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Engaging Primary School Students in Developing Fraction Sense through Animaker in a Realistic Context

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Abstract

Although fractions are commonly taught in mathematics education, students often demonstrate a limited understanding of them. This study aims to enhance students' fraction sense through the use of Animaker media, grounded in the principles of Realistic Mathematics Education (RME). The study employed a design research approach consisting of several stages: preliminary design, teaching experiment, and retrospective analysis. Classroom experiments included observation, video recordings, and document analysis. The participants comprised 135 fourth-grade students from two primary schools in West Java, Indonesia. The findings suggest that activities designed using Animaker media significantly enhanced students' fraction sense, particularly in understanding the part-whole relationship. Furthermore, the use of Animaker media within a realistic context not only strengthened their understanding but also fostered mathematical reasoning related to fractions. The contribution of this research lies in demonstrating how multimedia—specifically Animaker—can be effectively integrated into instructional tasks on fractions, providing a meaningful, context-based learning experience that enhances both understanding and application of mathematical concepts.

Keywords: Animaker, Design Research, Fractions, Primary School Students, Realistic Mathematics Education

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INTRODUCTION

Fractions remain an essential topic in mathematics education, offering rich opportunities to explore real-world problem-solving. Achieving proficiency in solving fraction problems is a fundamental aspect of mathematics education (Pramudiani, et al., 2024). In recent decades, numerous studies have explored the topic of fractions. For example, Kamberi et al. (2022) examined the impact of concrete representations on primary school students' understanding and use of fractions. Several researchers have examined operations with fractions, such as addition and subtraction (Setambah et al., 2021) and multiplication of fraction (Purnomo et al., 2022). They argue that building a strong conceptual understanding of fractions is essential for developing overall mathematical knowledge.

However, most of the literature focuses solely on the knowledge and understanding of fractions, while the development of fraction sense is often overlooked (Hoon et al., 2020). Yet, fraction sense plays a crucial role as a foundation for students to learn more complex fraction concepts and to solve fraction-related problems. According to Fennell & Karp (2017), understanding fraction sense is important for success in advanced mathematics and is applicable in various professions and everyday situations.

The study of Doğan & Tertemiz (2019) summarizes several research findings, indicating that fractions involve five distinct interpretations: part-whole relationship, measurement, ratio, division, and operator. One interpretation of a fraction is as a part of a whole. In accordance with this interpretation,

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a unit is divided evenly into equal parts, or a set is divided equally into smaller quantities (e.g., eighths, sixths, or halves), and the numbers of these parts are used to represent fractional amounts (e.g., three-eighths, five-sixths, one-half).

Fractions are commonly understood as numbers or objects divided into equal parts (Čadež & Kolar, 2018). However, in this study, a task was designed in which the sizes of the object's parts appeared unequal. This was intended to trigger students' disequilibrium, thereby strengthening their fraction sense as a foundation for developing other skills, such as mathematical reasoning. Some previous studies have shown that by experiencing disequilibrium, students continuously reconstructed their understanding (Cavicchi, 2018; Rizqika et al., 2021; Tucker, 2017). The study by Pramudiani et al. (2023) has shown that challenging tasks incorporating students' experiences of disequilibrium can stimulate their mathematical reasoning (defining, analyzing, determining, making conjectures, investigating conjectures, and drawing conclusions).

In this research, students' fraction sense was assessed with the support of multimedia tools, namely Animaker, within a realistic context. The use of Animaker within a realistic context is grounded in previous research findings, which demonstrate that both media and realistic approaches offer advantages that may play a significant role in this study. Recent research, including studies by Anisa et al. (2023) and Manik & Sukmayadi (2024), shows that Animaker enhances the teaching and learning process by offering engaging, interactive, and multimedia-rich tools that support student understanding, improve retention, and foster deeper learning, particularly in diverse educational settings such as language and mathematics.

To create the optimal conditions for effective learning, educators must have creative and innovative ideas for presenting the material and understand the criteria for selecting appropriate learning media. This aligns with Muhammad et al. (2025), who stated that developing media for teaching and learning is one way to foster creativity. The learning process requires meaningful, interactive media to convey content or learning material in the classroom. Mathematics and technology are interrelated and can positively impact mathematics education when integrated (Milakovich & Wise, 2019). Media is also designed as a tool for concept development, and technology helps students explore concepts efficiently while facilitating a deeper understanding of them (Haleem et al., 2022; Hidayati et al., 2024).

According to Smaldino et al. (2018), instructional media and technology can help audiences connect concepts to classroom applications. In this research, we use Animaker media as a tool for presenting learning materials to students. This media is developed using a Realistic Mathematics Education (RME) context as a foundation for developing mathematical concepts and ideas.

RME serves as the foundational context for the design of this research. In Indonesia, RME is known as Pendidikan Matematika Realistik Indonesia (PMRI), which has been implemented for over twenty years and is still regarded as a reliable constructivist and active-based mathematical learning approach (Prahmana et al., 2020; Zulkardi et al., 2020). The context designed in this research extends the use of the Indonesian sweet food martabak to explore the concept of missing parts in understanding fractions (Pramudiani et al., 2022). We hypothesize that students' fraction sense can be developed through a series of structured activities. Putri & Zulkardi (2019) stated that the characteristics of RME support the design of higher-order thinking tasks that facilitate the development of students' mathematical thinking. The importance of context in mathematics, particularly in teaching fractions, has also been demonstrated by Sukasno et al. (2024), who showed that real-world context offers an innovative pedagogical approach.

Therefore, in this study we formulated the following research question: "To what extent can Animaker media, when used within realistic context, develop students' fraction sense?" The integration of Animaker media within the RME framework is further elaborated in the following section.

