Realistic mathematics education: an alternative to improve students’ understanding of fraction concept

T Cendekiawaty and S Sugiman
Mathematics Education, Graduate School, Universitas Negeri Yogyakarta, Indonesia

E-mail: tiaracendekiawaty.2018@student.uny.ac.id

Abstract. Mathematics is a material that is considered difficult by students in learning mathematics so that students find difficulties in understanding concepts, especially the concept of fraction. Some students see fraction as whole numbers but only as a symbol that needs to be manipulated in various ways. The main factors that led to students' difficulties in understanding the concept of fraction are more frequent student to memorize than to build an understanding of the concept. Another factor is the approach used by the teacher is not orientated to the real world where the situation can be imagined by the students. Alternative approaches that can be used as a solution is a realistic mathematics education approach. This study tries to examine students' understanding of fraction concept through a realistic mathematics education approach by reviewing literatures. Through a realistic mathematics education approach, students had a chance to develop their knowledge by expressing their ideas during the learning process. Students were also able to imagine various situations occurred in a mathematical problems because those problems were in a real situation problems related to students’ life

1. Introduction
The fraction is one material that is difficult for students [1] [2]. Teachers also realize that the fraction is difficult as well. Lack of understanding the concept of fraction becomes a very important point of unsatisfied mathematical knowledge [1]. Siemon et al stated in teaching fraction, teachers often ask students to memorize and use formulas rather than to develop students' understanding [2]. This method gives less impact on the students' understanding of the material fraction. Ready and Duru express the same thing where the main reason behind students less understanding is students tend to only remember the formulas and algorithms and students' problem-solving only assume that the denominator and numerator of the fraction are two separate integers [3]. Though the students' understanding will be needed for the future, not only to develop an understanding of mathematics but also to support the students' daily lives [2]. To improve students understanding, teachers need to develop their knowledge in seeing what strategies students can use to improve their understanding of fraction. Students can represent the mathematical knowledge in a variety of ways, including through the spoken language, written language, manipulation, image, and real-world situations [4].

One strategy that can be used is to create a learning innovation by implementing a realistic mathematics education approach. Realistic mathematics education is an approach to learning that can be applied in mathematics. The characteristics of realistic mathematics education approach are very broad. One is the use of the context of a real situation. The situation considered "real" is important in the learning process [5]. A realistic mathematics education approach gives students the chance to build their knowledge. Students can also imagine various situations presented in the form of a question
because of the question about the real world that is certainly close to student life. Through a realistic mathematics education approach, students can improve their understanding of mathematics concepts [6] [7].

The use of real-world problems will help students to improve the comprehension of abstract concepts [8]. Because it uses a real-world problems, of course, the problems presented in a realistic mathematics education approach will be using the context of everyday life. Problems presented also raises the mathematization process. The matter of making students think in a variety of activities, serve as motivation and shows how mathematical concepts applied in the context of the question [9]. Shulman stated that the understanding of teachers not only helps through the knowledge of the concept but to furthermore applying context in the classroom [10]. Through a realistic mathematics education approach, the student alleged to enhance understanding of the concept of fraction. This study tries to examine students' understanding of fraction concept through the realistic mathematic approach to education.

2. Method
This article using a literature review method about knowledge, ideas, or findings contained in the literature. So that it can provide theoretical and scientific information related to realistic mathematics education approach to improve students' understanding of fraction concept. Data were collected and analyzed in the form of literature learning students' understanding of fraction concept and the realistic mathematics education approach. Data obtained from scientific journals and experience by observing sample. Data were analyzed throughout several steps. First, reducing existing data and chooses ideas about the use of realistic mathematics education approach can improve students' understanding of fraction concept. Second, identified the students' idea that divided into four levels in model development of realistic mathematics education approach. And the last step is conclude that realistic mathematics education approach can improve students' understanding of fraction concept.

3. Discussion
3.1 Realistic Mathematics Education Approach

3.1.1 Mathematics as a Human Activity Hans Freudenthal stated that mathematics is a human activity [11]. Mathematics as human activity has two meanings, namely: (a) The first is the mathematical form of human activity, and (b) can be implemented in the mathematics of human activity [12]. Mathematics form by an activity that's mean activity is formed from the experiences of the students. These experiences will form a knowledge through a process of abstraction. There is no human activity certainly does not escape from mathematics. Thus, students should understand the concept of mathematics properly so that students can apply in their lives.

