Implementing STEM Learning Using Student Worksheets on the Topic of Fraction Subtraction in Elementary Schools

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Abstract

Learning mathematics in elementary schools, particularly regarding fraction subtraction, is a challenge for both teachers and students. The purpose of this study was to describe students' EDP (Engineering Design Process) activities through the Implementation of Student Worksheets (LKPD) based on Indonesian Realistic Mathematics Education (PMRI) and the STEM (Science, Technology, Engineering, and Mathematics) approach, with the support of Artificial Intelligence (AI) on the concept of reducing fractions in elementary schools. The subjects in this study were fifth-grade students of SD Negeri 158 Palembang. The observation technique of document study of students' EDP activities in the implementation of LKPD based on PMRI and the STEM approach, with the support of AI, was categorised as good. It is recommended that the development of STEM-based Student Worksheets (LKPD) be continuously improved by taking into account the characteristics of students and the context of everyday life, so that the material on reducing fractions can be understood in a meaningful way.

Keywords

STEM learning, student worksheet, fraction subtraction, engineering design process, realistic mathematics education

Introduction

Learning mathematics in elementary schools, particularly regarding fraction subtraction, is a challenge for both teachers and students. In the context of elementary school mathematics learning, fractions, particularly fraction subtraction, are a complex topic that often leads to misconceptions among students (Widodo, 2018). These difficulties are frequently caused by a poor understanding of basic concepts, an abstract learning approach, and a lack of connection between the material and students' real-life experiences. To address these challenges, the Indonesian Realistic Mathematics Learning (PMRI) approach can be a solution. PMRI emphasises the importance of real-world contexts in the mathematics learning process, allowing students to construct their own knowledge through horizontal and vertical mathematization processes (Zulkardi & Putri,

2010). Therefore, a learning innovation is needed that not only integrates PMRI but also links it with the STEM approach and provides media support in the form of Student Worksheets (LKPD), so that learning about fraction subtraction can be more contextual, engaging, and meaningful for students.

Although PMRI and STEM have been implemented in mathematics learning, their application in fraction subtraction learning with the support of technology such as artificial intelligence (AI) is still less than optimal. Many studies show that the use of technology in mathematics education is not optimal, especially in terms of understanding basic concepts such as fraction subtraction (Yusuf, 2020). This may be due to limitations in applying appropriate technology in the learning context. Furthermore, many teachers are still not skilled in effectively integrating artificial intelligence into the learning process. Therefore, it is important to further research how AI can support PMRI and STEM in teaching fraction subtraction.

One solution to address these issues is through the implementation of context-based Student Worksheets (LKPD). LKPD functions as a tool that can facilitate active and independent student learning through structured and meaningful activities (Widjayanti & Jailani, 2019). In Indonesian realistic mathematics learning (PMRI), LKPD can be used as a medium to connect mathematical concepts with real-life situations, thus making it easier for students to understand the material on Fraction Reduction.

The Engineering Design Process (EDP) is a systematic approach used to solve problems through an iterative process that includes problem identification, information gathering, solution development, testing, and evaluation. EDP emphasises critical thinking, creativity, and collaboration, and is often used in STEM-based learning to encourage students to think like engineers. According to Nasution and Suryani (2020), the Engineering Design Process (EDP) is a learning approach in STEM that engages students in a scientific and systematic thinking process to design solutions to real-world problems. In other words, the EDP is very useful in developing 21st-century skills such as higher-order thinking, problem-solving, and collaboration.

In line with this, the STEM (Science, Technology, Engineering, and Mathematics) approach has great potential in improving the quality of mathematics learning (Efriani, 2025). STEM is a learning approach that integrates four fields of knowledge (science, technology, engineering, and mathematics) in a holistic learning process. Through STEM education, students not only acquire the technical skills needed in the future but also

learn to adapt to rapid changes (Bybee, 2013). STEM-based learning encourages integration between disciplines through project activities and problem-solving that foster critical thinking skills and reasoning skills. As students grow into professionals and leaders, the foundation gained from STEM education will empower them to make meaningful contributions to society and drive the advancement of various industries (Efriani, 2025). The integration of PMRI and STEM in Student Worksheets (LKPD) plays a crucial role in creating a holistic and meaningful learning experience, as it provides space for exploration, collaboration, and the application of concepts in real life.