METHODS

This research aims to enhance classroom activities in the teaching and learning of fractions using Animaker media. To achieve this objective, a design research approach was adopted, consisting of multiple stages: preliminary design, pilot experiment, teaching experiment, and retrospective analysis. The pilot experiment involved 70 students from three classes (4HA, 4HB, 4HC) at School H, while the teaching experiment included 65 students from three classes (4IA, 4IB, 4IC) at School I. The participants in this study were fourth-grade primary school students from two schools in West Java, Indonesia which have similar student characteristics.

As outlined by Bakker (2018), Van den Akker et al. (2013), and Wilkins & Norton (2018), the foundation of design research lies in identifying educational challenges that inform the design and development process. Data collection included video recordings, students' work, field notes from classroom observations, and evaluations with the teachers.

This study consists of three main phases. The first phase, task preparation and design, involves conducting a literature review and collaborating with practitioners to develop feasible and effective fraction tasks using Animaker videos. The second phase, experimental teaching, focuses on implementing the designed tasks in classroom settings to examine their effectiveness in supporting student learning. The final phase, retrospective analysis, entails reflecting on the process and outcomes to evaluate the success of the design, derive design principles, and gain insights into students' thinking and the overall learning process.

In the realistic mathematics learning approach, problems are introduced through everyday life contexts, which serve as the starting point for mathematization (Prediger et al., 2015). By engaging with real-life situations, students learn to transform contextual problems into formal mathematical representations, thereby developing their ability to mathematize. This approach helps students understand and apply the concept of fractions more deeply. This phase also involved emergent modelling, a method of presenting a mathematical problem either in a semi-formal or formal manner (Prediger et al., 2015).

According to Gravemeijer (2004), emergent modeling is a step in the mathematizing process that progresses through multiple stages: 1) the situational level, where students apply domain-specific knowledge and strategies within the context of the situation; 2) the referential level, where the problem sketch connects models and strategies to real-world situations; 3) the general level, where the focus shifts from contextual references to mathematical strategies; and 4) the formal arithmetic level, where traditional procedures and notation are used.

The media developed by the researchers is a cartoon story featuring a child named Zhian who buys a martabak with three toppings: banana, cheese, and chocolate. The illustrations highlight differences in how the toppings appear—while the banana topping clearly reveals the slice boundaries, the cheese and chocolate toppings obscure them, making the divisions less distinguishable. All three toppings are equal in size, each comprising three slices. However, because the slice boundaries of the cheese and chocolate toppings are obscured, students were asked: *"How much of the cheese, chocolate, and banana toppings represents parts of the whole?"* The story also presents a situation in which one slice of the banana topping is eaten by Zhian's brother, Haby. Students were then prompted to determine how much of the martabak had been eaten—specifically, the missing portion of the banana topping. The animated story video is accessible via the following link (https://www.youtube.com/watch?v=jnduHxGvp78).

RESULTS AND DISCUSSION

Emphasizing the principle that fractions must represent equal parts, the task was designed to assess students' sense of conceptual understanding of fractions. We hypothesized that the visual ambiguity of the partitions would induce cognitive conflict, eliciting diverse responses that reveal varying levels of fraction sense. We believe that the use of media such as Animaker can enhance students' understanding of fractions as equal parts of a whole. This section presents the research results, including the preliminary design, pilot experiment, teaching experiment, and retrospective analysis, as elaborated below.

Preliminary Design

Following a review of the literature on fractions, we collaborated with practitioners in the initial phase to design a feasible and effective task for implementing interventions in the target research context. Task I and Task II were designed to assess students' fraction sense and their understanding of fractions as equally divided wholes. Following the validation of the task design, the story was developed using Animaker.

Pilot Experiment

The pilot experiment was designed to examine the core principles behind the effectiveness of specific tasks in enhancing and refining teaching experiments. It included a pre-assessment to evaluate students' prior knowledge of fractions as parts of a whole.

The pre-assessment consisted of questions on the students' answer sheets (See Figure 1). In this stage, the students completed their tasks on paper without the use of Animaker media. Two tasks, grounded in the RME context, were presented using martabak, as outlined below.

Perhatikan gambar di bawah ini.  Berapakah bagian martabak dari keseluruhan untuk masing-masing: a. Rasa keju. b. Rasa cokelat c. Rasa pisang Jelaskan alasanmu.	**English version:** Look at this picture  How much of the martabak represents the whole for each of the following: a. Cheese flavor b. Chocolate flavor c. Banana flavor Explain your reasons.

Figure 1. Task I with martabak context

In the first task (Figure 1), the students were presented with a single image of a martabak that appeared to be unevenly divided. However, all flavors were divided into three equal parts (banana, cheese, and chocolate). The cheese and chocolate flavors were topped with layers, obscuring the visibility of their cut pieces. The students were asked: *"How much of the martabak represents the whole for each of the following: a. cheese flavor, b. chocolate flavor, c. banana flavor? Please explain your reasons."* Additionally, they were asked to provide explanations for their answers.

According to the students' work, various answers were given with different justifications. We categorized them into five classifications: 1) Subdivision into parts; 2) Subdivision as class–whole; 3) Use of fraction language (consistent); 4) Use of fraction language (inconsistent), and 5) Unclassified category. Examples of students' answers for each category are presented below. All student names are pseudonyms.

Using Subdivision into Parts

In this category, some students counted the parts as individual units, indicating an unclear understanding of the whole. Instead, they simply counted each topping on the martabak. Hana recognized three pieces in the banana, three in the chocolate, and three in the cheese, reasoning that she focused on the corner cut lines. This differed from Rini's response; she considered the chocolate and cheese as one part each and the banana as three parts. She explained that the chocolate and cheese flavors were not divided, whereas the banana flavor was split into three parts.

