Mathematical representation on fraction operation for seventh-grade students using collaborative learning

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Abstract. This research determined the students' mathematical representations ability after learning used the Indonesian version of Realistic Mathematics Education (PMRI) through Lesson Study for Learning Community (LSLC) on fractional operation. The subjects were seventh-grade students in SMP Negeri 18 Palembang. We used a descriptive method, which explains the stage of the research in detail. The data were collected through observation, written tests, and interviews. We used PMRI for material content and research context, and LSLC for the implementation of the learning process. We obtained that the students' mathematical representations ability in answering fractional operation problems has reached the indicators. The research showed that students' mathematical representation abilities have arisen, including solving problems involving mathematical expressions and load the problems situation based on data or representations given. The indicator that rarely appears is to draw geometric figures to clarify the problem and facilitate resolution. Giving real context through PMRI and collaborative learning process was to help students in bringing up mathematical indicators of representation.

1. Introduction
The fraction is a very important material in learning mathematics because it is related to daily life and is studied from elementary to secondary school [1]. Fractions are also used daily as a quotient, measurement, ratio, and operator [2]. However, many students have difficulty learning fractions because the fraction is contrary to the whole number, where the larger of dominator is smaller than the fraction value is [3]. The reason for the difficulty of students in learning fractions is the lack of assignments and students’ interest fraction itself [4]. To increase students’ interest in learning addition and subtraction of fractions, it is necessary to have a context in understanding fractions [5]. The use of real contexts such as using liquid objects, collections of objects, areas, number lines, and symbols can help students in representing material into real contexts [2].

Mathematical representation is very important in learning fractions, because students can find symbols, find solutions to problems, and get used to doing problems easily through mathematical representation ability [6]. However, the ability of students’ mathematical representation visually, verbally, and symbols are adrift low [7]. This is proven by the results of Indonesia’s ranking on PISA which is ranked 62 out of 70 countries in mathematical literacy [8]. To improve students mathematical representations skills be better, students should use context in daily life, such as using the context of swimming [9]. The real context of learning can be implemented in the Indonesian Version of the Realistic Mathematics Approach (PMRI) [10]. PMRI is a learning approach that emphasizes the process of finding knowledge that is relevant to problems in everyday life [11]. PMRI is a realistic learning.
approach that is close to students to other students themselves that can be directly involved in constructing the concept of knowledge processed which is represented in a form that students can easily understand [12][13][14].

Indonesia applied a 2013 curriculum where the application of 4C, namely communication, collaboration, critical thinking, and creativity is highly prioritized in learning [15]. Collaboration can be used in an activity that is Lesson Study for Learning Community (LSLC) LSLC is a system of higher quality learning processes that are carried out collaboratively [16]. Student learning achievement using Lesson Study-based learning is better than conventional mathematics learning [17].

Based on this introduction, the researchers interested in examining the ability of students’ mathematical representation of seventh-grade student using PMRI trough LSLC on the fractional operation. This research aimed to determine whether students’ mathematical representation ability after learning operational fractions using PMRI and LSLC in seventh-grade of secondary school.

2. Methods
This research used a descriptive method. The subjects in this study were 32 students in the seventh grade of SMP Negeri 18 Palembang. The data collection technique used was an observation, giving 2 test questions in the form of description, and interview. The analysis of the data used is descriptive. This research was carried out by the LSLC stages, namely plan, do, see, and re-design [18].

At the plan stage, the researcher prepares a research instrument, looks at some of the literature that is relevant to the study, validates the questions, and takes care of licensing to the school. The research instrument consisted of lesson plans, syllabus, learning scenarios, sharing task questions, jumping tasks, 2 description test questions, and student answer grids. On stage plan, teachers are given briefing materials about learning lesson study for community learning and collaborative learning. At the do stage, researchers and teachers conduct learning using PMRI through LSLC by jointly designed lesson plans. The researcher acts as an observer and the teacher acts as a model teacher in learning [18]. Learning consists of giving material (apperception), sharing task, jumping task, and giving two descriptions of problems done independently by students. After carrying out learning, the researcher and the teacher conduct a reflection activity, where the teacher gives an impression during the learning process, and the observer presents his findings in the field. After that, the researchers chose 3 students with high, medium, and low abilities based on the scores of the test results for an interview.

