

Students' learning obstacles in solving math story problems on number material during the Covid-19 outbreak

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Students' Learning Obstacles in Solving Math Story Problems on Number Material During the Covid-19 Outbreak

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Abstract. The Covid-19 outbreak greatly impacts education, particularly the ineffective learning process, with some pupils having learning obstacles. This study analyses the learning obstacle experienced by madrasah ibtidaiyah pupils in solving math story problems on numbers material during the Covid-19 outbreak. The research used a descriptive qualitative method. The data took from 19 fourth-grade pupils at one of the madrasah ibtidaiyah in Bandung district through tests and interviews. The data analysis through the stages of data reduction, data display, and conclusion. The results showed that pupils' learning obstacles were ontogenic, didactical, and epistemological. In the ontogenic obstacle, some pupils did not get the concept of summing fractions. The didactical obstacle that occurs in pupils due to learning during the outbreak held alternately online and offline, online learning held through the WhatsApp group, which was less effective, and no learning design combined online and offline methods effectively. The epistemological obstacle experienced by pupils was when the teacher gave questions in a different context from the examples. It happened due to the limited time of mathematics lessons during the outbreak.

INTRODUCTION

Numbers is one of the concepts taught in math learning. The theory of number is a branch of pure mathematics that studies the characteristics and relationships with open problems that can be understood even by non-mathematicians [1]. The concept of numbers is an essential basic concept in mathematics learning. Moreover, pupils learn the concept of numbers from an early age. Additionally, the concept of numbers is one of the centers of mathematics learning and can reduce the signs of early mathematical failures [2]. In addition, the concept of numbers

is essential because it can develop numeracy skills and readiness to follow primary education [3]. Therefore, the number of materials in elementary school or madrasah ibtidaiyah can encourage the pupils' mathematics abilities in daily life.

Program for International Student Assessment (PISA) research obtained by Indonesia in 2018 discovered that 28% of pupils in Indonesia reached level two or more in mathematics, while the average percentage of Organization for Economic Co-operation and Development (OECD) could get 76% [4]. These results indicated the low mathematics skills of the pupils in Indonesia. There is no denying that there were some pupils who encountered difficulties in learning mathematics. Mohamed and Johnny presented that the pupils met obstacles to relate their experiences with mathematical contents, reasoning, and building new schemes of previously learned knowledge not to solve the problems independently [5]. However, the pupils often encountered difficulty solving problems that were different from the example explained, especially math story problems that required the pupils to solve problems related to daily life from the implications of a math material.

Mathematical problem-solving skills of number materials possibly improved through learning with math story problems. Story problem learning could overcome elementary school pupils' issues [6]. A math story problem is a mathematical question presented with a language that includes many symbols and notations to convey the problem and its solution using a mathematical mindset or concept [7].

Various learning obstacles in solving a story problem in the number of materials appeared when learning mathematics. Learning barriers could prevent the pupils from acquiring and interpreting the learning [8]. Brosseau explained that pupils' cognitive abilities affect pupils' learning obstacles ontogenic, epistemological [9]. An ontogenic obstacle appeared because the pupils' mentality was not ready when learning, so it was related to the pupil's age and level of development [10]. A didactical obstacle might be caused by the teachers' readiness or mistakes in the learning system so that there was a mistake in the learning process [10]. An epistemological obstacle possibly happened by the limitations of specific contexts that might cause disjointed and incomplete concepts [11].

In early 2020 Indonesia and almost all countries in the world were suffering from the covid-19 outbreak. The outbreak spread through the respiratory tract rapidly and caused several deaths. Hu et al. enlightened that the SARS-CoV-2 virus raised histopathological changes mainly in the lungs [12]. Therefore, the pupil must limit interactions between others to reduce the spreading of the virus, including in the teaching and learning process. Online learning replaces face-to-face activities in the classroom, practicum in the laboratory, and teaching in the field. The restricted interactions are applied to prevent the virus that causes covid-19. Teachers and pupils were required to adapt to new habits in education [14].