Hana's Answer	***Rini's Answer***
Pisang : 3 bagian coklat : 3 bagian keju : 3 bagian Karena terlihat di ujungnya ada potongan	rasa coklat : 1 rasa keju : 1 rasa pisang : 3 Alasannya : karena keju dan coklat tidak dipotong kalau di pisang dipotong 3 bagian
English version: Banana: 3 parts, Chocolate: 3 parts Cheese: 3 parts Because it seems there is a cut line in the corner.	**English version:** Chocolate: 1, Cheese: 1, Banana: 3 The reason is because the cheese and chocolate flavor were not cut, whereas banana flavor was cut into 3 parts.

Figure 2. Students' answers using subdivision into parts

Based on Figure 2, the students viewed the parts as separate units instead of grasping the concept of the whole. They merely counted each topping on the martabak.

Using Subdivision as Class-whole

This category represents types of students' answers that applied the subdivision strategy. However, in this classification, the parts were interpreted not only as subdivisions but also as the whole or the sum of the components. For example, Rey's response in Figure 3 indicates that he viewed the total number of components for the cheese flavor differently. Unlike the other flavors, which he saw as divided into three parts each, he considered the cheese flavor to consist of four parts. Based on this, he calculated the total to be 10 parts. As shown in Figure 3, this answer differed from Dian's, who identified three parts for cheese, two for chocolate, and three for banana, concluding there were eight parts in total. Figure 3 illustrates this subdivision-class-whole categorization with their respective responses.

Rey's Answer	***Dian's Answer***
Rasa keju ada empat bagian Rasa coklat ada tiga bagian Rasa pisang ada tiga bagian keseluruhannya ada sepuluh bagian.	Rasa keju : 3 , Rasa coklat : 2 , dan rasa pisang : 3 dan seluruhnya : 8 bagian
English version: There are four parts of cheese flavor There are three parts of chocolate flavor There are three parts of banana flavor So, the total is ten parts.	**English version:** Cheese flavor: 3, Chocolate flavor: 2, and Banana flavor: 3. So, the total (whole): 8 parts.

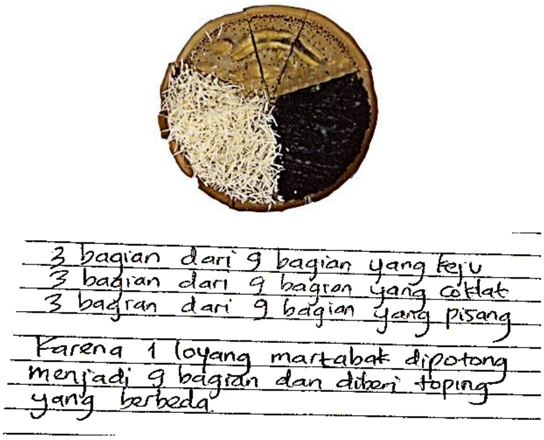
Figure 3. Students' answers using subdivision as class-whole

According to Figure 3, the students continued to employ the subdivision strategy. However, in this classification, the subdivisions were also interpreted as the sum of the parts or the whole.

Using Consistent Fraction Language

Some students in this category used fractional language to express their answers. For instance, Risa and Yaya both stated that each flavor—cheese, chocolate, and banana—comprised 3 out of 9 parts. Their reasoning was similar, each associated with a specific topping. The main difference in their approaches was that Yaya illustrated her thinking by drawing cut lines on the cheese section to show it was split into three parts, consistent with the other flavors, whereas Risa simply provided her answer without visualizing the divisions. Although neither student used formal fractional notation (numerators and denominators), their responses reflected an understanding of part-whole relationships. Both also correctly identified the whole by equally dividing each flavor into three parts, resulting in a total of nine equal parts. Figure 4 illustrates an example of consistent use of fractional language.

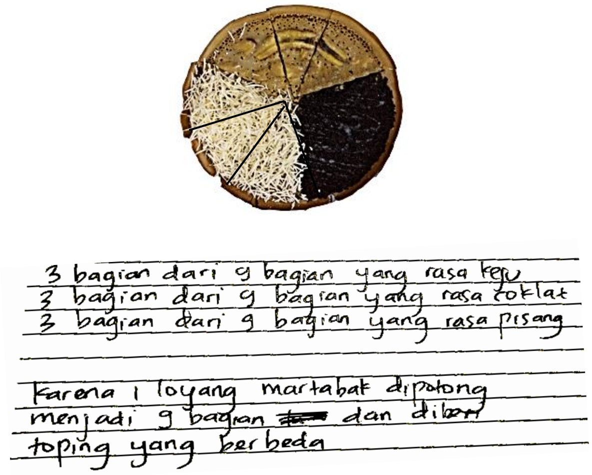
Risa's Answer



English version:

3 parts of 9 parts cheese flavor
3 parts of 9 parts chocolate flavor
3 parts of 9 parts banana flavor
Because 1 martabak pan was cut into 9 parts and that topped with the different toppings.

Yaya's Answer



English version:

3 parts of 9 parts cheese flavor
3 parts of 9 parts chocolate flavor
3 parts of 9 parts banana flavor
Because 1 martabak pan was cut into 9 parts and that topped with the different toppings.

Figure 4. Students' answers using consistent fraction language

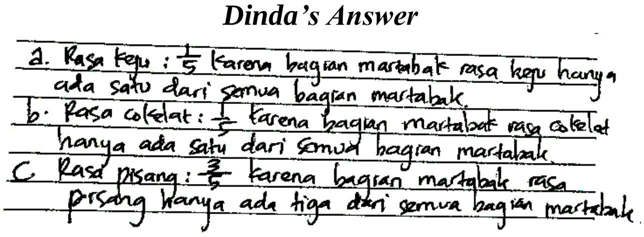
As shown in Figure 4, the students demonstrated an understanding of fractional language. They identified the whole by evenly dividing the martabak into three parts for each topping, resulting in a total of nine parts. Therefore, their responses were classified as consistent use of fractional language.