To improve learning effectiveness, Artificial Intelligence (AI) is beginning to be utilised in education as an interactive tool capable of presenting adaptive learning, providing real-time feedback, and assisting teachers in monitoring student progress (Holmes et al., 2019). The application of AI in fraction learning, particularly through interactive media and AI-based applications, can help visualise abstract concepts and adapt to students' learning styles more personally.

The purpose of this study is to describe students' EDP activities through the application of Student Worksheets (LKPD) based on Indonesian Realistic Mathematics Education (PMRI) and the Science, Technology, Engineering, and Mathematics (STEM) approach, with the support of Artificial Intelligence (AI) on the concept of fraction reduction in elementary schools.

Method

A qualitative descriptive study (Sugiyono, 2017) was used in this research. Qualitative descriptive research aims to provide a qualitative overview of generated data. The subjects of this study were 24 fifth-grade students of SD Negeri 158 Palembang, in the even semester of 2025.

The data collection techniques used included observation and document study. Observations were conducted to observe student activities during the learning process, both individually and in groups, using PMRI-based Student Worksheets (LKPD) and the STEM approach with AI support, particularly in terms of engagement, collaboration, and understanding of the concept of fraction reduction (Sugiyono, 2017). Document study was conducted through photographs and student worksheets as evidence of activity

implementation and to support data analysis. The aspect assessed in this study was the achievement of EDP when students worked on the LKPD, as presented in Table 1.

Table 1. Engineering Design Process (EDP) Stage

No	Stage	Activity	Maximum Score
1.	Identification of Problems	1) What foods have you consumed this week?	10
		2) Do you exercise often?	10
2.	problem Analysis	1) Are your calorie needs met?	10
		2) What factors influence calories for the body?	10
3.	Generating Ideas	1) Fill in the data table of calories that children need according to their individual needs.	10
		2) Are the calories needed appropriate to each child's needs?	5
		3) Determine the difference in calories needed by each child.	5
4.	Testing the Design	1) State the calories each child needs on a number line.	10
		2) Express the calories each child needs from the food they have brought using a number line.	10
		3) State the calorie needs of each child by comparing the calories obtained from the provisions brought compared to the calories needed.	10
5.	Communicate	1) How to determine subtraction of fractions.	10
Total			100

The achievement test for the EDP aspect in the PMRI and STEAM-based LKPD with AI support is calculated using the following formula (Zahroh & Yuliani, 2021):

$$Value = \frac{The\ Total\ Value\ Obtained}{Maximum\ Score} \text{ X } 100$$

The assessment criteria for control values, rationalism values, and student learning outcomes are shown in Table 2.

Table 2. Assessment Criteria for Control Values, Rationalism Values, and Learning Outcomes

Grade	Category
85,0 – 100	Very Good
70,0 - 84,9	Good
55,0 - 69,9	Enough
40,0 - 54,9	Not Enough
0 - 39,9	Very Less

(Modified by Arikunto, 2012)

Data from the questionnaire were analysed quantitatively for closed statements (in percentage form) and quantitatively for open statements.

The application of STEM learning combined with PMRI-based LKPD on the material of reducing fractions encourages active student involvement through the Engineering Design Process (EDP) stages, which can be assessed in the following Table 3.

Table 3. Engineering Design Process (EDP) Stages

No.	Stage	Average
1.	Dentification of Problems	100%
2.	Problem Analysis	83,3%
3.	Generating Ideas	75%
4.	Testing Design	55,5%
5.	Communicate	66,6%

Results

On May 2, 2025, the second Friday of learning in class V of SD Negeri 158 Palembang, we conducted observations, first asking for permission to conduct a trial of the instruments we tested on class V students. We were greeted warmly and enthusiastically by the teachers and students there. After getting permission, we carried out learning activities. Learning began with checking student attendance and introductions of each student and students of UIN Raden Fatah Palembang. Students were informed that they would practice the LKPD instrument in their class. Before starting, students would convey a little about the material related to the LKPD and divide into 3 groups.

