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Ratio Material Learning Design Using the Context of Cooking Rice to Help Elementary Students Understand Concepts

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Abstrak

Pemahaman konsep merupakan hal yang perlu dimiliki siswa karena konsep-konsep dalam materi matematika saling berhubungan satu sama lain. Tujuan penelitian ini adalah untuk mengetahui desain pembelajaran materi rasio menggunakan konteks memasak nasi yang dapat membantu siswa Sekolah Dasar dalam memahami konsep rasio. Peneliti merancang lembar aktivitas siswa dengan konteks memasak nasi sebelum melakukan penelitian. Penelitian desain ini dilakukan pada siswa kelas VI salah satu SD Negeri di Belitang yang dilakukan dalam tiga tahap yaitu *the preparing for the experiment, the design experiment, and retrospective analysis*. Pengumpulan data melalui lembar aktivitas siswa dan wawancara. Teknik Miles dan Huberman digunakan untuk menganalisis data yang meliputi reduksi data, penyajian data, dan penarikan data. Hasil penelitian menunjukkan bahwa desain pembelajaran materi rasio menggunakan konteks menanak nasi dapat membantu siswa dalam memahami konsep rasio. Lintasan pembelajaran terdiri dari empat aktivitas, yaitu (1) menonton video memasak nasi, (2) mengetahui hubungan jumlah nasi dengan jumlah air pada proses memasak nasi, (3) membuat tabel rasio tentang jumlah beras dan jumlah air yang dibutuhkan dalam proses memasak nasi, (4) menyimpulkan pengertian rasio berdasarkan aktivitas memasak nasi.
Kata kunci: Desain Research, Pemahaman Konsep, PMRI, Rasio.

Abstract

Understanding concept is something that students need to have because the concepts in mathematics material are interconnected with each other. The purpose of this research is to determine the learning design of ratio material using the context of cooking rice which can help elementary school students understand the concept of ratio. Researchers designed student activity sheets using the context of cooking rice before conducting research. This design research was carried out on class VI students at one of SD Negeri in Belitang and was carried out in three stages, namely the preparing for the experiment, the design experiment, and retrospective analysis. Data collection through student activity sheets and interviews. Miles and Huberman techniques are used to analyze data which includes data reduction, data presentation, and data conclusion. The results showed that ratio material learning design using the context of cooking rice can help students understand the concepts of ratio. The learning track consists of four activities, namely (1) watching videos of cooking rice, (2) determining the relationship between the amount of rice and the amount of water in the process of cooking rice, (3) making a comparison table of the amount of rice and the amount of water needed to cook rice, (4) conclude the meaning of ratio based on the activity of cooking rice.
Keywords: Design Research, PMRI, Ratio, Understanding Concept.

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INTRODUCTION

In mathematics learning, concept understanding is important and is the basis for solving problems (Mayasari & Habeahan, 2021). Permendikbud number 58 of 2014 states that concept understanding is one of the learning objectives of mathematics to be achieved (Sari et al., 2022). Concepts in mathematics are interrelated with each other (Ostian et al., 2023), so it is important to have an understanding of concepts in order to continue learning to the next level (Brinus et al., 2019). Students who have a good understanding of concepts will be able to solve math problems well without experiencing significant obstacles (Sari et al., 2022). The characteristics of a student having an understanding of concepts in a particular material are that students can restate concepts that have been learned, are able to provide examples and distinguish those that are not examples and use concepts to solve problems (Dafrita & Nurmaningsih, 2019).

One of the material concepts that students need to have in learning mathematics is the concept of ratio (Lestari et al., 2019). Understanding the concept of ratio is needed if students want to succeed in learning mathematics in grades 6-8 (Diba & Prabawanto, 2019). Many mathematics materials require ratio materials such as proportions, fractions, probability, plane geometry, and algebra (Nur & Sari, 2022). There are also many problems in everyday life that require the concept of ratio including price comparison, map scale, percentage, recipe, weight, number of children, and value of money (Nur & Sari, 2022; Puspita et al., 2023).

However, in reality students have difficulty in understanding the concept of ratio (Muttaqin et al., 2017). Many students do not have a good understanding of the concept and have difficulty in solving problems related to ratios (Diba & Prabawanto, 2019; Setyaningsih et al., 2018). Difficulties in solving ratio problems are caused by lack of knowledge related to prerequisite material, lack of understanding of concepts and lack of application of concepts during learning (Wahyuningrum et al., 2019). Therefore, it is necessary to improve the quality of learning that can help students' understanding of concepts related to ratios. One alternative solution is to design learning ratio materials using real contexts to help students' concept understanding.