Using Inconsistent Fraction Language

In this category, some students used fractional language to express their answers; however, not all grasped the idea of equal partitioning. For example, Figure 5 shows the responses of Dinda, Doni and Ahmad. Dinda identified a total of five parts—one for cheese, one for chocolate, and three for banana—indicating that when a cut line is not visible, she may interpret the part as a single whole.

Doni's reasoning aligned with this idea, as he interpreted the chocolate part as a single whole piece due to the absence of visible divisions. However, he viewed the cheese and banana sections as having three parts each. Based on this reasoning, he concluded that the martabak consisted of seven parts. Both Dinda and Doni demonstrated a developing understanding of fractional language. However, because they misunderstood the concept of 'whole' in fractions, their answers were classified as using inconsistent fractional language. Ahmad provided another example, where he counted each topping as three parts but still identified the fraction as $\frac{1}{9}$. He also determined the whole based on the total number of parts, which was 9.

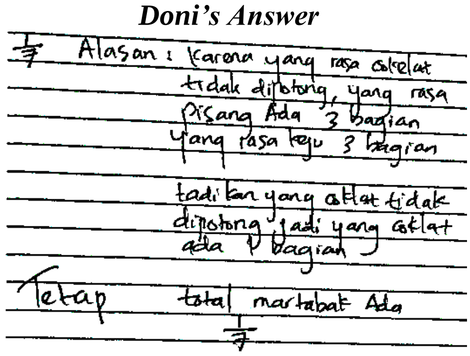
Dinda's Answer



English version:

Cheese flavor: $\frac{1}{5}$ because cheese martabak is only one of all martabak parts.
Chocolate flavor: $\frac{1}{5}$ because cheese martabak is only one of all martabak parts.
Banana flavor: $\frac{3}{5}$ because banana martabak is only three of all martabak parts.

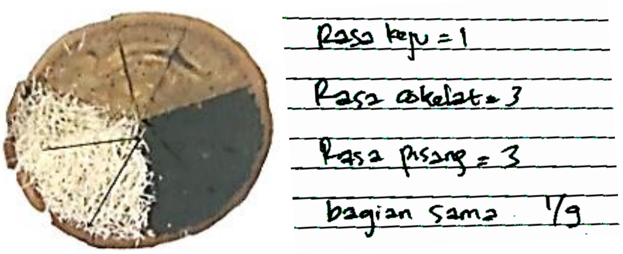
Doni's Answer



English version:

$\frac{1}{7}$, The reason: because the chocolate flavor was not cut, the banana flavor was 3 parts, the cheese flavor was 3 parts. So, since the chocolate flavor was not cut, it is 1 part.
The total martabak is $\frac{1}{7}$.

Ahmad's Answer



English version:

Cheese flavor: 3,
Chocolate flavor: 3,
Banana flavor: 3
The same partition: $\frac{1}{9}$.

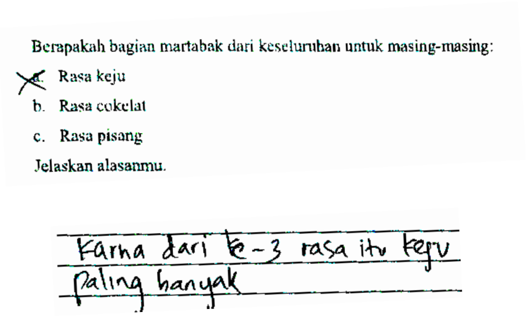
Figure 5. Students' answers using inconsistent fraction language

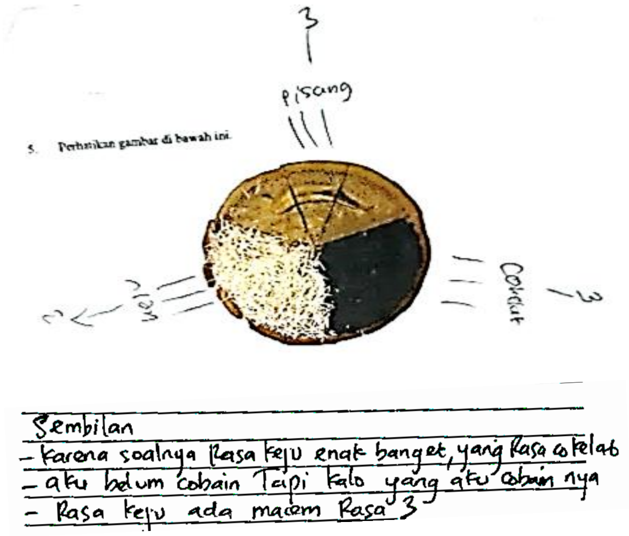
We hypothesized that students may struggle to grasp the idea that fractions must be divided equally when cut lines are not clearly visible (See Figure 5). While both students demonstrated an emerging understanding of fractional language, their interpretations reflected a continued misunderstanding of the concept of the whole. As a result, their responses were categorized as inconsistent use of fractional language. Another response was made by Ahmad. Ahmad had a basic understanding of fractions. He identified the whole as consisting of nine parts in total. However, when expressing his answer in fractional form, he wrote $\frac{1}{9}$, which did not accurately reflect the question—

specifically, how much each topping constitutes of the whole. Therefore, his answer is classified as inconsistent use of fractional language.

Unclassified Category

The unclassified category refers to student responses that did not demonstrate an understanding of fractions or mathematical concepts. For instance, Dodo misunderstood the question, treating it as a multiple-choice item. He simply selected option (a) for the cheese flavor, stating that it was the largest portion. Similarly, Sisi answered 'nine', but her explanation indicated that she was drawing from personal experience with eating martabak rather than applying mathematical reasoning, as illustrated in Figure 6.