There were some challenges of online learning, such as internet connection, data plan, increased screen exposure time, a less conducive learning environment, and a lack of parental guidance at the time of learning. Elementary school pupils desperately needed parental guidance to run their learning effectively [15]. Many pupils or teachers, and other academic communities criticized the challenges of online learning. Online learning conducted in all subjects, including math learning, online learning was causing new problems both in the acquisition of mathematical knowledge or math problem-solving skills.

The challenges and limitations of learning due to the covid-19 outbreak might increase the learning barriers to the pupils. Moreover, solving the math story problem on numbers material taught in elementary school or madrasah ibtidaiyah might arise. Therefore, this study analyzed the learning barriers of madrasah ibtidaiyah pupils in solving the math story problem of the number of subjects during the covid-19 outbreak.

RESEARCH METHOD

This study used a qualitative approach with the case study method. The case study allowed the researchers to explore the authentic dynamics of the participants' situations and conditions, including the motivations and reasons [16]. To analyze and explore the central phenomenon of pupils' difficulties in solving story problems in numbers during the covid-19 outbreak using the case study method. The purpose of the case study research is to provide an in-depth picture of the various phenomena representing life in a bonded system [17]. The researcher researched one of the Madrasah Ibtidaiyah in Bandung Regency, Indonesia. The participants were 19 pupils in grade IV between the ages of 10 to 11 years. In collecting data, researchers use tests and interviews. The written test contained the story problem of the numbers adjusted to the basic competencies in the 2013 curriculum. The tests were fractional numbers.

Furthermore, the interview was conducted with the pupils and teachers to know the learning obstacles following the material asked in the questions. Data were analyzed through data reduction, data display, and conclusion. The validity of the data in this study used triangulation and reflexivity.

RESULTS AND DISCUSSION

This research began with distributing the pupils an ability test to identify learning obstacles faced by them in the context of a story problem of numbers. Fourth-grade pupils take the test after studying the number material. This research is limited to fractional numbers. After the test, interviews were conducted with several pupils. Interviews were conducted with teachers and pupils who made mistakes in answering questions. The test can see in the following:

Mr. Robi led a running test for four of his pupils. The following is a timetable for four pupils to complete the 100-meter run.

No.	Name	Time
1	Aldi	$\frac{2}{5}$ minutes
2	Barra	$\frac{1}{2}$ minutes
3	Chairul	$\frac{1}{3}$ minutes
4	Dani	$\frac{3}{4}$ minutes

Who's running faster?

FIGURE 1. The first problem was given to the pupil

Mr. Andri has rice fields. In the harvest season, he harvests his rice for several days. The first day he harvested $\frac{3}{8}$ hectare. The second day he harvested $\frac{1}{6}$ hectare. How many hectares of Pak Andri's rice fields have been harvested over the past two days?

FIGURE 2. The second problem was given to the pupil

Of the 300 cinemagoers, $\frac{1}{3}$ of them were men. How many female audience members are in that cinema?

FIGURE 3. The third problem was given to the pupil

Based on the analysis of learning obstacles from the test results and supported by interview results with the pupils and teachers, we found three learning obstacles: ontogenic, didactical, and epistemological obstacle. Here are the results of the analysis found.

Ontogenic Obstacle

In the first problem, pupils asked to look for "pupil who runs faster," meaning the time spent was the least. In this case, the concept used was to sort the fractions. To solve the problem, the pupils change each fractional number to be the same and then look for the smallest number. Based on the analysis of the pupils' answers, some pupils already got the meaning of the problem but were wrong in operating, especially in simplifying fractions, as can see in Figure 4.