Indonesian Realistic Mathematics Education (PMRI) is learning that adapts to the Realistic Mathematics Education learning theory developed by Fruedhental in the Netherlands (Utari et al., 2023). The characteristic of RME learning is the use of realistic situations in learning. Realistic in RME is not fixated on the context in the real world but also includes the context that students can imagine (Zulkardi & Putri, 2019). So that the problems presented in PMRI learning are problems in the real world, the world of fantasy or fairy tales, the formal

world of mathematics as long as the problem is a real experience that can be imagined in the minds of students.

The use of real contexts characterizes PMRI learning. Learning using the PMRI approach starts from real situations or the context of students' daily lives which are used as a bridge to connect the informal stage to the formal stage of mathematics (Mubharokh et al., 2022). The use of context in mathematics learning will make it easier for students to understand problems and do problem solving (Zulkardi, 2002). Through learning using the context of students' personal lives, it is expected that mathematics learning becomes more meaningful to students (Fitrisyah et al., 2023).

Some previous studies that have designed learning ratio materials using real contexts include Muttaqin et al. (2017) using the context of East OKU, Ayan et al. (2019) using the context of fish and fish feed, and the development of learning media using RME by Maryam & Sampoerno (2021). Based on previous research, no researcher has designed learning ratio material using the context of cooking rice to help students understand the concept of ratio. This article specifically discusses how the learning design of ratio material using the context of cooking rice can help elementary school students understand the concept. So that through this article, we will know the learning design of ratio material using the context of cooking rice that can help elementary school students understand the concept.

METHOD

This study is a design research type validation studies that aims to develop local instructional theory through collaboration between teachers and researchers to improve the quality of learning (Gravemeijer & Cobb, 2006). In this study, learning activities that are close to students' daily lives are designed to help students understand the concept of ratio.

Design research has three stages, namely preparing for the experiment, the design of the experiment, and retrospective analysis (Gravemeijer & Cobb, 2006). In the research preparation stage, the researcher conducted a literature review related to ratio material, design research, and realistic mathematics education as material for formulating the hyphopthetical learning trajectory (HLT). HLT contains learning objectives, learning activities carried out by students, and conjectures (allegations) of how students think during the learning process (Sunedi, 2021). The experimental design stage is divided into two stages, namely pilot experiment and teaching experiment. At the pilot experiment stage, the researcher tested the HLT that had been made to a small group of students, namely six grade VI students at SD Negeri Tepungsari who had heterogeneous abilities (high, medium, and

low). The results of the pilot experiment stage will be used as material for revising the HLT to make it better and more perfect. The revised HLT was tested on one grade VI class at one of SD Negeri in Belitang in the teaching experiment stage. At this stage the researcher is only an observer in learning activities and the teacher as a teacher. The researcher will observe and analyze what happens during the learning process. The third stage is retrospective analysis, by comparing the data obtained from the results of the teaching experiment with the HLT that has been formulated at the beginning. The results of the analysis will produce local instructional theory (LIT).

Data collection was done by giving Student Activity Sheets (LAS) and interviews. Data collection of student activity sheets and interviews were conducted at the pilot and teaching experiment stages. The interview was conducted to confirm the answers on the student activity sheet and obtain additional information that was not obtained during the learning. Data were analyzed using the Miles and Huberman method which consists of data reduction, data presentation and data conclusion.

RESULTS

At the research preparation stage, after conducting a literature study, the researcher together with the teacher formulated the Hyphothetical Learning Trajectory (HLT). The HLT that has been prepared can be seen in Table 1.

Table 1. Design HLT

Activity	Learning Objectives	Students Learning Activity	Conjecture/Predict Student Answers
1	Observe daily activities related to ratio material	Students watch the rice cooking process video carefully	- Students watch the video carefully and can write down the tools, ingredients and steps for cooking rice. - Students do not watch the video carefully and cannot write down the tools, ingredients and steps to cook rice completely.
2	Identify the relationship between two quantities.	Students identify the relationship between the amount of rice and the amount of water in the process of cooking rice.	- Identify the relationship between two quantities.
3	Creating a Ratio	Students create a	- Students can make a table