<table>
<tr><th>Dodo's Answer</th><th>Sisi's Answer</th></tr>
<tr><td>


</td><td>


</td></tr>
<tr><td>English version:
Because the cheese flavor is the largest part among the three flavors.</td><td>English version:
Nine. Because the cheese flavor is very delicious. I have never tried the chocolate flavor, but I have tried the cheese one, and there were three pieces with cheese flavor.</td></tr>
</table>

Figure 6. Students' answers with unclassified category

Based on Figure 6, Dodo and Sisi's answer could not be incorporated into the previous classification, as they are unrelated to the concept of fractions or mathematical principles.

Students' Answers of Task II

In the second task (See Figure 7), we developed a task asking students to identify the missing part of martabak relative to the whole. The task presented students with an image of a martabak with one slice removed. The question posed was: "*If one piece of the banana flavor has been eaten, how much does it represent of the whole martabak? Explain your reasons!*"

Perhatikan gambar di bawah ini:  Jika satu potong martabak sudah dimakan, maka berapa bagian martabak yang dimakan tersebut dari keseluruhan? Jelaskan alasanmu.	**English version:** Look at this picture  If one piece of martabak has been eaten, how much of the martabak does that represent from the whole? Explain your reasons.

Figure 7. Task II with martabak context

Based on the students' answers, the researchers categorized the responses into four groups: (1) using fraction language with signs of understanding, (2) using fraction language without signs of understanding, (3) dividing into parts or units, and (4) the unclassified category, which included answers unrelated to fractions or mathematical concepts. Examples from students' responses in each category are described below.

Using Fraction Language with Signs of Understanding

As shown in Figure 8, the students used fractional language to describe both the missing part and the total parts of the whole, stating that it was 1 part of banana flavor out of 9 parts in total. This indicates that the students understood the concept of a fraction as part of a whole. For example, Dewi explained that since one part was eaten out of nine, the missing part was one out of nine. Although Dewi did not write the fraction in the form of a numerator and denominator, her use of fractional language suggests an understanding of fractions. Similarly, Ana, who shared Dewi's reasoning, expressed the fraction using both a numerator and a denominator, specifically $\frac{1}{9}$.

Dewi's Answer	***Ana's Answer***
1 bagian dari 9 bagian karena 1 bagian dimakan dari 9 bagian **English version:** 1 part out of 9 parts because 1 part was eaten from 9 parts.	$\frac{1}{9}$ karena 1 loyang dipotong menjadi 9 potongan dan 1 rasa pisang dimakan oleh pemiliknya. **English version:** $\frac{1}{9}$ because one martabak pan was cut into 9 pieces, and one banana-flavored piece was eaten by its owner.

Figure 8. Students' answers using fraction language with signs of understanding

Figure 8 demonstrated the students' use of fractional language and their reference to the missing part and the total parts as a whole, that is, one part of banana flavor out of nine parts. Consequently, this shows that the students understand the idea of a fraction as a part of a whole.

Using Fraction Language without Signs of Understanding

Some students also used fractional language, as shown in Figure 9, although it was evident that they did not fully grasp the concept. For example, Sasa stated that the missing part was $\frac{1}{8}$. She explained that it was originally $\frac{1}{9}$, but since one piece had been eaten, it became $\frac{1}{8}$. Sasa's response reflected the application of subtraction based on whole numbers. Similarly, Didi stated that the missing part was $\frac{1}{5}$, arguing that one part of five had been eaten. This suggests that Didi considered the total to be five.

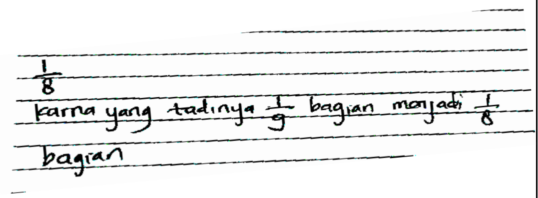
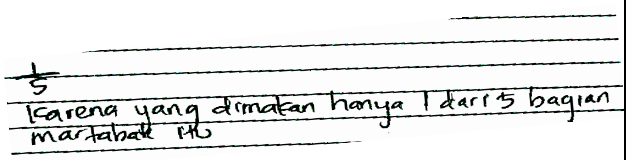
Sasa's Answer	***Didi's Answer***
	
English version: $\frac{1}{8}$ because what was initially $\frac{1}{9}$ has now become $\frac{1}{8}$ parts.	**English version:** $\frac{1}{5}$ because only 1 out of the 5 parts of the martabak was eaten.

Figure 9. Students' answers using fraction language without sign of understanding

Based on Figure 9, some students also used fractional language, but it was evident that they misunderstood the concept of the whole. Therefore, the researchers classified the answers in Figure 9 as the use of fractional language without signs of understanding.

Using Subdivision into Parts or Units

Some students continued to rely on subdivision when answering questions about parts or units, indicating a lack of understanding of fraction language. For example, in Figure 10, Wawan responded with '1', explaining that only one piece was clearly missing. Similarly, Salis also answered '1', explaining that only one piece of the banana-flavored martabak had been eaten.

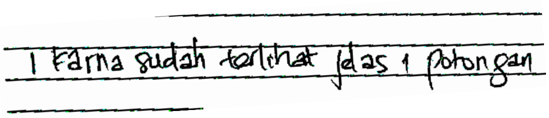
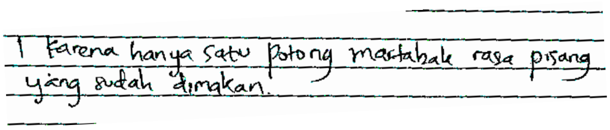
Wawan's Answer	***Salis's Answer***
	
English version: 1 because it is obvious that it is 1 piece.	**English version:** 1 because only one piece of the banana-flavored martabak has been eaten.

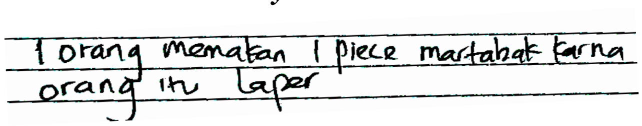
Figure 10. Students' answers using subdivision into parts or units

Figure 10 depicts students who continued to answer using subdivision into parts or units, indicating a lack of understanding of the concept of fractions.