After explaining the material, the students explained the instructions for filling out the worksheets they had prepared to the students. The students were very enthusiastic, then the students distributed the worksheets to the students. The students asked the students to work on the worksheets that had been distributed. They worked on the worksheets with great enthusiasm and discussed with their group members. There were some students who were still confused about how to answer the worksheets, and the students helped explain them again so they understood the instructions in the worksheets.

Figure 1. Documentation of Students Working on LKPD

The following are the results of the PMRI and STEAM-based LKPD with AI support that have been answered by students.

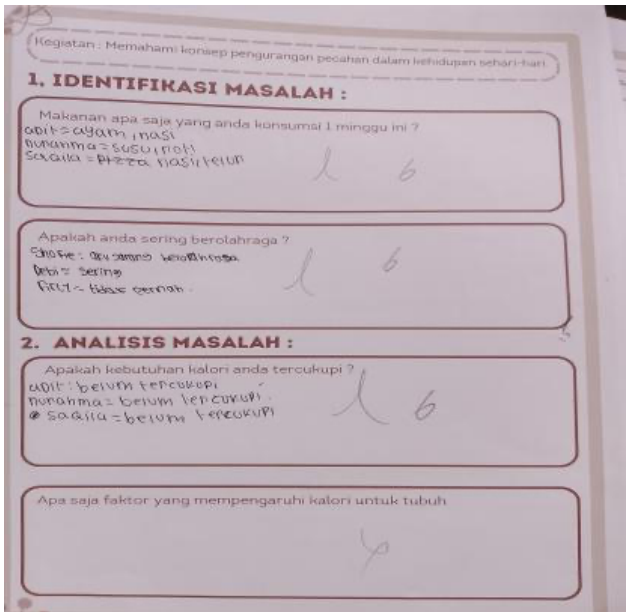
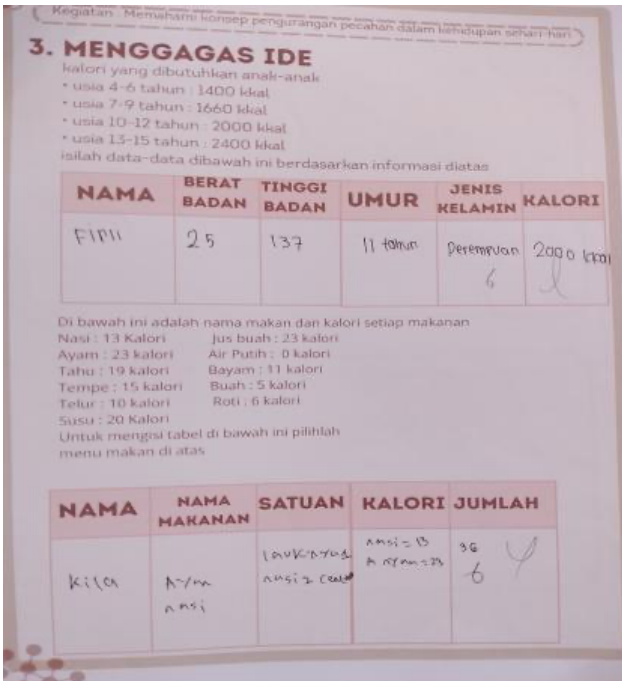


Figure 2. Student LKPD Related to Problem Identification and Analysis

Based on the results of the Student Worksheet (LKPD) answers in activities aimed at understanding the concept of fraction reduction in everyday life, students were asked to identify and analyse problems related to food consumption, physical activity, and body calorie adequacy. In the problem identification section, students recorded various types of food consumed over the course of one week. Adit consumed chicken and rice, Nurahma consumed milk and bread, while Saqila mentioned rice and eggs. This shows variations in dietary patterns that can affect the number and type of calories entering the body. In addition, in terms of physical activity, there were differences in frequency between students. Shofie said she rarely exercised during gym class, Debi answered often, and Firly stated she never exercised.

