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Teacher Efforts in Developing Student Creativity through Realistic Mathematics Education in Elementary School

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Abstrak

Penelitian ini dilakukan dengan latar belakang guru yang cenderung menggunakan soal jawaban tunggal dibandingkan dengan soal jawaban yang beragam sehingga menyebabkan rendahnya kreativitas siswa. Pendekatan yang digunakan untuk mengatasi permasalahan tersebut adalah melalui Realistic Mathematics Education (RME). Penelitian ini bertujuan untuk mendeskripsikan upaya guru dalam mengembangkan kreativitas siswa pada pembelajaran pecahan melalui RME. Metode yang digunakan dalam penelitian ini adalah kualitatif. Subjek dalam penelitian ini adalah seorang guru kelas 2 sekolah dasar di Banda Aceh. Instrumen yang digunakan adalah catatan lapangan dan wawancara. Teknik analisis data menggunakan reduksi data, penyajian data, dan penarikan kesimpulan. Berdasarkan hasil analisis data dapat disimpulkan bahwa upaya guru dalam mengembangkan kreativitas siswa yaitu dengan menggunakan berbagai metode dan kegiatan pembelajaran, menggunakan pertanyaan terbuka, menggabungkan tugas kelompok dan individu, menggunakan pendekatan pembelajaran yang sesuai, dan bertindak sebagai fasilitator dan koordinator.
Kata Kunci: Kreativitas; Upaya Guru; RME.

Abstract

This study was driven by the recognition that teachers often rely on single solution instead of multiple solution problems, limiting student creativity. To address this, the study took a unique approach, employing Realistic Mathematics Education (RME). The goal was to describe teacher's endeavors to nurture student creativity while teaching fractions through RME. This study employed qualitative methods, including field notes and interviews. The subject was a Grade 2 teacher from one of elementary schools in Banda Aceh. Data analysis involved data reduction, presentation, and conclusion drawing. The analysis revealed that the teacher's strategies to foster student creativity include a range of teaching methods and activities, open-ended questions, group and individual assignments, an appropriate learning approach, and a role as a facilitator and coordinator.
Keywords: Creativity; Teacher Efforts; RME.

I. INTRODUCTION

Mathematics is an important subject to learn at every level of education (Syahara & Astutik, 2021). Mathematics not only provides math skills for students at school but also trains thinking skills so students can think at a higher level, from analyzing to solving problems (Rafiqoh, 2020). Learning mathematics is closely related to solving problems that require thinking and logical skills (Uno in Syahara & Astutik, 2021). This is because learning mathematics aims to enable students to have creative thinking skills (Saefudin, 2012).

Creative thinking means solving problems in new and unique ways (Mahmudi, 2008). Creative thinking can be developed through a learning process that motivates and stimulates student creativity combined with various learning methods, such as problem-solving (Rusman in Faturohman & Afriansyah, 2020). Spesifically, Mathematical creative thinking is the ability to solve problems and identify relationships between concepts to uncover essential aspects of mathematics (Tall in Rahayu, Liddini, & Maarif, 2022). If students possess creative thinking skills, they will find it easier to achieve a deeper understanding (Faturohman & Afriansyah, 2020).

Creative thinking is crucial for students to solve problems, particularly in mathematics. However, many students lack this ability (Ismunandar et al., 2020). According to Kim (2021), the decline in creative thinking skills begins in early childhood and continues up to the third grade of elementary school. Similarly, a study by Marliani (2015) found that many students have low creative thinking skills.

The low student creativity is due to the teacher's lack of attention to creativity in learning (Saefudin, 2012). In addition, the learning in the classroom is teacher-centered, conventional, and mechanistic (Arsaythambi & Zubainur, 2014). The teacher only explains the subject matter and students accept explanations from the teacher and assume that the method shown by the teacher is the only way to answer questions (Febriani & Ratu, 2018). The teacher also often provides examples of questions with a single answer compared to open-ended questions (Utami, Endaryono & Djuhartono. 2020). This causes students not to look for other ways to solve problems and not to have flexibility as an essential factor in creative thinking skills (Febriani & Ratu, 2018).

Based on observations and interviews with a second-grade teacher at an elementary school in Banda Aceh, it was found that during mathematics lessons, the teacher often provides direct explanations and uses single-solution problems rather than multiple-solution problems. Additionally, the teacher assigns practice problems similar to those previously exemplified. This approach contributes to the low creativity of students in solving the given problems.