Unclassified Category

Despite the varying responses from students, which reflected both their understanding and misconceptions of fractions, some students provided answers that lacked any mathematical reasoning. For example, in Figure 11, Roy's response was: "*One person ate one piece of martabak because he is hungry*".

Roy's Answer



English version:

One person ate one piece of martabak because he was hungry.

Figure 11. Students' answer using unclassified category

Roy's response in Figure 11 could not be classified within the previous categories, as he did not apply any mathematical concepts. Although he mentioned the number (one piece), his answer was unrelated to the question asked.

Teaching Experiment

Based on the results of the pilot experiment, we decided to develop the task by incorporating a narration created in an Animaker video. Since the pilot experiment revealed that students were still unclear about the concept of fractions with equal parts, we developed an illustration in the video that demonstrated how a piece of banana martabak was taken through animation, using the following story.

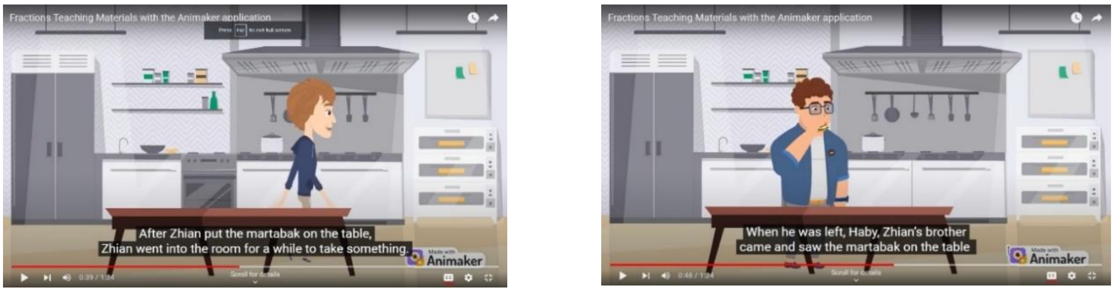
The Storyboard of Task I

The first task in the teaching experiment remained the same as in the pilot experiment. It aimed to assess the students' understanding of fractions as the parts of a whole, with some pieces being invisible (the cheese and chocolate flavors). However, unlike the pilot experiment, we introduced a cartoon story in which a child purchases a martabak. Before the students responded to the question, the teacher presented this story, which was accessible via a link (https://www.youtube.com/watch?v=jnduHxGvp78). The question posed in Task I is: "*How much of the whole does the cheese, chocolate, and banana flavors represent?*" Figure 12 illustrates the storyboard of Task I.

Figure 12. The storyboard of Task I

The Storyboard of Task II

After watching the story shown in Figure 12, the students moved to Task II, as depicted in Figure 13. In this task, they were asked to determine how much of the martabak had been eaten—specifically, the missing banana-flavored slice—relative to the whole. Using Animaker, Task II visually illustrated the removal of the martabak slice, a detail not clearly shown in the paper-based version used during the pilot experiment. This animation was designed to help students better understand the process of removing a part of the whole. The storyboard of Task II is shown in Figure 13.



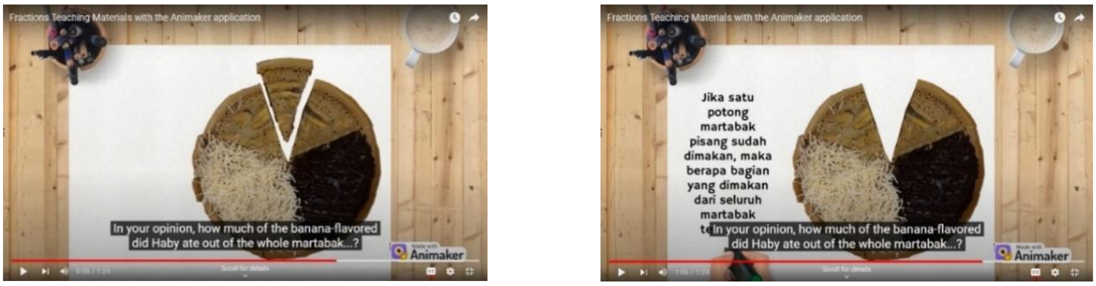


Figure 13. The Storyboard of Task II

In the teaching experiment, the teaching and learning process involved ongoing trials, revisions, and the development of instructional activities (Gravemeijer, 2004). The aim was to collect data to answer the research question. This study was conducted by developing interactive media using Animaker, based on the principles of RME. The experiment focused on improving students' understanding of mathematical concepts. Before the instructional activities, the teachers and researchers discussed the sequence of tasks to be implemented in the classroom. After the activities were carried out, they engaged in reflective discussions to refine the task design and provide feedback to address any challenges or shortcomings in the teaching and learning process. The teaching experiment involved 65 fourth-grade students and three teachers from School I (SI).

Retrospective Analysis

After implementing the teaching experiment using Animaker media within the RME framework, a noticeable improvement was observed in students' understanding of fractions, as shown in Figure 14. The participants included 70 students from three classes (4HA, 4HB, 4HC) in the pilot experiment at School H and 65 students from three classes (4IA, 4IB, 4IC) in the teaching experiment at School I. The indicator of fraction sense showed significant progress in the teaching experiment (FI-B), as evidenced by the increasing number of students who answered the fractional task using consistent fractional language (depicted in the green graph), compared to the pilot experiment (FI-A).

Figure 14 illustrates the improvement in the use of fraction language among students from the pilot experiment to the teaching experiment across all three classes: FI-A-1 to FI-B-1, FI-A-2 to FI-B-2, and FI-A-3 to FI-B-3.

