most challenging during the planning and the implementation*

The study tries to look for teachers' struggles during the RME lesson planning and its implementation. We reach the aims by asking these two questions. The first question is about the teachers' difficulties while design RME lesson planning. The results were shown in figure 4 below.


**Figure 4.** The teachers' difficulties when designed RME lesson planning.

The pie chat illustrates that the most teachers' difficulties while designed RME lesson planning were to find suitable media for activities and mathematics learning (23,3%), changing informal mathematics to formal mathematics (18,6%), and both finding relevant contextual situation and designing a continue series for mathematics learning, each has the same percentage 12,8%. The theory suggests by Fry, Ketteridge, and Marshall [14] that media have function as mediator between learning context and students. Therefore, media is a tool for delivering messages and the materials in RME learning. The teachers should be innovative at choosing proper media in RME learning because it has the biggest affect for elementary students to understand the abstract concepts.

Furthermore, teachers found challenges in changing informal mathematics to formal mathematics. In the RME theory, this movement called vertical mathematization (3). Vertical mathematization is a shifting process involving symbolizing from model of to model for. In other words, Pinero Charlo [15] stated its focus on mathematical processing. It requires teachers to master the mathematical concepts, and teachers have to capable in making innovation in their teaching practices [16].

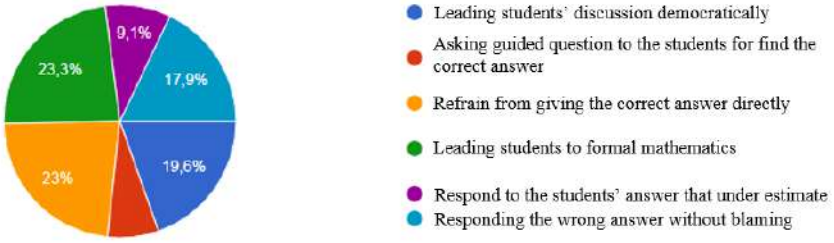


**Figure 5.** The teachers' difficulties when implementation RME learning.

Figure 5 presents the most teachers' difficulties when implementation RME learning was leading students to formal mathematics (23,3%). Brendefur et al. [17] argue that teachers' struggles happened because it demands on teacher's deeper knowledge in mathematics and students' thinking. Moreover, leading students to formal mathematics is a part of RME characteristics called guided reinvention, in which the teachers help students to move from their representations to abstract or symbolized mathematics. At least there two roles teachers must fulfil in such level, understanding mathematics behind students' representations and bringing such understandings into proper formal knowledge by guided questioning [18].

Posing guided questions apparently is another struggle as well even though it does not have major percentage in the chart. Nevertheless, we can interpret its relation to the second biggest percentage, namely teachers refrain from giving the correct answer directly. Demonstrating and providing direct correct answers are simpler for teachers than coming up with various questions in mind to respond to students' unexpected answers. The finding is in line with Franke et al. [19] conclusion from their research that teachers are struggle with following up students' ideas. In the study, although teachers can come up with a question such as "how did you get that?", they were not really assured whether following questions could help constructing students' further understanding.

## 4. Conclusion

In a nutshell, the findings and discussion capture teachers' perception in their understanding of RME and its implementation in their best practices after series of workshops. The workshop series provided RME materials, simulation during the workshop, teachers implementing in their best practice, and the workshop to discuss their experiences. The data demonstrate teachers' confidences is higher that their understandings of RME characteristics. It makes them believe that they have implemented the RME approach well during their best practices in the second week. However, they confessed that they did find difficulties during the implementation.

Teachers struggled to apply some principles of RME during the planning stage in designing mathematics activities and during the lesson. When planning the lesson, teachers found it most challenging in finding suitable media which can help students to do vertical mathematization. It affected their teaching practices, they also found problematic in doing guided reinvention because they barely told students the correct answer directly when they made mistakes.

These results suggest that the most impactful workshop is better, followed by best practices and participants' reflection afterward. However, further workshop should be conducted to train teachers in understanding students' ideas and posing proper guided questions.

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