This data is important because physical activity greatly affects calorie burning and the body's energy balance. In the problem analysis, three students, namely Adib, Nurahma, and Saqila, stated that their calorie needs were not met and . This can be caused by an unbalanced diet or a lack of physical activity that can stimulate appetite and body metabolism. In the final section, students were asked to identify factors that affect body calories, but this section has not been filled in. In fact, factors such as food type, meal frequency, physical activity, age, and health conditions play a very important role in determining calorie needs and fulfillment. Based on the analysis, the score obtained for problem identification was 60 and for problem analysis was 50.


Kegiatan : Memahami konsep pengurangan pecahan dalam kehidupan sehari-hari

3. MENGGAGAS IDE

kalori yang dibutuhkan anak-anak
- usia 4-6 tahun : 1400 kkal
- usia 7-9 tahun : 1660 kkal
- usia 10-12 tahun : 2000 kkal
- usia 13-15 tahun : 2400 kkal

isilah data-data dibawah ini berdasarkan informasi diatas

NAMA	BERAT BADAN	TINGGI BADAN	UMUR	JENIS KELAMIN	KALORI
FIPH	25	137	11 tahun	Perempuan	2000 kkal

Di bawah ini adalah nama makan dan kalori setiap makanan

Nasi : 13 Kalori
Ayam : 23 kalori
Tahu : 19 kalori
Tempe : 15 kalori
Telur : 10 kalori
Susu : 20 Kalori
Jus buah : 23 kalori
Air Putih : 0 kalori
Bayam : 11 kalori
Buah : 5 kalori
Roti : 6 kalori

Untuk mengisi tabel di bawah ini pilihlah menu makan di atas

NAMA	NAMA MAKANAN	SATUAN	KALORI	JUMLAH
Kiki	Ayam nasi	Lauk/nasi nasi 2 centi	nasi = 13 Ayam = 23	36 6

Figure 3. Student LKPD Related to Generating Ideas

In the third section of the Student Worksheet (LKPD), titled "Generating Ideas," students are asked to calculate their calorie needs based on their age and match them to their food intake. According to the table, Firili, an 11-year-old girl, weighs 25 kg and is 137 cm tall. Based on the calorie requirement guidelines, children aged 10–12 years old need approximately 2,000 kilocalories (kcal) per day. This information serves as the basis for analysing whether their daily food intake meets their body's needs. Next, students were asked to select foods from the provided list and calculate their calorie count. Kila chose chicken and rice as her preferred meals. Rice contains 13 calories per serving, while chicken contains 23 calories. Kila's total calorie intake from one meal was 36 calories. Compared to her daily requirement of 2,000 kcal, this amount is clearly insufficient. This activity trained students to understand the relationship between the body's calorie needs and food intake. They were also introduced to the basic concept of contextual fraction subtraction, which involves calculating the difference between calorie needs and consumption.