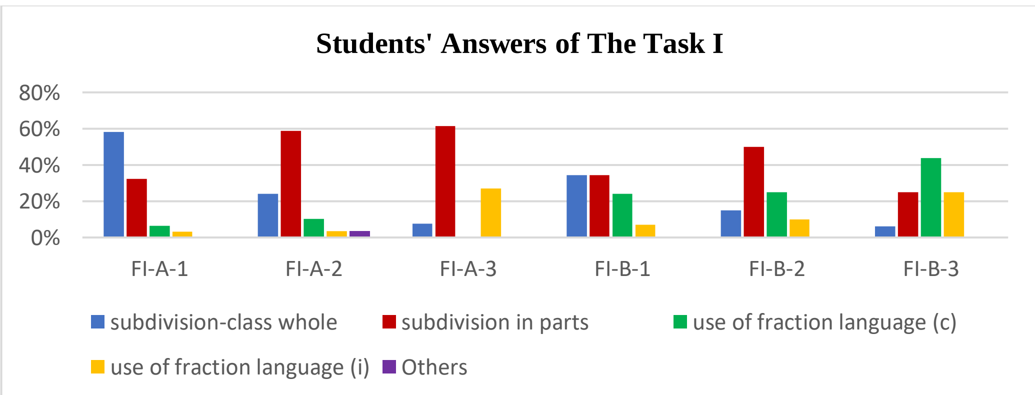


Figure 14. The visualization of students’ answers for the Task I

Similarly, for Task II, there was an improvement in students' understanding of the part-whole relationship when a segment was missing, as represented by the blue graph. Figure 15 visually illustrates the students' responses to Task II.

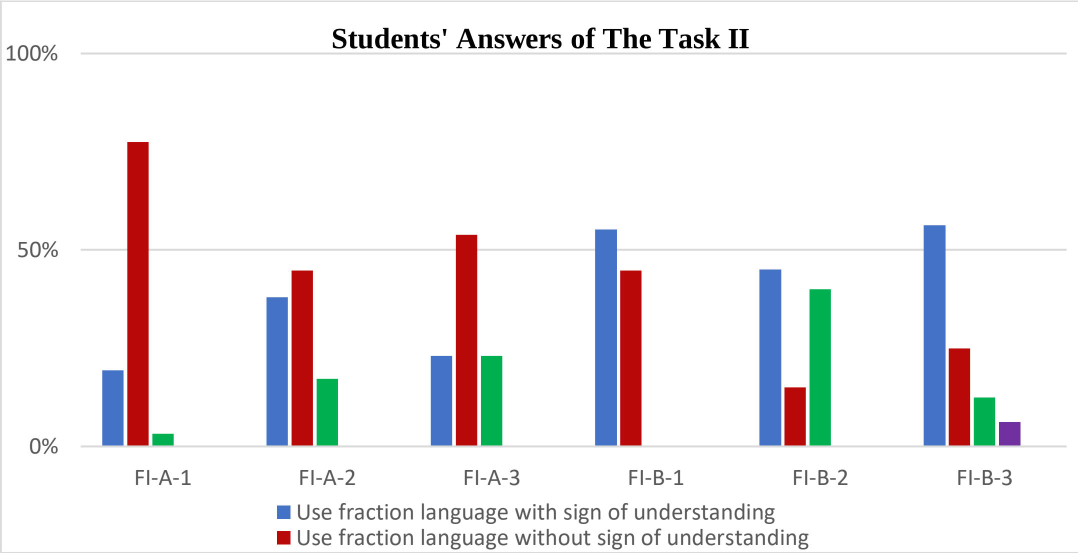


Figure 15. The visualization of students' answers for the Task II

Figure 15 shows an improvement in the number of students using fractional language, indicating a better understanding from the pilot experiment to the teaching experiment across the three classes: FI-A-1 to FI-B-1, FI-A-2 to FI-B-2, and FI-A-3 to FI-B-3. These findings suggest that the use of Animaker Media in a practical classroom setting can enhance students' comprehension of fractions.

In addition to evaluating students' understanding of fractions, we also collected their feedback on the teaching and learning experience using Animaker media. Figures 16 and Figure 17 present the students' responses.

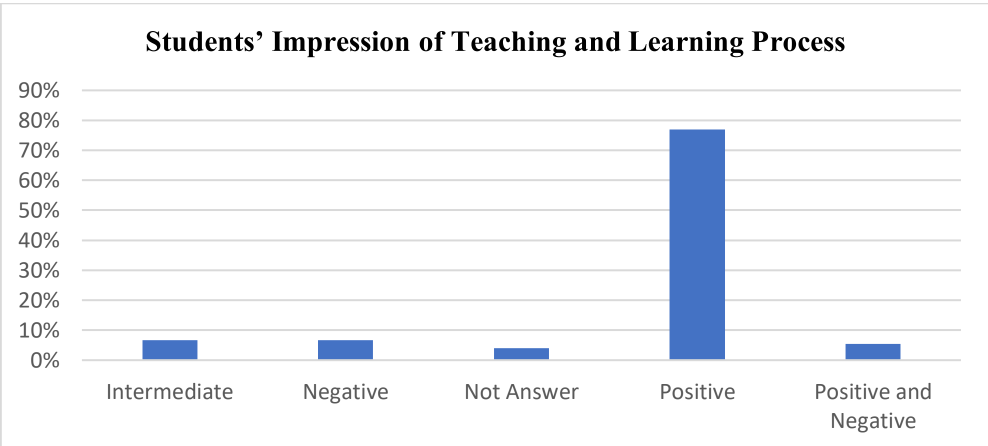


Figure 16. Students' impression of the teaching and learning process

As shown in Figure 16, 78% students provided positive feedback on the teaching and learning experience, highlighting the engaging nature of martabak story. However, when asked whether they preferred solving fraction problems using only worksheets and paper-based images, as in the pilot experiment, or through Animaker media, not all students preferred the latter. Figure 17 illustrates the students' preferences regarding the different methods for learning fractions.