One way that can be done to overcome these problems is by implementing realistic mathematics education (RME). RME was coined by Freudenthal, who stated that mathematics is a human activity (Freudenthal, 1991). Freudenthal believes that students are not passive beings who only accept mathematical finished products

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but beings who are capable of developing and reinventing mathematical concepts with guidance from the teacher (Johar et.al, 2021).

RME is an approach that begins learning by presenting realistic problems (Johar, Zubainur, Ikhsan, & Zubaidah, 2021). RME learning is guided by six principles: the principle of activity, which positions students as active participants in their learning; the principle of reality, which starts with problems from everyday life or those that students can imagine and solve in their own way; the principle of level, which involves students progressing through various stages, from informal understanding to formal knowledge; the principle of linkage, which emphasizes the connections between different mathematical topics; the principle of interactivity, which views mathematics as a social activity rather than an individual one; and the principle of guidance, which involves the teacher playing an active role in designing and developing learning activities that facilitate student understanding (Treffers, 1987).

One material requiring creativity is fractions. Fractions are one of the essential subjects (Siegler et al., 2012). Fractions can be interpreted as part of the whole (van de Walle,2013). A study by Sowder and Wearne (2006) showed that many students have difficulty understanding the concept of fractions. In addition, many students make mistakes in learning fractions, such as not understanding the properties of fractions (Loc, Tong, & Chau, 2017).

To teach creative thinking skills, creative teachers are needed. MRayyan (2006) explains that to produce creative students, creative teachers are also needed. Therefore, the Research and Development Center for Indonesian Realistic Mathematics Education (PRP-PMRI) team from Universitas Syiah Kuala has provided training and assistance to six elementary school teachers through the Ministry of Education and Culture's- Mover Organization Program (Program Organisasi Penggerak-POP) held by YPMIPA in implementing RME. One of the teachers who received training and assistance was a a second-grade teacher at an elementary school in Banda Aceh.

Thus, this study was conducted to examine the teacher's efforts to develop student creativity in fractions through RME in Grade 2. This study aimed to describe the teacher's efforts to develop student creativity in fractions through RME.

II. METHOD

This section only contains the method. The approach used in this study was a qualitative approach with a descriptive type. A qualitative approach is used to obtain descriptive data from selected research subjects (Creswell, 2014). The subject in this study was a teacher teaching class II-A at an elementary school in Banda Aceh with 37 students consisting of 19 male students and 18 female students. The subject chosen was the teacher assisted and trained by the Research and Development Center for Indonesian Realistic Mathematics Education (PRP-PMRI) team from Universitas Syiah Kuala through the Ministry of Education and Culture for Program Organisasi Penggerak

(POP), held by YPMIPA to implement RME in mathematics learning. The Program Organisasi Penggerak is a government-supported initiative to enhance teacher and principal quality through proven training models that improve the learning process and student outcomes.

The instruments used were field note sheets linked to eight indicators to find out the efforts made by the teacher to develop student creativity in fractions through RME, namely (1) using various learning methods and activities, (2) using an appropriate learning approach; (3) using open-ended questions; (4) giving different assignments according to students' abilities; (5) combining group and individual assignments; (6) using technology; (7) using realistic problems; (8) acting as facilitator and coordinator in learning (Kattou, Kontoyianni & Christou: 2009). In addition to using field note sheets, video recordings of learning are also used.

In order to observe the efforts made by the teacher to develop student creativity in fractions through RME, learning activities were designed in three meetings. The learning tools used in this study were developed with the PRP-PMRI Team in the form of icebergs and during the three meetings are presented in the following Table 1.

Table 1.
Learning Activities for three meetings

Meeting	Activities
1	Dividing a concrete object into several parts
2	Dividing mini *martabak* (Indonesian stuffed pancake) and shapes
3	Finding the meaning of fractions related to Prescription Experience, Writing Fraction Symbols, and Drawing shapes according to fraction

The iceberg that visualizes learning activities is shown in Figure 1.