Activity	Learning Objectives	Students Learning Activity	Conjecture/Predict Student Answers
	Table	table comparing the amount of rice cooked from 1 to 6 cups and the amount of water needed.	comparing the amount of rice and the amount of water from 1 cup of rice to 6 cups of rice. - Students cannot make a table comparing the amount of rice and the amount of water needed.
4	Explain the definition of ratio and ratio notation	Students write the definition of ratio based on the relationship between the amount of rice and the amount of water in the process of cooking rice.	- Students can write the definition and notation of ratio - Students cannot write the definition and notation of ratio

Based on Table 1, it is known that researchers designed four activities that students must go through to be able to understand the concept of ratio. The four activities are presented in a Student Activity Sheet (SAS). Through the LAS, the researcher taught mathematics from an informal situation, namely the activity of cooking rice and guided students to arrive at a formal situation, namely explaining the definition and notation of ratios.

At the experimental design stage, the pilot experiment stage was carried out by testing the LAS that had been designed on 6 grade VI elementary school students with 2 students each with high, medium and low abilities. The results of student answers at the pilot experiment stage were used as input for improving the HLT to make it more perfect. Based on the analysis of students' answers in each activity, only the answers in activity three showed that the questions needed to be improved. The following are the results of students' LAS answers that became the improvement material for HLT presented in Figure 1.

In the third activity, students were asked to make a table comparing the amount of rice cooked from 1 to 6 cups and the amount of water needed. However, as listed in Figure 1 that the table made by students is not correct, students do not write many glasses of rice cooked from 1 glass of rice, 2 glasses of rice, and so on until 6 glasses of rice but only write the comparison of the amount of rice cooked 1 glass and 6 glasses of rice.

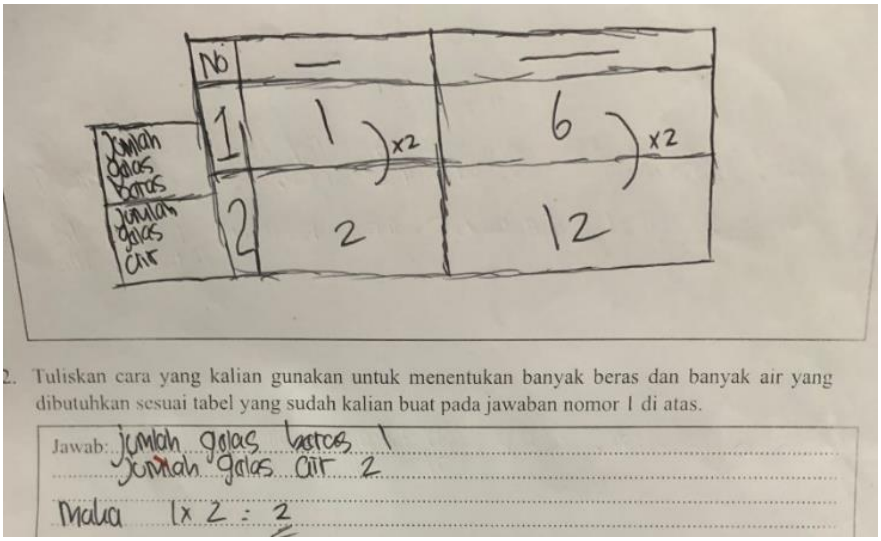


Figure 1. Example of Student Answers in the Third Activity

After exploring more deeply through interviews, it was found that students did not understand the meaning of the problem and had difficulty in making tables. The findings in this study also support the research of Muttaqin et al. (2017) that students' difficulties in ratio material are related to the form of questions and information in the problem and the ability to present problems in tabular or graphic form. The following are the results of interviews with subject S-1, a student representative from the low group.

P : *"What is this table about? (pointing to the table drawn by the student)."*
S-1 : *"A table comparing rice and water mom..."*
P : *"Can you explain that 1 times 2 gets 2 then 6 times 2 results in 12, what does that mean?"*
S-1 : *"It means the number of glasses of rice is 1, the number of glasses of water is 2. So 1 times 2, 2."*
P : *"Okay then what does 6 and 12 mean?"*
S-1 : *"Yes, the same as before, the amount of rice and the amount of water."*
P : *"Do you understand the question's instructions?"*
S-1 : *"Actually I'm confused mom, because I don't understand."*
P : *"Besides the question being difficult to understand, what are your difficulties in doing this problem?"*
S-1 : *"I'm also confused about how to make the table."*

Based on this, it is necessary to make improvements to the question narrative in the third activity so that students can more easily understand the question instructions. The results of the third activity revision are listed in Table 2.

