

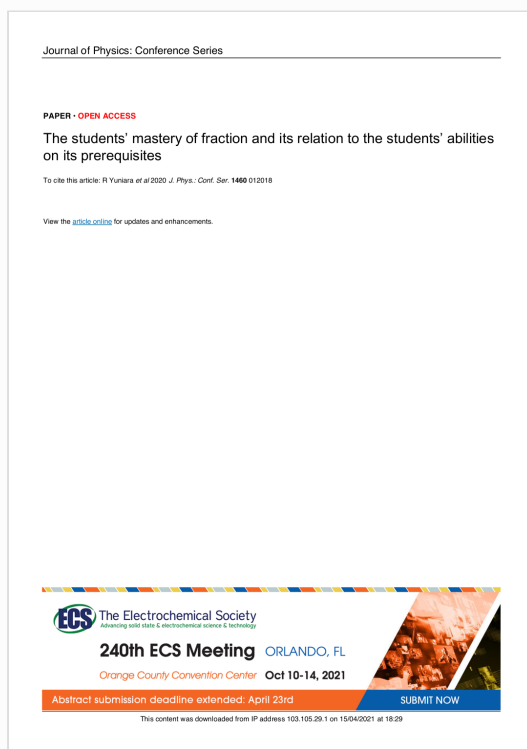


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The students' mastery of fraction and its relation to the students' abilities on its prerequisites

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Abstract. Fraction is one of the important topics in learning mathematics. However, it is still challenging for students. Lack of students' mastery of the prerequisite topics might be one of the potential causes. For this reason, this study aims to: 1) Investigate whether students' mastery of fractions and prerequisite topics in the 7th grade of a junior high school in Banda Aceh, Indonesia has reached the minimum learning mastery standard and 2) Investigate the relationship between students' mastery of fractions and their abilities to understand the prerequisite topics in the 7th grade of a junior high school in Banda Aceh, Indonesia. This study used a quantitative approach. Data were collected from 50 students selected randomly from all of the 7th grade students in the junior high school. The results showed that the students' mastery of fractions and their abilities to understand the prerequisites has achieved the minimum learning mastery standard. Also, there is a significant relationship between students' fractions mastery and their abilities in the prerequisites. Finally, the lack of students' mastery of the prerequisites resulted in students' beliefs that the concept of fractions is difficult.

1. Introduction

In this modern age, the application of mathematics is increasingly needed because it continues to underlie the development of science and technological advances. The curriculum 2013, aligned with the Law on the National Education System No.20/2003, aims to prepare Indonesians to have the ability to live as individuals and citizens who are faithful, productive, creative, innovative, and effective and be able to contribute to the nation and the world civilization [1]. In accordance with these objectives, at schools, students are taught mathematics through themes found by students in everyday life. Thus, early on, students are taught not only to master mathematics, but also to associate, practice, and utilize the knowledge in their lives. If students learn mathematics apart from their daily experiences, they will quickly forget and cannot apply mathematics in real-life situations [2]. On the contrary, students can find the easiness in learning if learning contents and contexts related to their daily activities [3].

One of the basic topics in mathematics is fraction. Formally, fraction is one of the topics that must be learned both in elementary and middle school levels. Fraction is very important for students to



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master since it is not only useful for learning other mathematics concepts, but also helps students overcome daily problems related to fractions. Students' success in mastering fractions becomes an increasingly important predictor for future achievement in used tasks on number concepts, as the students grow older [4]. Moreover, the importance of fractions extends beyond math classes and the school years [5]. Fractions also have an important role in applying physical, biological, and social sciences and in a wide range of middle-income occupations that do not require advanced math, including carpentry, nursing, and auto mechanics [6].

However, the facts show that many students of junior high school still find difficulties in understanding fractions [7]. For example, children aged 13 to 17 years are expected to add fractions with the same denominators successfully. However, only a third of children aged 13 years and two-third of children aged 17 years are able to add $\frac{1}{3}$ and $\frac{1}{2}$ correctly. One of the factors contributing to this issue is the lack of understanding of the fraction concepts taught since elementary schools. Children's success in solving various problems related to the operations on fractions is still relatively low [8]. Over 20 years mathematics educators have been working to investigate why students encounter difficulties in learning fractions and finding out ways to teach fractions effectively [9]. Furthermore, according to the 7th grade mathematics teachers in one of the junior high schools in Banda Aceh, there are some students who still face difficulties in learning fractions. It means that there are some students that have not mastered fractions yet. In other words, their mastery has not reached the minimum learning mastery standard (MLMS). The MLMS for mathematics subject set in the junior high school is 82. The facts reveal that fraction as a basic topic is quite challenging to learn by students.