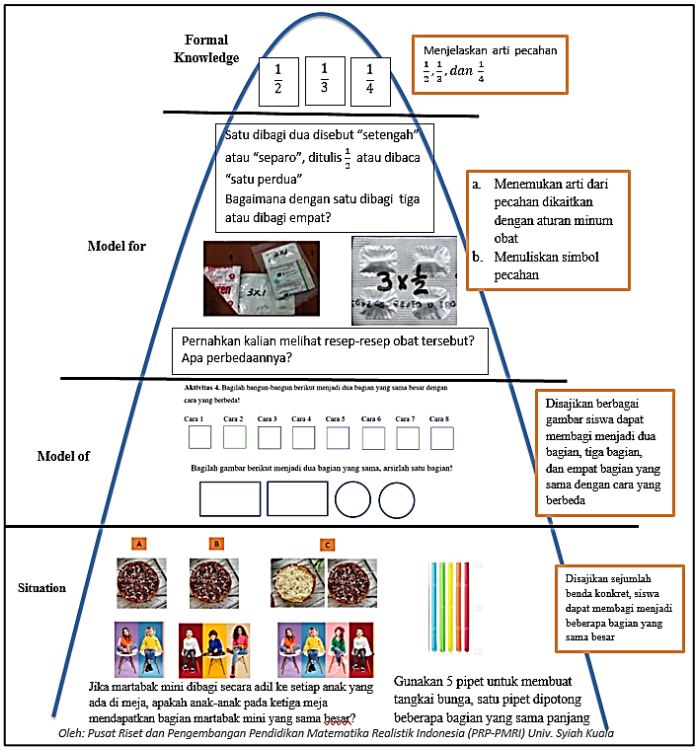

Figure 1. Learning Activities in Iceberg

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The data analysis technique used in this study consisted of data reduction, data presentation, and conclusion drawing (Miles & Huberman, 1994).

III. RESULT AND DISCUSSION

The first meeting activity consisted of one activity, namely dividing a concrete object into several parts in groups. The teacher used various learning methods and activities, proposed open-ended questions, and combined group and individual assignments (Efforts 1, 3, and 5). Each group was given five colored pipettes, post-it, paper, scissors, and glue. The teacher asked the students to use five different colored pipettes and find different ways of dividing the pipette into flower stalks and other parts. The following excerpts are the results of teacher and student discussions.

Teacher : What should be done so that the pipette pieces used are the same length? (Effort 7)
Students : First, fold it into two parts, then cut in the middle.
Teacher : Correct, now try applying it on each pipette.

After the teacher asked the question, the students then repaired the flower stalks that had been made before.

After all groups had finished their work, the teacher asked each group to present their work. Each group was asked to explain what was contained in their work. The teacher gave appreciation in the form of 10 stars to all groups that have completed their assignments well. The second meeting activity consisted of several activities, such as dividing the *mini martabak* into several parts, the 2D-shape into several parts, and square into two parts in various ways (Efforts 1 and 3). The first activity, namely dividing the *mini martabak* into several parts, was done in groups (Effort 5). In dividing the *mini martabak* into several parts, the students experienced difficulties when dividing the *mini martabak* into three equal parts. The following excerpts are the results of teacher and student discussions.

Teacher : (Approaching the table of one of the groups) I asked you to divide it (the mini martabak) into three equal parts. Has it been divided into three parts? (while pointing at the picture made by the students)
Students : Not yet; the image is divided into four parts.
Teacher : How do you make it into three equal parts? What to do with this martabak?
Students : I know the shape of this mini martabak when it is divided into three parts, but I don't know how to cut it so that it becomes three equal parts.
Teacher : Keep trying to draw it on the paper first.

The discussion in the article aims to (1) answer the problem formulation.

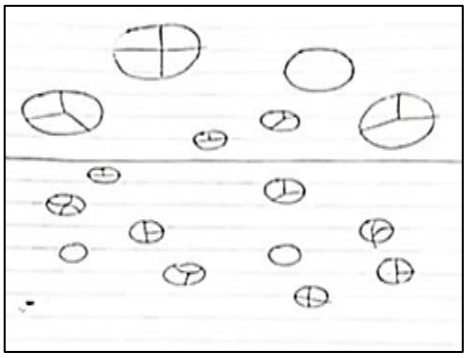

Figure 2. Student Efforts to Find the Right Way to Divide the Mini *Martabak* into three Equal Parts

After getting directions from the teacher, the students returned to doing trial and error repeatedly and holding discussions with their group mates. Finally, they found a way to correctly make divisions of three equal parts and applied it to the given *martabak*.