<p> $ald = \frac{2}{5} \times 60 \text{ detik}$ $= \frac{120}{5}$ $= 24 \text{ detik}$ </p> <p> $Barra = \frac{1}{2} \times 60 \text{ detik}$ $= \frac{60}{2}$ $= 30 \text{ detik}$ </p> <p> $Chairul = \frac{1}{3} \times 60 \text{ detik}$ $= \frac{60}{3}$ $= 20 \text{ detik}$ </p> <p> $Dani = \frac{3}{4} \times 60 \text{ detik}$ $= \frac{180}{4}$ $= 45 \text{ detik}$ </p> <p> yg berlari lebih cepat adalah Barra </p>	<p>Translation</p> <p> $Ardi = \frac{2}{5} \times 60 \text{ seconds}$, $Barra = \frac{1}{2} \times 60 \text{ second}$, $Chairul = \frac{1}{3} \times 60 \text{ seconds}$ $= \frac{120}{5}$ $= 24 \text{ seconds}$ </p> <p> $= \frac{60}{2}$ $= 30 \text{ seconds}$ </p> <p> $= \frac{60}{3}$ $= 20 \text{ seconds}$ </p> <p> $Dani = \frac{3}{4} \times 60 \text{ seconds}$ $= \frac{180}{4}$ $= 45 \text{ seconds}$ </p> <p>Barra run faster than others</p>
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FIGURE 4. Pupils answers (on the first problem) that experience ontogenic obstacle

Another obstacle was that the pupils have not yet caught the concept of summing fractions differently, as shown in Fig. 5.

$$+3+8+1+6=18$$

FIGURE 5. Pupils answers (on the second problem) that experience ontogenic obstacle

After conducting the interview, the pupils thought that the summation of fractions was still abstract. The pupils could not imagine the summation of objects or anything else in the context of fractions. It happened because, at the time of introducing the concept of fractions, the pupils were given a direct explanation from semi-concrete to abstract form, including the concept of summing fractions. In the third problem, based on the pupils' answers, they tried to solve the problem with the help of drawings so that their understanding of fractions was semi-concrete. However, the image made by the pupils did not represent the number of female cinemagoers, which is, as shown in Fig. 6.

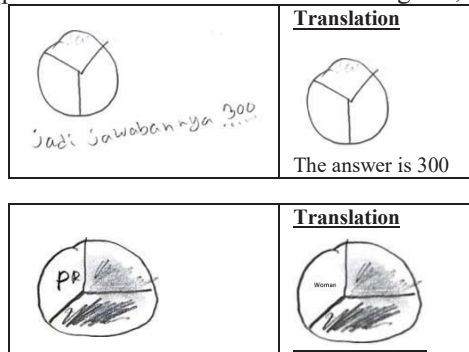


FIGURE 6. Pupils answers (on the third problem) that experience ontogenic obstacle

Didactical Obstacle

From question number 2, some pupils have errors in answering, as shown in the following Fig. 7.

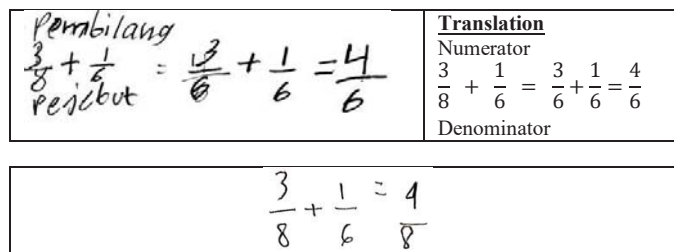


FIGURE 7. Pupils answers (on the third problem) that experience ontogenic obstacle

Figure 7 showed that the pupil's mistake in performing a different summation operation without equating the denominator first so that the result went wrong. Based on these results, pupils missed the concept of the addition of fractions. It was also what made them experiencing learning obstacles. According to the interview, the pupils think that fraction summing operations were the same as the concept of summing operations on integers that only needed to operated numbers. In addition, the pupils also did not comprehend the concept of fractions, namely the meaning of denominator and numerator of a fraction. It occurred because there was no strengthening of the concept on the concrete recognition of fractional forms in the learning process conducted by teachers.

In addition, it was still the same problem that the pupils were wrong because they could not equate the denominator by using the concept of the Least Common Multiple (LMC), which can see in Fig. 8.