Table 2. LAS Improvement Results

Activity	Before Revision	After Revision
3	Make a table comparing the amount of rice cooked from 1 to 6 cups and the amount of water needed.	Make a table comparing the amount of rice and the amount of water needed to cook 1 cup of rice to 6 cups of rice.

After the LAS was improved according to the input at the pilot experiment stage. Furthermore, the teaching experiment stage was carried out by giving the LAS to one class VI of one of the State Elementary Schools in Belitang. The teacher acted as a teacher and the researcher as an observer who observed each student activity. In the first activity, after watching a video tutorial on cooking rice, students were able to write down the tools and ingredients used in cooking rice as well as the steps of cooking rice properly and correctly. Examples of students' answers are described in Figure 2.

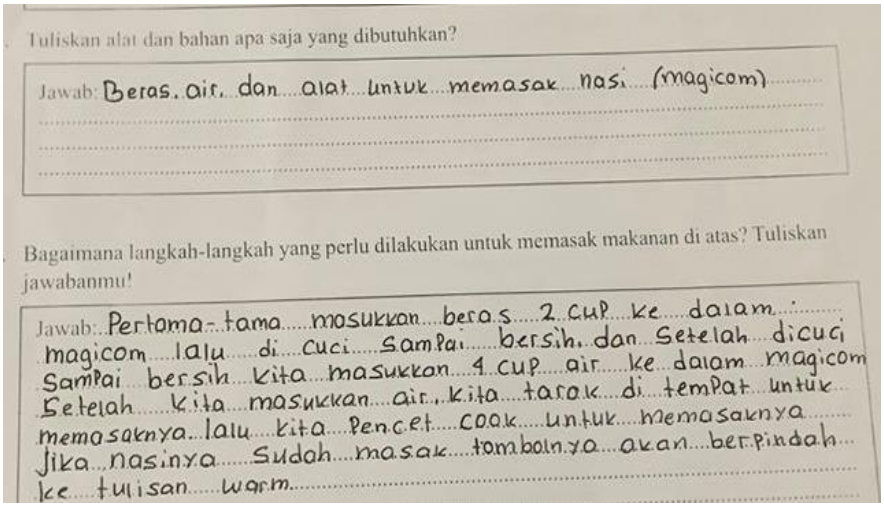


Figure 2. Questions and Sample Student Answers in the First Activity

In Figure 2, it is known that students are able to answer questions in detail and thoroughly about the tools, ingredients and steps in cooking. Students mentioned that cooking rice requires several ingredients and tools, namely rice, water, and a rice cooker. Students can also write the steps of cooking rice properly and correctly. In the second activity, students were asked to write the relationship between the amount of rice and the amount of water in the process of cooking rice. An example of students' answers related to the second activity is presented in Figure 3.

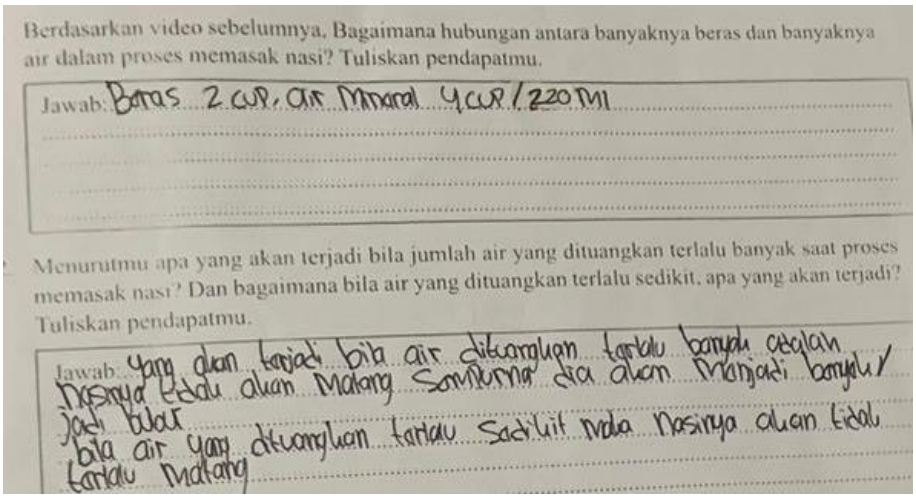
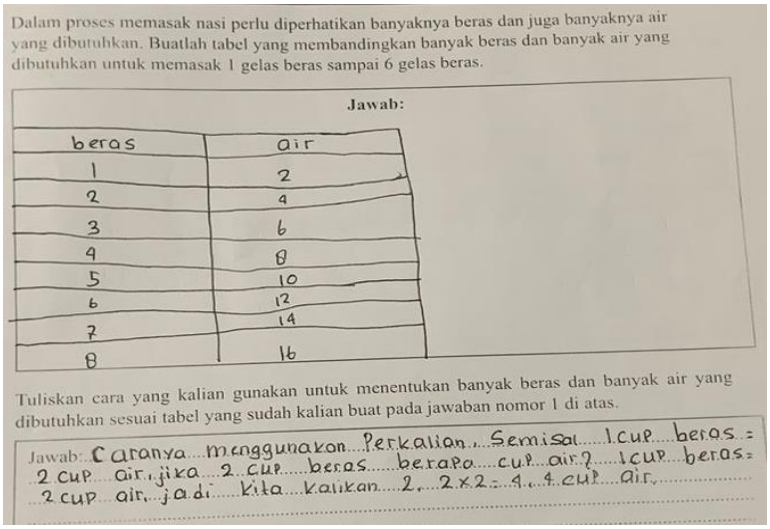