3.1.2 The Meaning of Realistic in Realistic Mathematics Approach Realistic in realistic mathematics education approach is often mistaken for the real world [13]. This led many to assume that a realistic mathematics education approach solely concerned to always use real-world problems is close to the students. The real world is important in realistic mathematics education approach but realistic itself has a wider meaning than just a real problems [5]. Realistic refer to anything that can be imagined by the students. So, realistic not just limited to the problems that uses real-world situation that is close to students life, but rather the problems that the situation can be imagined by the students.

3.1.3 Mathematization Process In a realistic mathematics education approach, mathematics not only about knowledge but activities to solve the problems known mathematization process [14]. There are two processes, namely horizontal mathematization and vertical mathematization. Students start mathematization from real-world problems. In a realistic mathematics education approach, real-world problems form by contextual problems. The contextual problems is a starting point in realistic mathematics education approach [15]. Students should change the contextual problems into
mathematical forms by their way. This process called horizontal mathematization. Horizontal mathematization process play an important role in the process of vertical mathematization. A horizontal mathematical process is fundamental to the process of vertical mathematization. The vertical mathematization process occurs when students are used to resolving the contextual problems and understand the concept, so that through the concept which is formed during the process of horizontal mathematization students can solve problems that are not contextual problems [16].

3.2 Understanding the Concept
A concept is a group of objects, events, and characteristics based on general property [17]. The concept is also an abstract idea that generalized from specific examples [18]. The concept is an abstract idea of an object that is useful in forming a generalization. In mathematics, the concept used to categorize or classify an object of mathematics. In mathematics, the concept is usually limited by definition and can be formed through the use of examples and non-examples. There are two ways to build a concept, by classifying the examples that are useful in forming a concept and through the activity of listening, reading, or otherwise to give names or other symbols on a concept [19].

Gagne stated that conceptual understanding is an ability that is divided into two types of concepts concrete and abstract concepts. Students learn the concept of concrete when students will recognize the new object, whereas concrete concepts students learn when to use the definition to explain the examples that have not previously studied [20]. Conceptual understanding, including an understanding of the concepts, operations, and relationships in mathematics [21]. Involves a conceptual understanding of students' understanding of concepts and relationships between concepts which are both becoming fundamental [22]. When students can develop an understanding of the concept is that students can rebuild the forgotten steps of problem solving [23]. Students who do not have a more understanding of mathematical concepts do not have that many opportunities to challenging [24]

3.3 Understanding the Concept of Fraction
The concept begins with the concept of the fractional part of the whole [23]. For example: $\frac{5}{7}$ expressed as five of seven parts. So that students can learn fraction then the teacher must instill a strong understanding of the concept of the student [25]. Students need to learn through experience in learning so that students understand the concept of the fractional part of the whole itself. Thus, students can build a strong understanding of fraction.

Instilling the concept of fraction is not easy. Clarke stated that the concept of fraction is a concept the most difficult to be taught and learned [26]. However, understanding the concept of fraction is very important in the development of mathematics [27]. Understand what fraction and how to use fraction is the foundation for the study of higher mathematics concepts [25]. The difficulty to be learned and taught through the course is due to an inhibiting factor. The factor is that students do not look fraction as whole numbers but only as a symbol that needs to be manipulated in various ways [1]. Wu also mentioned some problems in studying the concept of fraction, namely the concept of fraction is not well-defined and a general explanation of the material fraction is still lacking [28]. In the end, when the students do not understand what fraction and how to manipulate fraction, then students will simply memorize are certainly not accurate and has short term. It makes students not be able to apply the concept of fraction when students are confronted to contextual problems [29].

3.4 Realistic Mathematics Education Approach as an Alternative to Improve Students’ Understanding of Fraction Concept
Basically, students can learn fraction correctly, the teacher must instill a strong understanding of concepts through real-world situations. The representation of real-world situations can build students' understanding of the concept of fraction [29]. The use of real-world situations can create more meaningful mathematical knowledge of students [23]. Realistic mathematics education approach also helps students to improve their understanding of abstract concepts that tend [8]. This is because the approach of realistic mathematics education is using contextual issues which corresponds to real-world
situations and can be imagined by the students. Also, a realistic mathematics education approach provides opportunities for students to be active during learning [30]. During the learning, students have opportunities to express their ideas where the ideas becomes a concept.

In a realistic mathematics education approach, the students' ideas are in the form of a model. Gravemeijer mentioned four levels in the development of a model that is situational level, referential level, the level of general and formal level [13]. Four levels in model development will be illustrated by the following contextual questions:

Zia invited seven of her friends to celebrate her birthday. After she blew the candles, a birthday cake was cut into 24 pieces s Zia. Zia and 7 friends got the same piece of cake. How much of the fraction was obtained by each child?