$\frac{3}{8} + \frac{1}{6} = \frac{6}{48} + \frac{8}{48} = \frac{14}{48}$	$\frac{3}{8} + \frac{1}{6} = \frac{18}{96} + \frac{8}{96} = \frac{26}{96}$
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FIGURE 8. Pupils answers (on the second problem) that experience didactical obstacle

Based on the interview results with the pupils, it concluded that the pupils did not understand how to equate denominators with finding LMC, and they remember more quickly by the way that teachers given by multiplying the denominator. Due to teaching, it was due to teaching who did not understand the concept of equating denominators concretely before giving by through finding the LMC. Nevertheless, the teacher gives a quick way to equate the denominator by multiplying the denominator. After interviewing with the teacher, the lack of strengthening of introducing concrete fraction forms and granting a quick way to perform a different fraction summation operation was because the learning process during the covid-19 outbreak applied on a limited basis. The teacher felt difficulty choosing practical approaches, models, methods, and learning media. Learning was done online through the WhatsApp group but encountered obstacles because not all pupils have adequate devices. They used their parents' mobile phones when studying, so they had to take turns with their parents and siblings. Furthermore, the school made a policy to conduct learning by integrating online and offline learning. Offline learning was carried out twice a week with incomplete lesson hours. It certainly causes the math lesson hours could not be maximized.

Epistemological Obstacle

Another way to solve problem number 1 was changing the minutes into seconds. The pupils changed multiplication counting operations for each number with 60 (1 minute = 60 seconds) to obtain the number of numbers in seconds. Then they got the smallest number of numbers. Some pupils forgot about the concept of time units. They already understood the meaning of the problem and turned the math story problem into mathematical form correctly. However, pupils face obstacles when integrating the concept of fractions with other concepts in mathematics. This case appeared due to the pupils' understanding in a limited context; it only understood the concept of fractions.

<p>Aldi = $\frac{2}{5}$ menit = 0,4 menit</p> <p>Barra = $\frac{1}{2}$ menit = 0,5 menit</p> <p>Chairul = $\frac{1}{3}$ menit = 0,2 menit</p> <p>Dani = $\frac{3}{4}$ menit = 0,75 menit</p> <p>dan Barra = Dani = 0,75 menit</p>	<p>Translation</p> <p>Ardi = $\frac{2}{5}$ minutes = 0,4 minutes</p> <p>Barra = $\frac{1}{2}$ minutes = 0,5 minutes</p> <p>Chairul = $\frac{1}{3}$ minutes = 0,2 minutes</p> <p>Dani = $\frac{3}{4}$ minutes = 0,75 minutes</p> <p style="text-align: right;">The faster is Dani 0,75 minutes</p>
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FIGURE 9. Pupils answers (on the first problem) that experience epistemological obstacle

According to the data, some of the pupils were correct in converting to seconds, but they did not finish precisely to answer "who runs faster"; they instead sort the fractions without concluding "who runs faster". After being interviewed, the pupils were used to sorting the fractions, but they were not correct where questions were in a different context. It happened due to the ability of the pupils was limit.

<p>Aldi = $\frac{2}{5} \times 60$ detik = 24 detik</p> <p>Barra = $\frac{1}{2} \times 60$ detik = 30 detik</p> <p>Chairul = $\frac{1}{3} \times 60$ detik = 20 detik</p> <p>Dani = $\frac{3}{4} \times 60$ detik = 45 detik</p> <p>Chairul, Aldi, Barra, Dani</p>	<p>Translation</p> <p>Ardi = $\frac{2}{5} \times 60$ seconds = 24 seconds</p> <p>Barra = $\frac{1}{2} \times 60$ seconds = 30 seconds</p> <p>Chairul = $\frac{1}{3} \times 60$ seconds = 20 seconds</p> <p>Dani = $\frac{1}{2} \times 60$ seconds = 45 seconds</p> <p>Chairul, Aldi, Barra, Dani</p>
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FIGURE 10. Pupils answers (on the first problem) that experience epistemological obstacle

In question number 3, the pupils have not understood yet that all the cinemagoers were 1. The number of all cinemagoers is 1 or could be replaced by $\frac{3}{3}$, so the number of female cinemagoers is $1 - \frac{1}{3} = \frac{2}{3}$. Nevertheless, what occurred here, some pupils failed to describe the story problem in the context of mathematics correctly. Here is the pupil's answer:

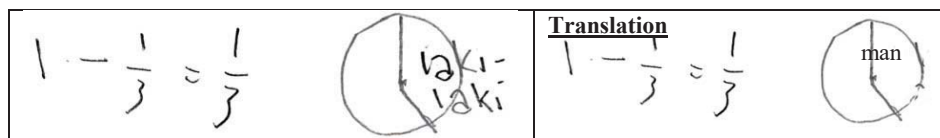


FIGURE 11. Pupils answers (on the second problem) that experience epistemological obstacle

Figure 11 above shows that the pupils have not converted the story questions into mathematical form correctly. Even though the pupil understands the problem in number 3, all the moviegoers represented in the fraction material are 1. However, making the operation in the form of a mathematical context is still wrong. It happened because their abilities were still limited even though the pictures helped them.