In elementary schools, the concepts of fractions which should be mastered by students consist of ordinary fractions, mixed numbers, percentages, decimals, and so on. These concepts are the prerequisites for fractions in junior high school level. In junior high schools, students learn addition and subtraction of fractions, division of fractions, and others. Fractions learned in elementary and junior high schools might be similar and related to one another. One of the differences is that junior high school students have been directed to think deductively. Also, fractions in junior high schools are more abstract compared to fractions in elementary schools. Thus, fractions in elementary schools are the foundation for students before proceeding with the advanced fractions in junior high schools.

The students' understanding will be deeper and longer-lasting if they can connect mathematical ideas in learning [10]. Hence, teacher should require students to remember and be responsible for their prior experiences and use them as the knowledge to learn the new ideas [10]. Those facts show that the difficulties found by junior high school students in understanding the fractions are caused by a lack of understanding of the concept of fractions in elementary schools. Some previous studies only focus on looking at students' difficulties in solving fraction word problems [11], misconception related to addition and subtraction of fractions [12], and so on. Nevertheless, there is a scarce study on the relationship between students' mastery of fractions and their abilities to understand the prerequisite topics.

Based on these issues, this present study aims to: 1) Investigate whether students' mastery of fractions and prerequisite topics in the 7th grade of a junior high school in Banda Aceh has reached MLMS; and 2) Investigate the relationship between students' mastery of fractions and their abilities to understand the prerequisite topics in the 7th grade of a junior high school in Banda Aceh.

2. Method

This study is descriptive and inferential research. The population was all students in the 7th grade of a junior high school in Banda Aceh, where the school is one of the best school of junior high school in Banda Aceh. Then the sample consisted of 50 students was chosen randomly. The data were collected from the results of the student mastery test on fractions and the results of the student ability test on prerequisite topics. The questions were selected from predetermined textbooks. The fraction questions were adopted from a seventh-grade textbook and the questions related to the prerequisites were taken from an elementary textbook.

There are two techniques of data analysis used in this study, namely:

- 1) The data were analyzed by using statistical analysis to obtain answers about the students' mastery of fractions and students' abilities on the prerequisites. The hypothesis whose formulation contains equal sign or proposes that no statistical significance exists called the null hypothesis (H_0), in opposition to the alternative hypothesis (H_1) which contains unequal, bigger or smaller sign [13].
 - a. To test the students' mastery of fractions, the hypotheses used are:
 $H_0 : \mu = \mu_0$: {the students' mastery of fractions has not reached MLMS}
 $H_1 : \mu > \mu_0$: {the students' mastery of fractions has reached MLMS}
 - b. To test the students' ability on the prerequisites, the hypotheses used are:
 $H_0 : \mu = \mu_0$: {the students' ability on the prerequisites has not reached MLMS}
 $H_1 : \mu > \mu_0$: {the students' ability on the prerequisites has reached MLMS}

The two hypotheses above were tested manually by using t-test [13].
- 2) The data to find out the relationship between students' mastery of fractions and their abilities to understand the prerequisite topics were analyzed manually by using the product-moment correlation test. Then, the linear regression equation was determined by first finding the coefficient of constant a and b , and then substituted the values to the linear regression equation, that is $\hat{Y} = a + bX$ [13].