Next, the teacher asked the students to divide 2 *mini martabak* for four people in two different ways (Effort 3). In this activity, many students found it difficult to find two different ways of dividing 2 mini *martabak*s for 4 people. The following excerpts are the results of teacher and student discussions.

Teacher : (Approaching one of the groups) You have found one way to divide these two mini martabak for four people. Now, try to find another way of dividing these two mini martabak for four people (Efforts 3 and 8).

Students : We can't; there's no other way.

Teacher : There is, let's take a look. How do you divide these two mini martabaks differently?

Students : Should we shape these into a box?

Teacher : Try to apply it first (the students looked confused)

Then, the teacher visited another group. The group has found two different ways of dividing two mini *martabak* for four people. It's just that when the students showed the results of their mini *martabak* cutouts, the teacher did not respond, so students were confused about whether the results were right or wrong. Afterward, the teacher and students discussed which table (group) got the same amount of mini *martabak*. The following excerpts are the results of teacher and student discussions.

Teacher : Do the students at the three tables get the same amount of mini martabak? (Pointing at the picture on the blackboard) (Effort 7)

Students : No, the first table gets a bigger part than the other tables.

Teacher : Let's re-look at the picture (As seen in Figure 3)

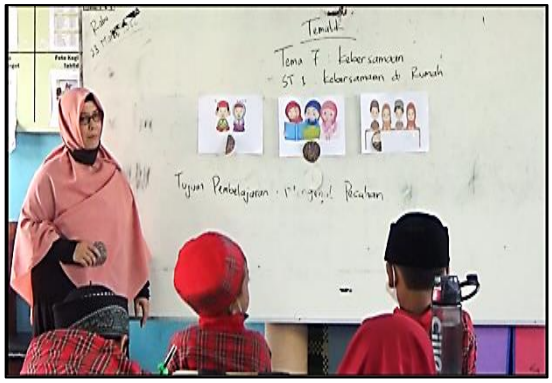

Figure 3. The teacher and the students are discussing

After the students looked back at the picture, which was accompanied by questions that led them to find the correct answer, they finally discovered that the first and third tables had equal parts (same amount of mini *martabak*).

Learning was continued with individual activities, namely dividing the 2D-shape into several parts and dividing the square into two parts in eight ways (Effort 3). The teacher gave a student worksheet and directed that each 2D-shape on the worksheet must be divided into two, three and four parts in two different ways, and one of the parts is shaded. When doing this task, some students found it difficult to divide a 2D-shape into two parts, three parts, and four parts in two different ways (Effort 8). The teacher directed the

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students to find the answer until they could answer correctly. The teacher did the same thing when directing the students to divide a square into two parts in various ways; the results are shown in Figure 4.

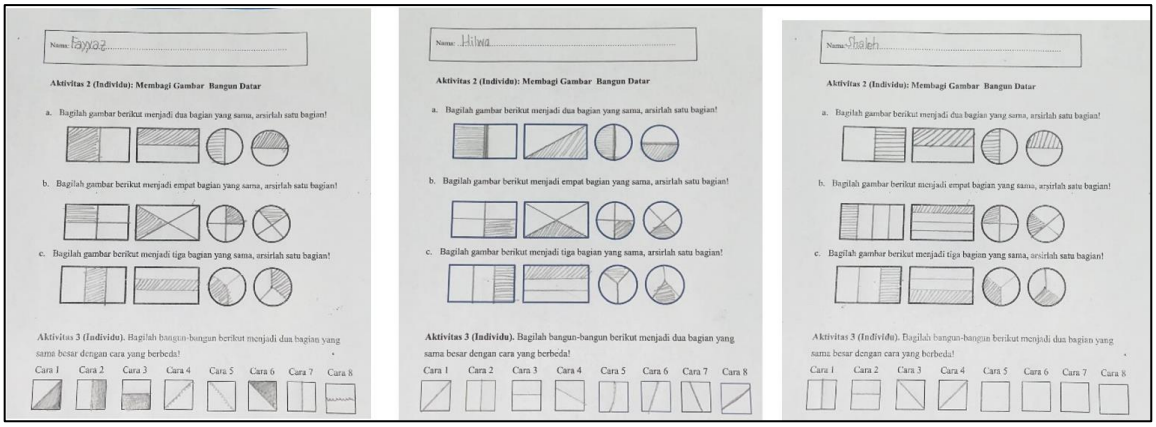

Figure 4. Student answers on the student worksheet

The third meeting activity consisted of several activities, such as writing fractional symbols based on a series of flower stalks that had been made at the previous meeting, describing 2D-shapes according to the specified fractions, and determining whether the fraction image given is correct (Effort 1). The lesson began with the teacher showing medicines labeled with the prescriptions 2 x 1 and 3 x 1, then asking students questions about the meaning of the prescription. All students answered that the meaning of the prescriptions was that each medicine should be taken twice and three times a day.