- **Situational Level**

  Students at this level have not been able to think abstractly so that the teacher's role is very important. To facilitate students in understanding of fraction concept, a teacher asks students to do the activities the situation is the context or role-playing. At the beginning of the learning, the teacher provokes questions that motivate students and the questions are useful in role-playing. Questions such as: "If it is a birthday cake then usually it shapes like what? Will, it is circular or rectangular?". From these questions, some students answered that it could be either a circle or a rectangle. After knowing the students' answers, the teacher facilitates a paper, either circular or rectangular shape, which is then cut into 24 parts. Through the media, the students try to distribute 24 pieces of cake to 8 children fairly. At this level, students will solve problems by counting pieces of paper as a representation the piece of cake and take the cake sequentially starting from Zia to seven friends. For example, starting from Zia, Zia’s first friend, and so on up to Zia’s seventh friend. If Zia took the first of 24 key pieces of cake so that means Zia took \( \frac{1}{24} \) part of cake. Similarly, for each part taken by Zia’s friends sequentially until it runs out the pieces of cake. Here's how students in sharing the cake. Similarly, for each part taken by Zia’s friends sequentially until it runs out the pieces of cake. Here's how students in sharing the cake:

  ![Figure 1](image1.png)  ![Figure 2](image2.png)  ![Figure 3](image3.png)

- **Referential Level**

  At this level, students have started to think abstractly. Students who are at the level of referential no longer need a paper cut. Students make a model as a representation of the context of the situation by drawing on paper. Students create a model to describe the situation context. Teachers give students a piece of paper where the paper is used to describe a representation of the cake in the form of a rectangle or circle. In this activity, the teacher's role is to help students to draw a rectangle or a circle divided into 24 parts. When finished drawing, the students tried to distribute 24 pieces of cake to 8 children. Here is how the students draw and share the cake.
• General Level
Students who are on the general level has begun to focus on mathematics. This level is based on the previous level. In the previous level, students have to sort or classify even parts cake obtained every child. For students who sort the parts of the cake, then these students classify parts obtained cake every child and then add the pieces of cake. As for the students who have grouped parts cake obtained every child, then these students simply to add the pieces of cake from each child. Let's say for part Zia:
\[ 1 + 1 + 1 = 3. \]
\[ 3 \text{ of } 24 \text{ part means } \frac{3}{24}. \]
Similarly, to calculate the earned portion of each Zia’s friends.

• Formal Level
Students who are at the formal level will understand the value of fraction so that students will develop algorithms in the form of 24 : 8 = 3. 24 is the part number the pieces of cake and 8 is the number of children who will take the cake. 3 of 24 parts means \( \frac{3}{24} \). From thus concept, students will refer to the simplification of a fraction to obtain that \( \frac{3}{24} = \frac{1}{8} \). In this case, the teacher has an important role as it relates to conclude the concept of fraction. The inference concept of fraction is done jointly between teachers and students through class discussion.

Horizontal mathematization is starting from students who are seeking mathematical tools to manage and solve real-world problems. Meanwhile, vertical mathematization is the process of rearranging the mathematical system itself [31]. When linked with the level of development of a model that has been submitted previously, the situational level, referential, and the general part of the horizontal mathematization process. With the horizontal mathematization process, students get hands-on experience that can shape the concept of fractional itself. When the student has reached the general level then the student can generalize the concept of fraction, where it refers to the formal level. Generalization of the concept of fraction will students use to solve fraction with no context. This refers to the vertical mathematization process. Through a realistic mathematics education approach, students can improve their understanding of the concept of fraction [32] [33].

Based on the exposure of the discussion, it can be concluded that realistic mathematics education approach can be used as an alternative to improve students’ understanding fraction concept, which is described in the following scheme:
4. Conclusion
The concept of fraction is the most difficult concepts to be taught and learned. This is because some students do not see fraction as a whole number but only as a symbol that needs to be manipulated in various ways. So that students can learn fraction correctly then the teacher must instill a strong understanding of concepts through real-world situations. The learning approach that can facilitate the approach is realistic mathematics education. The results show a realistic mathematics education approach can improve students' understanding of concepts in material fraction. Through the implementation of a realistic mathematics education approach, fraction as an abstract material can be understood by students because it uses real-world situations. Real-world situations help students understand a concept in which the representation of the world situation can build students' understanding of the concept. Thus, students can build and improve their understanding of the concept of fraction.

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