Based on the analysis of the result of pupils' ability tests, we found several learning obstacles. The pupils' learning obstacles in solving a story problem occurred because it was difficult to understand the story. In addition, they did not understand the sentence in question, both known and asked in the question or how to solve it [18]. In line with this opinion, the pupils' obstacles in solving a story problem were the majority of the pupils were unable to translate the sentences in the question into their language and the lack of ability of the learners in changing the sentences contained in the problem into mathematical models [19]. Learning obstacles in solving math story problems could not be avoided by the pupils when they were not getting used to solving a mathematical problem. Early efforts in justification by children would involve trial and error or unsystematic trials in many cases [20]. Another thing that made the obstacles of learners solve a story problem in math was that the learners had not profoundly understood the concept of the material studied [21].

When the pupils were delivered a different math story problem of summing fractions, some pupils had difficulty completing them. They already got the meaning of the problem, but they have difficulty operating the fractions' summation. The pupils still considered fractional questions to be abstract. They were still at the stage of concrete operational cognitive development in thinking. Obstacles experienced include ontogenic obstacles occurring due to pupils' lack of mental readiness in facing the learning process [9]. Didactical obstacles experienced by pupils appeared because of the teaching readiness by the teacher who is facing the learning process during the covid-19 outbreak. Mathematics learning had not run to the maximum as planned. The teacher also had not found an effective learning design either from the selection of methods, approaches, or the use of teaching media whose purpose was to provide a deeper understanding in conveying material concepts. Thus, the teacher explained some concepts of fractions using a quick way without understanding more deeply to the pupils regarding the concept of fractions. In addition, the supporting facilities and infrastructure for online learning were also not wholly-owned by all pupils. The offline learning was carried out in a limited time, not even by the planned lesson hours. It is in line with Rohmah's opinion that the teacher's readiness in choosing learning strategies or errors in the learning system causes didactic obstacles to pupils [9]. There was a mistake in the learning process.

The epistemological obstacle experienced by some pupils happened because of the limitations of knowledge that they have on the fractional material studied. In completing the summation of different fractions, they must master the prerequisite material to equate the denominator using the Least Common Multiple (LMC). Another prerequisite material was the concept of multiplication and division of numbers that was still an obstacle for some pupils. The cause of this obstacle was the limitations of math lessons during the covid-19 outbreak. Epistemological obstacle occurred because someone did not seek knowledge by itself, which results in limited knowledge [22]. Learning obstacles experienced by the pupils could be overcome when the learning process was going well. A good learning process can overcome learning barriers faced by pupils. Teachers need to consider developing a didactic design for developing mathematical story problem-solving skills. Being didactic by a teacher in the learning process would create a situation that could be the starting point for the learning process. This didactic action would elicit a diverse response from pupils. This response depended on the learning activities designed by the teacher.

CONCLUSION

According to the study results, the pupils experienced learning obstacles in ontogenic obstacles, didactical obstacles, and epistemological obstacles. Some pupils did not get the concept of summing fractions that were still considered abstract on ontogenic obstacles. A didactical obstacle that appeared among the pupils was the learning process during the covid-19 outbreak organized by alternating online and offline methods. Online learning organized

through the WhatsApp groups that were less effective, and no learning design effectively combines online and offline modes. The epistemological obstacle experienced by pupils when they were given a question with a different context with the example that the teacher has explained occurred because of the limited hours of mathematics lessons during the covid-19 outbreak.

In addition, a learning design that combines online and offline methods are needed to reach all pupils' understanding. Teachers can use the design developed as an alternative to teaching materials used in learning number material, especially in solving math story problems.

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