Then, the teacher showed another medicine with the prescription 3 x ½ and asked the students about the meaning of the prescription. The following excerpts are the results of teacher and student discussions.

Teacher : How to take medicine with a prescription 3 x ½? (Effort 7)
Students : Cut the medicine and drink it three times a day.
Teacher : What is the use of the center line in tablet medicine? (Attempt 7)
Students : To divide it into two equal parts.
Teacher : Excellent (Then inviting other students to give applause)

Next, the teacher asked the students again about how to read fractional values and asked student representatives to write the symbols for fractions 1/2, 1/3, and 1/4. After the students know the meaning of fractions, The teacher distributes straws and several circular pieces of paper and asks the students to cut them into several parts congruently, arrange them into flowers or any interesting designs, glue them on the paper and then ask the students to write the fraction symbols of these partsfor each parts (Attempts 1 and 3). When writing down the fractions in the series, some students had difficulty determining the fractions, so the teacher directed them. The following excerpts are the results of teacher and student discussions.

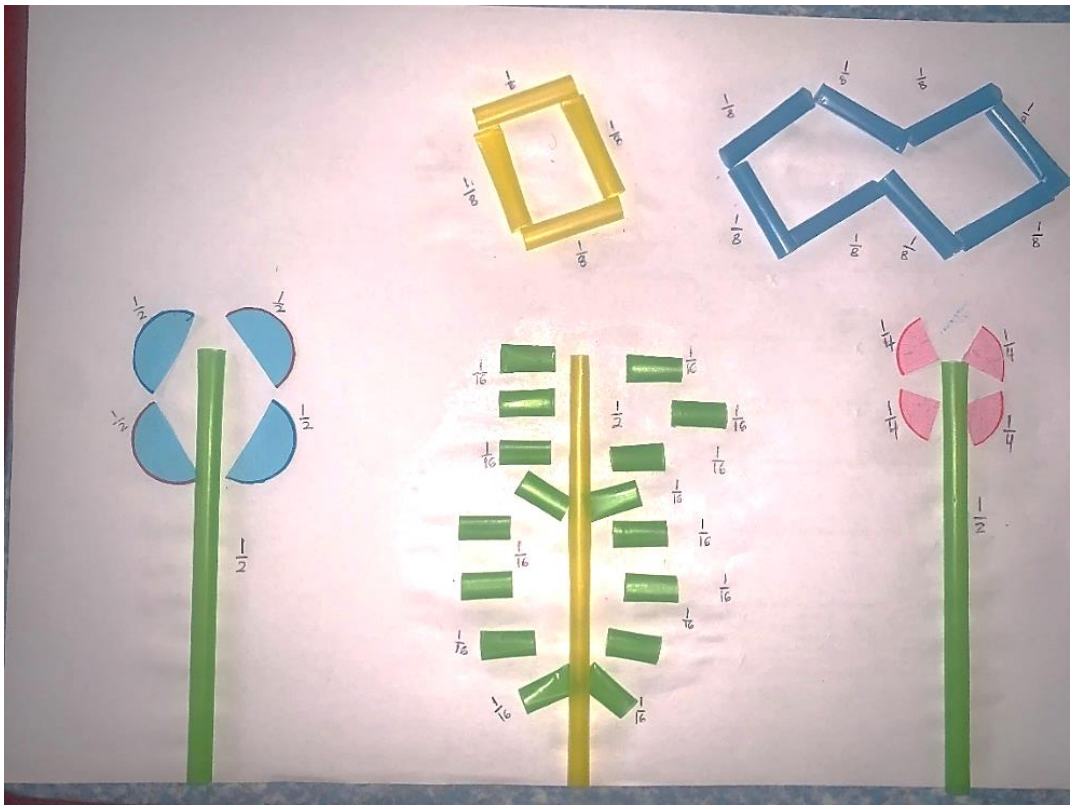

Figure 5. Students write fractions on flower straws

Teacher : *Take a look at this part and this part (pointing to the part that is 1/8). If one part is equal to 1/8, can parts of the same size have different values? (Attempt 7)*