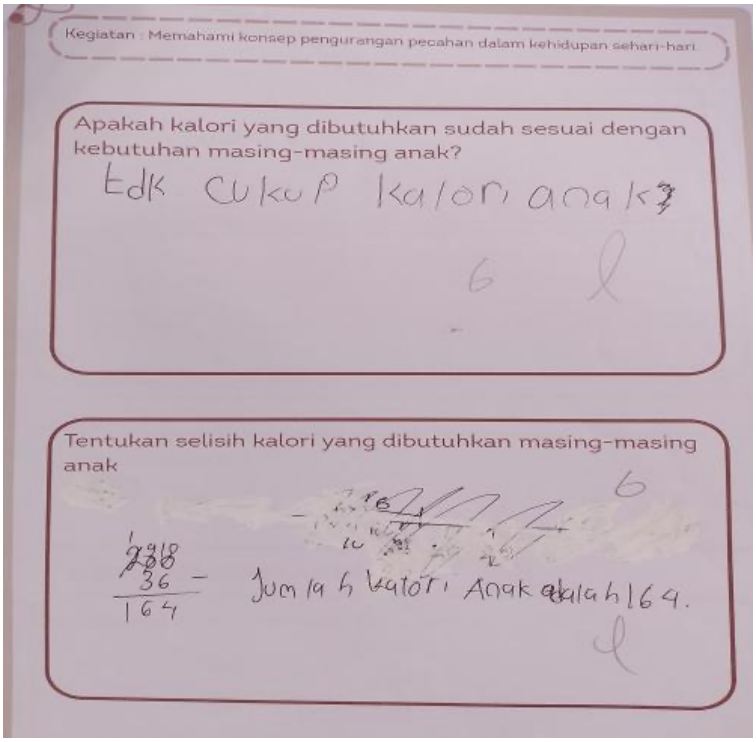


Figure 4. Student LKPD Related to Generating Ideas

At the end of this Student Worksheet (LKPD), students are asked to draw conclusions regarding the adequacy of their calorie intake compared to their daily calorie needs. Based on previous calculations, the calorie requirement for an 11-year-old child like Firli is 2,000 kilocalories per day. However, from the menu chosen (chicken and rice), the

calories consumed are only 36 kilocalories. This indicates a significant discrepancy between calorie needs and intake. Students note that "the child's calories are not enough," indicating an understanding that the number of calories consumed is still far from the ideal number. Next, students subtracted the need (200 kcal) from the actual consumption (36 kcal), and obtained a difference of 164 kcal. Although the writing appeared to contain several scribbles and corrections, the final result showed that students had been able to apply the concept of subtraction in a real context. This activity indirectly helped students connect mathematics lessons with their life experiences, especially in terms of maintaining a healthy diet. By understanding the difference between calorie needs and intake, students are expected to be more aware of the importance of eating a balanced diet to support their growth and activities. Based on the analysis of the scores obtained to initiate idea 45.

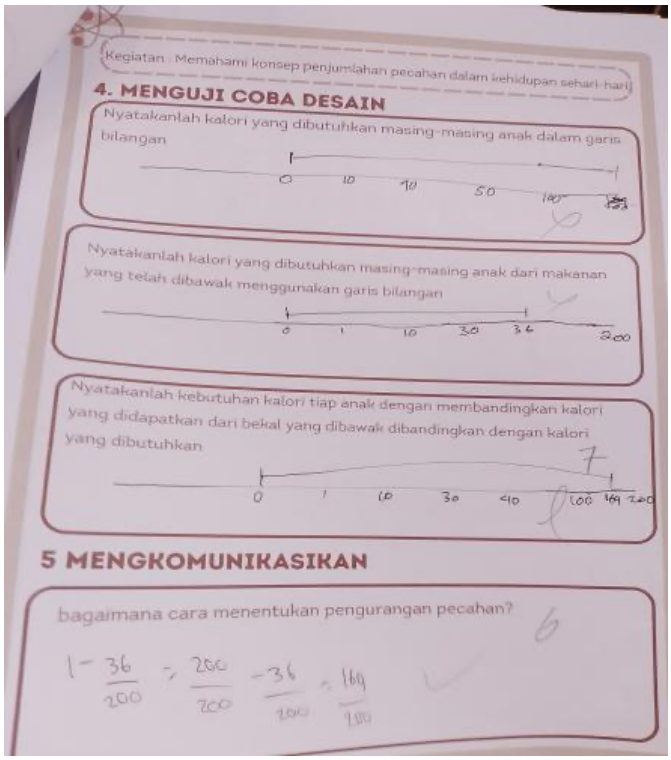


Figure 5. Student LKPD Related to Testing Designs and Communicating

In the fourth and fifth sections of the Student Worksheet (LKPD), students are asked to test their understanding of the concept of fraction subtraction through the context of calorie needs and consumption. This activity uses a number line representation to help students visualize the comparison between the number of calories needed and calories consumed. In the "Provoking Design Experiments" subsection, students plot the calories needed (2000 kcal) and the calories carried or consumed (36 kcal) on a number line. The

use of this line aims to clarify the large difference between needs and intake and helps students understand the difference visually. From the graph, it can be seen that point 36 is far before point 2000, indicating that calorie intake is still very low compared to needs. Next, in the "Communicating" section, students are asked to explain how to determine fraction subtraction.