Figure 3. Questions and Sample Student Answers in the Second Activity

In Figure 3, it can be seen that students are able to write the relationship between the amount of rice and the amount of water in the process of cooking rice is if the rice is 2 cups then the water needed is 4 cups. The answer is in accordance with the information in the rice cooking video. From the confirmation of students' answers through interviews, it is obtained that students understand that in cooking rice, more water is needed to cook rice, with each cup of rice requiring two cups of water. The following are the results of interviews with student representatives in class VI of one of the State Elementary Schools in Belitang, namely student S-2.

P : *"Based on the video you saw about the process of cooking rice, what is the relationship between the rice being cooked and the water used."*
S-2 : *"In the video, the rice was 2 cups and the water was 4 cups. So there is more water mom."*
P : *"If the amount of water is equal to the amount of rice cooked, what do you think will happen?"*
S-2 : *"The rice will not cook, it will be hard. It's because there's less water mom."*
P : *"Okay, if you add 2 cups of water. So cooking 2 cups of rice uses 6 cups of water. What do you think will happen?"*
S-2 : *"Well, the rice becomes porridge, it's mushy and has too much water."*
P : *"Okay, so in order for the rice to cook well, what is the right amount of water to cook one glass of rice?"*
S-2 : *"If 2 cups of rice is 4 cups of water, so every 1 cup of rice uses 2 cups of water ma'am."*

In the third activity, students were asked to make a comparison table of the amount of rice and water used to cook 1 cup of rice to 6 cups of rice and write down the operations used to get the results in the comparison table. Examples of students' answers are included in Figure 4.


Dalam proses memasak nasi perlu diperhatikan banyaknya beras dan juga banyaknya air yang dibutuhkan. Buatlah tabel yang membandingkan banyak beras dan banyak air yang dibutuhkan untuk memasak 1 gelas beras sampai 6 gelas beras.

Jawab:

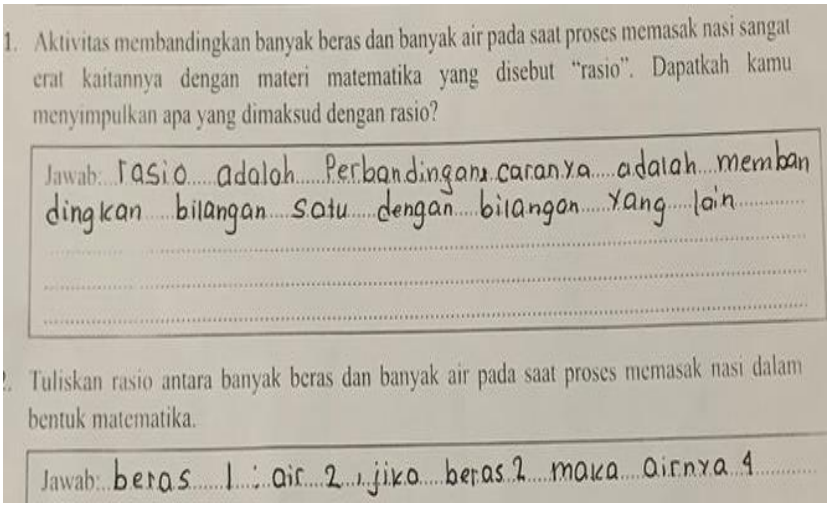
beras	air
1	2
2	4
3	6
4	8
5	10
6	12
7	14
8	16

Tuliskan cara yang kalian gunakan untuk menentukan banyak beras dan banyak air yang dibutuhkan sesuai tabel yang sudah kalian buat pada jawaban nomor 1 di atas.