3. Result and discussion
This research was conducted at SMP Negeri 18 Palembang with a total of 32 grade VII students with high, medium, and low abilities. In this study, researchers only found 3 steps from LSLC, namely plan, do, and see. At the plan stage, the researcher prepares several instruments such as a learning plan, sharing tasks, jumping tasks, learning scenarios, test questions, student answer grid, interview guidelines, and observation sheets. Researchers also held initial training to introduce schools about Lesson Study for Learning Community. Besides, researchers conducted observations in schools to see the students who would be the subject of research.

In the plan stage, the researcher, the team, and with teachers validate together with the instruments of sharing tasks, jumping tasks, and test questions that will later be given to the research subjects. The validation results are then corrected and tested in small groups to students at the school but not to the research subjects. Researchers conduct licensing administration activities while simultaneously observing and validating in stages.

In the do stage, the researchers took the data with a total of 32 participants in seventh-grade students. Data were collected with a duration of 120 minutes. The researcher here acts as an observer in charge of observing student activities, and the model teacher as a teacher in learning activities [18]. The researchers does not become a model teacher because only the model teacher knows how the everyday behavior and psychology of students are at school [16].

Implementation activities at the do stage are divided into 3, namely introduction, core activities, and closing. The model teacher gives apperception by bringing apples, oranges, and knives to cut so that
students can understand the real context of the fraction. After that, students are divided into groups where each group consists of 3-4 people. The division of groups has been planned at the plan stage and each group consists of high, medium, and low abilities.

Each group will be given worksheet (LKPD) 1 which is a sharing task and will be filled in by each student. Later, students will answer LKPD 1 which contains the problem and will be answered to each student. Students who are confused and cannot answer correctly are obliged to ask their classmates for help and provide ways for students who ask for help to answer correctly without giving answering directly. After LKPD 1 has been completed, the model teacher will choose students to explain the results of the answers then proceed with LKPD 2, the jumping task.

In LKPD 2, students will answer problems related to the addition and subtraction of fraction numbers. The form of work on LKPD 2 is the same as the work on LKPD 1. The difference between LKPD 1 and LKPD 2 lies in the level of difficulty, in LKPD 1 the level of difficulty of the problem is at the easy and medium level, whereas LKPD 2 is at the intermediate and difficult level. Of the 5 observers who participated in the implementation activities, the researcher and observer 1 decided to observe one group, namely group 4, where observer 1 focused more on student A (see figure 1). From the beginning of learning, student A seemed to be quiet. Student A only plays paper and hands and does not invite friends to discuss. Student A is silent when the group's friends discuss it.

![Figure 1. Student A is seen not working on LKPD.](image)

After seeing the student answer sheet, student A sees his friend using paper and scissors on the table. Student A is finally interested and follows a groupmate to work on LKPD (see figure 2).

![Figure 2. Student A is assisted by a groupmate.](image)

After working on LKPD 2, the model teacher gives 2 test questions outlining the problems, and students are asked to answer within 20 minutes. Students are asked to answer individually and cannot ask friends for help. After the work has completed, students are asked to collect answer sheets. Students are asked to conclude the results of the learning and close the learning with prayer.

In the see stage, the model teacher first conveys the message impression that has been felt after teaching. Next, the observer submits his findings in the field. The observer findings in the form of conditions and learning processes of students as well as positive suggestions and input can be used to redesign better learning [19]. After the retrieval of data, the researcher corrected LKPD 1, LKPD 2, and the test description questions that students had answered. Researchers took 3 students to do interviews that have high, medium, and low abilities. Interviews were conducted to dig deeper into information regarding the ability of student representation (see figure 3).
Figure 3. Interview stage.

After conducting the mathematical representation ability test at the do stage and conducting reflection and interview activities, the following test results are obtained in Table 1.