This step demonstrates that students are able to apply fraction subtraction operations in real-world contexts. By making the denominators the same (2000), students can easily subtract the numerators and obtain a final result that shows the difference in calorie needs. This activity not only reinforces the concept of fraction subtraction but also develops students' critical thinking skills and contextual understanding. They are encouraged to connect mathematics lessons with everyday situations, particularly in terms of maintaining a healthy and balanced diet. This activity not only reinforces the concept of fraction subtraction but also develops students' critical thinking skills and contextual understanding. They are encouraged to connect mathematics lessons with everyday situations, particularly in terms of maintaining a healthy and balanced diet. Based on the analysis of scores obtained for testing the design 50 and analysis for communicating 20.

Table 4. Results of data analysis of 24 students and 3 groups

No.	Stage	Total Score Obtained	Maximum Score	Score Value
1.	Identification of Problems	20+20+20=60	20x3=60	$\frac{60}{60}x100$ =100
2.	Problem Analysis	20+20+10=50	20x3=60	$\frac{50}{60}x100$ =83,3
3.	Generating Ideas	20+15+10=45	20x3=60	$\frac{45}{60}x100$ = 75
4.	Testing Design	30+20+0=50	30x3=90	$\frac{50}{90}x100$ =55,5
5.	Communicate	10+10+0=20	10x3=30	$\frac{20}{30}x100$ =66,6

Discussion

The implementation of PMRI and STEM-based LKPD in fraction subtraction learning at SD Negeri 158 Palembang explicitly includes five stages of the Engineering Design Process (EDP), namely: Ask, Imagine, Plan, Create, and Improve. In the Problem Identification (Ask) stage, students are invited to understand contextual problems related to food consumption and calorie needs, as reflected in the initial LKPD filling in which

students identify types of food and physical activity. This shows that students are beginning to develop an understanding of the scientific context that emphasises the importance of reality in mathematics learning (Zulkardi & Putri, 2010), especially in nutrition and body metabolism. In the Problem Identification stage, students with a score of 100% are categorised as Very Good.

Next, in the Imagine stage, students calculate calorie needs based on age, height, and weight, then match them with food intake. When students generate ideas by comparing food intake and calorie needs based on their age and body data, students begin to develop problem-solving strategies by selecting foods from the table and calculating their calories as a plan to achieve adequate body calories. This activity reflects systematic thinking skills in developing problem-solving strategies, which are part of engineering and technology literacy in STEM learning (Bybee, 2013). At the Imagine stage, students with a score of 75% are categorised as Good.

In the context of STEM, this represents the strengthening of science and engineering aspects because students are required to analyse and predict the impact of food consumption on health. In the Problem Analysis stage, students with a score of 83.3 are categorised as Good. The Design Trial (Create) stage is seen when students apply calorie calculations to number lines and subtraction of fractions to show the difference in calorie needs and consumption. The use of number lines and equalising denominators becomes a practice. Students use number line visualisation as an aid to understand the concept of reducing fractions more concretely when applying mathematical concepts and visualisation techniques. In the Design Trial (Plan) stage, students with a score of 55.5% are categorised as Enough. In the Communicating (Improve) stage, students evaluate the difference in the results of calculating calorie needs and consumption, and then they conclude whether their calorie consumption is sufficient or not. In the Communicating stage, students with a score of 66.6% are categorised as Enough.

This indicates that the majority of students not only understood the contents of the Student Worksheet (LKPD) but also showed a positive response to the integrated learning activities of students with science, engineering, and contextual problem-solving. This finding aligns with the opinion of Fatimah & Mulyana (2020), who stated that PMRI-based learning and contextual media can improve interest and learning outcomes in mathematics. With the support of PMRI, the STEM approach, and AI technology, the LKPD can provide students with a holistic and applicable learning experience in real life.

Conclusion

From the research results, it can be concluded that students' Engineering Design Process (EDP) activities through the application of Student Worksheets (LKPD) based on Indonesian Realistic Mathematics PMRI and the STEM (Science, Technology, Engineering, and Mathematics) approach, with the support of Artificial Intelligence (AI) on the concept of reducing fractions are categorised as Very Good. It is recommended that the development of STEM-based Student Worksheets (LKPD) be continuously improved by taking into account the characteristics of students and the context of everyday life, so that the material on reducing fractions can be understood in a meaningful way. Transition and mentoring are also needed for teachers so that they are able to design and implement STEM-based Student Worksheets, especially in improving critical thinking and problem-solving skills.

Declarations

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