Students : *No*

Teacher : *If so, if this part is equal to 1/8, then what is the value of this part? (pointing to the part in question)*

Students : *1/8*

Teacher : *Write it next to each pipette.*

Then, the teacher distributed the student worksheet and directed how to work on the worksheet individually (Effort 8). The teacher directed the students to describe a 2D-shape according to the fractions that is freely given (Attempt 3) and determine whether the 2D-shape that has been divided into several parts is true or false. When doing this task, students used a variety of 2D-shapes. For example, one student used a triangle to show the fraction of 1/3. The direction given by the teacher is constructive for students in solving the problems.

Based on Kattou, Kontoyianni, and Christou (2009), of the eight efforts explained, only six were used by the teacher to develop student creativity, namely using various learning methods and activities, using an appropriate learning approach, combining individual and group assignments, using open-ended questions, providing realistic problems in learning, and acting as a coordinator and facilitator.

Choosing the proper learning method can stimulate students to hone their thoughts and find various ways to solve the

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questions, affecting student creativity development (Nur, 2016).

Furthermore, the assignments given by the teacher should be done individually or in groups. Giving both individual and group assignments can affect student creativity (Pusfita & Fitiryani, 2017; Suwarno, Wahidin, & Nur, 2020). Working in groups can help students work together in solving the problems given, responding to other groups' ideas and completing deficiencies found when solving problems (Faturohman, Afriansyah, 2020). In addition to working on the problems in groups, students must be allowed to work individually. The purpose of individual exercises is to measure students' creative thinking skills in solving the problems (Faturohman, Afriansyah, 2020).

Furthermore, to develop students' creative thinking skills, they must become accustomed to working on open-ended problems (Febriani & Ratu, 2018; Yayuk, Purwanto, As'ari, & Subanji, 2020). Open-ended problems challenge students to measure their understanding of certain mathematical concepts and allow for various problem-solving methods (Febriani & Ratu, 2018; Khalid et al., 2020). Consequently, students' creative thinking skills will improve as they become used to solving open-ended problems, making their creative problem-solving processes more visible (Febriani & Ratu, 2018).

Additionally, it is important to consider that RME is a learning approach capable of developing student creativity and fostering an engaging classroom environment where students engage in questioning, working on the problems and generating solutions (Sholeh & Fahrurozi, 2021). This is consistent with a study by Yudistira and Rabbani (2020), which found that using RME in learning can create an active, creative, and meaningful learning atmosphere.

Implementing those efforts mentioned earlier cannot be separated from the role of a teacher. In developing student creativity, the teacher acts as a coordinator and facilitator. To bring out student creativity, the teacher must know that each student's creative skill varies according to their background (Kau, 2017; Sun, Wanga, & Wegerif, 2020). Therefore, as a facilitator, the teacher plays a role in helping students bring out the creative potential that each student already has (Kau, 2017).

Effort that the teacher did not make is using technology in learning. This is because the teacher is not accustomed to using technology in everyday learning. Pope (2013) emphasized that the use of technology in mathematics provides opportunities for students to understand and master mathematical concepts and principles by finding patterns, changes, and relationships using exploration assisted by technology. Using technology also contributes to student engagement in math learning (Attard & Holmes, 2020).

Besides not incorporating technology into learning, the teacher did not differentiate the problems given to students with varying levels of creativity—high, medium, and low. This study found that the teacher had never apllied RME before. Developing student creativity requires an experienced teacher. Well-

trained teachers are essential for fostering student creativity (Murdiana, Jumri, and Damara, 2020).

Therefore, it is essential to hold training for teachers in designing problems meeting the indicators of creativity. A study by Djamilah and Ariyanti showed that providing training to teachers in compiling creative thinking questions can provide understanding and provision for teachers to apply in learning. A similar study was carried out by Lathiifah, Apriani, and Agustine (2019). The results of their study showed that the training provided to prospective teachers in designing RME-based teaching materials can contribute to developing students' creative thinking skills in mathematics.

IV. CONCLUSION

Based on the results of the study, it can be concluded that the teacher's efforts to develop student creativity through RME at a primary school in Banda Aceh include using various learning methods and activities, employing the RME approach, incorporating open-ended problems, combining group and individual assignments, presenting realistic problems, and acting as a facilitator and coordinator.

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