Jawab: Caranya menggunakan Perkalian. Semisal 1 cup beras = 2 cup air, jika 2 cup beras berapa cup air? 1 cup beras = 2 cup air, jadi kita kalikan 2, 2 x 2 = 4, 4 cup air.

Figure 4. Questions and Sample Student Answers in the Third Activity

In Figure 4, it can be seen that students can make a comparison table of a lot of rice and a lot of water correctly and as instructed in the problem. Then students can determine the operation used to fill in each answer in the comparison table is multiplication. In activity four, students are asked to provide conclusions related to the meaning of ratio and ratio notation in mathematics. Students define what ratio is and also write ratio notation based on the relationship between the amount of rice and the amount of water needed in the process of cooking rice. Examples of student answers are described in Figure 5.


1. Aktivitas membandingkan banyak beras dan banyak air pada saat proses memasak nasi sangat erat kaitannya dengan materi matematika yang disebut "rasio". Dapatkah kamu menyimpulkan apa yang dimaksud dengan rasio?

Jawab: rasio adalah perbandingan caranya adalah membandingkan bilangan satu dengan bilangan yang lain

2. Tuliskan rasio antara banyak beras dan banyak air pada saat proses memasak nasi dalam bentuk matematika.

Jawab: beras 1 : air 2, jika beras 2 maka airnya 4

Figure 5. Questions and Sample Student Answers in the Fourth Activity

In Figure 5, it can be seen that students have been able to understand the meaning of ratios even though they have not been able to write the meaning in detail. Students have also been able to write ratio notation.

Based on retrospective analysis from comparing the results of student answers on student activity sheets and HLT that have been designed, it is known that the four learning activities designed using the context of cooking rice can guide and help students understand the concept of ratio.

DISCUSSION

In this study, researchers designed learning to help students understand the concept of ratio from informal situations, namely rice cooking activities to formal situations, namely explaining the definition and notation of ratio. This is in line with the opinion of Mubharokh et al. (2022) that the use of context will help students understand mathematics from something real (informal) to be able to write its formal form through the mathematization process. The learning trajectory designed consists of four activities that students must go through, namely in the first activity, students are asked to watch a video of the rice cooking process and observe the steps and things that must be considered in the rice cooking process. Without students realizing it, it turns out that in the activity of cooking rice using mathematical concepts, especially ratio material. The activity of observing the rice cooking video is a step to introduce the concept of ratio in a nonstandard way to students. In the second activity, students realize that in the process of cooking rice there are things that need to be considered, namely the relationship between the amount of rice and the amount of water needed, which indirectly the relationship between the two turns out to be related to mathematical material, namely ratio. In the third activity, students try to make a comparison table and determine what operation is used to answer the comparison table. Students are asked to make a comparison table of how much rice and how much water is needed to make it easier for students to understand the concept of ratio. This is in accordance with the opinion of Muttaqin et al. (2017) that the right model for teaching ratio material is to use a ratio table. Through the use of ratio tables, students can understand that solving ratio problems involves multiplicative strategies (multiplication). The findings in this study support the research results of Civak et al. (2022); Oktaviani (2019); and Sumarto et al. (2013) that the use of ratio tables and real contexts can help students understand ratio material and what operations are used in solving ratio problems.

The impact of the results of this study, on the learning trajectory designed, students learn mathematics ratio material through rice cooking activities in everyday life which are contained in four activities. Until finally in the last activity students can understand the meaning and notation of ratios based on rice cooking activities. The series of learning

activities will provide a memorable and meaningful learning experience for students because in addition to gaining an understanding of ratio material, students also gain knowledge about how to cook rice that can be applied in real life.

CONCLUSION

Based on the research results, it can be concluded that the learning design of ratio material using the context of cooking rice can help students understand the concept of ratio. The learning trajectory consists of four activities, namely (1) watching a video of cooking rice, (2) determining the relationship between a lot of rice and a lot of water in the process of cooking rice, (3) making a comparison table of a lot of rice and a lot of water needed in cooking rice, (4) concluding the notion of ratio based on rice cooking activities.

The researcher suggests that future researchers who are interested in researching ratio or comparison material should use ratio tables and use other real contexts that are also close to students that can help students understand the concept of ratio.

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