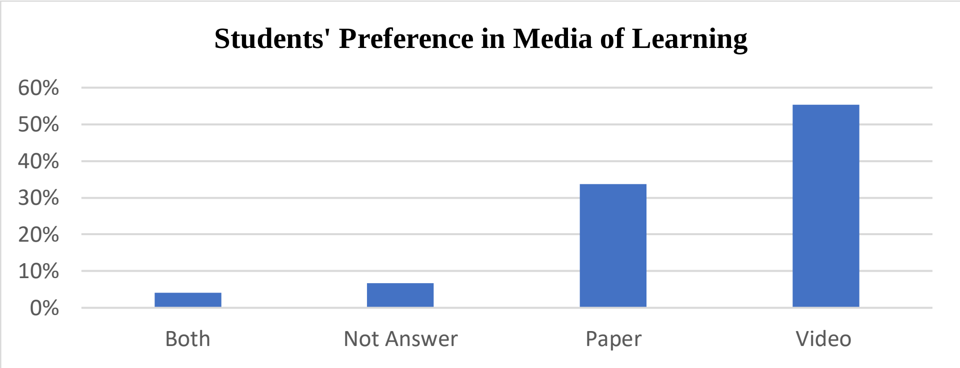


Figure 17. Students' preference in media of learning

As shown in Figure 17, 4% of students felt that both methods were equally effective for understanding fractions, while 7% of students did not respond to the question. Meanwhile, 34% of students preferred using paper or worksheets due to their simplicity, and 55% of students indicated that Animaker media enhanced their understanding of fractions.

The findings indicate that using Animaker Media within a realistic context for task design can develop students' understanding of fractions. According to Gravemeijer (2004), contextual or realistic problems can help students "rediscover" the characteristics or definitions of mathematical concepts. This aligns with the study of Prahmana et al. (2020), which emphasized that in teaching mathematics, teachers should consider students' prior knowledge and connect it to a realistic context as a foundation for learning activities. When presented with meaningful tasks embedded in realistic contexts, students have greater opportunities to construct their understanding of mathematical concepts (Putri & Zulkardi, 2019). Furthermore, in the RME approach, the process of progressive mathematical problems serves as a tool for students to construct a formal understanding of mathematical concepts (Van den Heuvel-Panhuizen, 2020). In addition, Pramudiani et al. (2023, 2024) emphasized that learning mathematics should encourage students to rediscover concepts, rather than rely solely on the transfer of knowledge from teacher to student.

Based on the explanation above, using a meaningful context as a foundation for concept formation is essential. According to Putri & Zulkardi (2019), the key to helping students understand mathematics lies in presenting meaningful context. Therefore, the context must be both relatable and factual in students' minds. During the teaching and learning process, students actively engaged in discussions about the context of Indonesian food, specifically martabak, as presented through the Animaker media. By emphasizing a contextual and narrative approach, rather than focusing solely on abstract or procedural aspects of fractions, students were better able to rediscover and understand the concept of fractions.

However, this study has a limitation. Only a few students explicitly demonstrated the models and strategies they used. Since the question asked, "*how much*" and "*please give the reason*", most students responded with written explanations rather than constructing mathematical models. Referring to the modeling stages in RME proposed by Gravemeijer (2004) and Van den Akker et al. (2013), it appears that the students' understanding remained at the situational level. At this stage, domain-specific knowledge and strategies are applied within the context of the situation, without yet transitioning to more formal or mathematical representations. There were no clear indications of students progressing from the referential to the general level, which bridges informal understanding to formal mathematical concepts. As a result, the mathematics process was not adequately captured. Nevertheless, most students in the teaching experiment were able to articulate their answers and provide clear reasoning. They demonstrated the ability to develop their own justifications when responding to questions related to the given problem.

The use of Animaker media effectively illustrated the removal of a martabak slice, a detail that was not clearly conveyed in the paper-based task. Based on students' responses, this visual representation enhanced their ability to conceptualize the situation. In everyday life, the ability to visualize and apply this sense is crucial (Hoon et al., 2020). However, the sense of reality is often overlooked or given insufficient attention by researchers and mathematics educators. This study demonstrates that this sense can significantly support students in understanding mathematical concepts.

The role of mathematical sense established the foundation, framework, and authenticity of mathematics, while also enhancing the significance of this sense and the development of mathematical concepts, extending to students' reasoning (Pramudiani et al., 2023). Consequently, it can be inferred that mathematical sense serves as the foundation for students' mathematical reasoning and decision-making.

In summary, mathematics and technology are inseparable in 21st-century learning. To foster students' mathematical thinking, it is essential to provide supportive tools that engage them in problem-solving. Applying RME through meaningful and relatable stories can enhance students' understanding of fractions. When combined with technology—such as Animaker media, RME can significantly strengthen students' reasoning by allowing them to recognize mathematical problems through sensory-rich experiences.

CONCLUSION

This research emphasizes the necessity of incorporating active learning approaches, such as Realistic Mathematics Education (RME), with technology to enhance the contextual aspects of the learning environment, in line with the demands of 21st-century education. The task design developed in this study illustrates the evolution of students' understanding of fractions as they progressively reconstruct their mathematical reasoning. Analysis of students' responses reveals that the use of

Animaker media within a realistic context can effectively develop their fraction sense and foster their mathematical reasoning. However, the study also revealed certain limitations, particularly in embedding emergent modeling within progressive mathematization and in students' readiness to engage with technology. Therefore, future research should focus on strengthening support systems that equip students with the necessary digital competencies, including access to rich, meaningful, and challenging tasks. Collaboration among all stakeholders is essential to ensure the successful integration of technology into teaching and learning practices.

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