Table 1. The number of students who fulfill the mathematical representation indicators.

| Indicators | The number of students who fulfill the indicator |
|------------|-----------------------------------------------|
|            | Question 1 | Question 2 |
| Create geometric shapes to clarify problems and facilitate resolution | - | 18 |
| Solving problems involving mathematical expressions | 20 | 12 |
| Create a problem situation based on data or representation provided | 22 | 22 |

3.1 Question Number 1

After data retrieval was complete, the researchers carry out activities following scoring researched one of the answers number one. Figure 4 showed that an indicator 1, students can make a problem situation based on data provided precisely and completely so that it gets a score of 4. In indicator 2, students can solve problems using mathematical expressions correctly, but there are still errors in the calculation so that it gets a score of 3. In question number 1, students get a score of 7.

Figure 4. The answer to test question number 1.
3.2 Question number 2

The researcher scoring one of the answers of students in number 2. Figure 5 showed that an indicator 1, students can create geometric figures to clarify problems and facilitate correct and complete resolution so students get a score of 4. In indicator 2, students can solve problems by involving mathematical expressions correctly and completely so that students get a score of 4. In indicator 3, students can create a problem situation based on data or representations that are given but are incomplete and inaccurate so that students get a score of 1. In problem number 2, students get a score of 9.

![Figure 5: The answer to test question number 2.](image)

Students can solve problems by involving mathematical expressions completely and precisely.

Students can make a problem situation based on data or representations provided but are incomplete and inaccurate.

Students can create geometric figures to clarify problems and facilitate correct and complete resolution.

The research that has been done shows that the mathematical representation of students is quite good after the application of learning using the PMRI approach through LSLC on fractional material. This can be seen from the number of students who have raised the requested learning indicators. However, there is one indicator that is not raised by students when answering question number 1. In learning, only a few students who ventured to say "please teach me" to their friends who can answer the activities of sharing tasks and jumping tasks. So that in the future, the culture of "please teach me" needs to be put forward later so that students are accustomed to helping each other in collaborative learning.

Learning with PMRI through LSLC can indirectly guide students to develop and improve their mathematical representation abilities. This can be seen from the activities of students when working on the task sharing and jumping tasks where students interact and contribute students to their team [20]. Learning using PMRI is seen when students work on sharing tasks and jumping task using the context of *kain jumputan* [21]. The use of models when students work on sharing tasks and jumping tasks direct students to represent problems correctly [22]. Student contribution is seen when students collaborate with a group of friends in doing sharing tasks and jumping tasks [23]. So that the PMRI approach through LSLC can be applied in schools. Students can find the concept of fractions and solve problems gradually using sharing tasks and jumping tasks that have been given. Through contextual problems, students can represent problems in mathematical language correctly [24]. The provision of jumping tasks with high levels of difficulty (HOTS) is a stepping activity of students heading to the test questions that the level of difficulty is also almost the same [25]. Giving a group of 4 students and sitting face to face makes student collaboration run smoothly [26]. Students are also given time to discuss through collaborative learning through group discussions while working on sharing tasks and jumping tasks [27] and student activities are more compared to teacher activities with collaboration [28]. Activities please help students when learning not very active. There are some who say "please teach me" when sharing tasks and
jumping tasks are done because students' awareness has not yet arisen to help one another [29]. A habituation is needed for students to help each other so that learning activities are more active. So, the application of PMRI and collaborative learning in LSLC can already be applied to improve students' mathematical representation abilities.

4. Conclusion
Based on the results of research in the seventh grade of SMP Negeri 18 Palembang from the test results supported observation and interviews obtained students' mathematical representation ability in learning using PMRI through LSLC on the subject of addition and reduction of fractions in all students has reached verbal, symbolic, and visual representations. Mathematical representation indicators that often appear in the problem are problem-solving by involving mathematical expressions, and making the problem situation based on the data or representation provided. Research showed that students' mathematical representation abilities have arisen, including solving problems involving mathematical expressions and loading problem situations based on data or representations given. The indicator that rarely appears is to draw geometric figures to clarify the problem and facilitate resolution. Giving real context through PMRI and collaborative learning process helps students in bringing up mathematical indicators of representation.

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