3. Result and discussion

Testing the first and second hypotheses began with comparing the results of the student mastery test on fractions and the student ability test on the prerequisites with MLMS. Then, the normality test was conducted to determine whether the data were drawn from a normally distributed population and the test results showed that the data were normally distributed. Then, the t-test was utilized to test the first and second hypotheses. The results of testing the first hypothesis showed that $t_{score} < t_{table}$ or $-10.65 < 1.6755$, then, H_0 was accepted. Thus, the students' mastery of fractions in the 7th grade of a junior high school in Banda Aceh has not reached MLMS. Next, the results of testing the second hypothesis showed that $t_{score} < t_{table}$ or $-2.29 < 1.6755$, then, H_0 was accepted. As such, the students' ability on the prerequisites in the 7th grade of a junior high school in Banda Aceh has not reached MLMS. There are several factors that caused students were not able to master fractions in elementary and the seventh grade levels. One of them is that the MLMS set was probably too high for students. For that reason, the researchers tried to re-test students' mastery of fractions with the MLMS of 65. Then, the results revealed that $t_{score} < t_{table}$ or $-4.64 < 1.6755$. Thus, H_0 was accepted. This result indicated that the students' mastery of fractions had not reached MLMS. Therefore, the high MLMS did not influence the results of students' mastery of fractions.

The results of the correlation analysis between students' mastery of fractions and their abilities to understand the prerequisite topics using the product-moment correlation formula showed that $r_{XY} = 0.62$, where the value of r moves between 0 and +1. It showed a positive correlation between variables X and Y . According to [14], this correlation was considered in the sufficient category, where the range was between 0.6 and 0.8. Meanwhile, according to [15], the correlation was in the strong category, where the range was between 0.6 and 0.79. Similarly, according to [16], the correlation was in the strong category, where the range was between 0.68 and 1.0. Based on these statements, we could say that the correlation indicated a significant relationship between students' mastery of fractions and their abilities on the prerequisite topics. Furthermore, we found that the coefficient of determination or the amount of contribution of students' abilities in understanding the prerequisites toward their mastery of fractions was $R = 38.44\%$ (sufficient), while other variables determined the remaining 61.56%. Moreover, a linear regression equation was determined to investigate the functional relationship between students' abilities on the prerequisite topics (X) and their mastery of fractions (Y). By carrying out the procedures as described in the method, we got $\hat{Y} = 15.86 + 0.51X$. Figure 1 illustrates the functional relationship between the two variables.

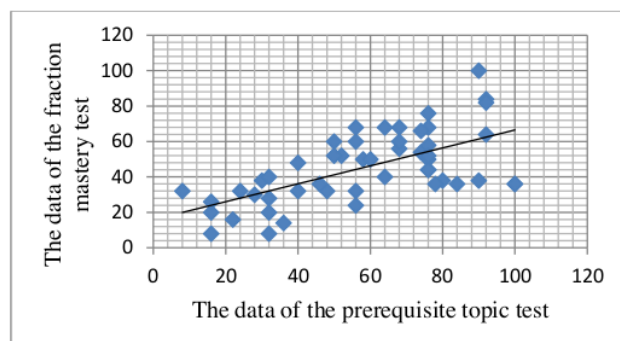


Figure 1. Linear regression chart.

Based on the results stated above, we identify that students' mastery of fractions and prerequisites in the 7th grade of a junior high school in Banda Aceh has not reached MLMS. Then, we also identify that the prerequisites had an effect of 38.44% (enough) to the students' mastery of fractions in junior high schools. Suffice it to say; the students did not master the fractions due to lack of understanding of the prerequisites taught in elementary schools. If students are able to understand the concept of fractions they have learned in elementary schools, they will find it easier to learn fractions in junior high schools, because fractions in elementary schools are highly related to the fractions in junior high schools.

Moreover, students could not master the prerequisites and fractions due to lack of the teacher's ability to meaningfully teach the fraction concepts [17]. As a result, in the test, students also found it difficult and could not even answer the test questions. In the end, many students obtained scores that did not meet the MLMS set by their school. The students' performance in mathematics is supported by teachers' content knowledge of mathematics, strategies, methods of presentations, and methods of evaluations [18]. The low quality of learning is a result of teaching instructions that merely relied on a textbook. Whereas, the textbook only contains formulas and exercises which, in some cases, cannot be applied in real-life situations. This way of learning makes students easily get bored and dizzy, and cultivate a belief that mathematics is merely about abstract objects that are not useful in their lives. An effective learning should allow students to explore the mathematics concepts, especially fractions, by representing fractions with an object that can be imagined or seen by students. Teachers have an important role in supporting students' mathematical representations [19] and the students are given the freedom to use multiple representations to develop their fractional understanding [20]. Also, in groups, students can discuss open-ended problems that can be applied in their lives. Such methods help and encourage students to learn mathematics, specifically fractions.

As we previously explained, the tests in this study contain multiple-choice and essay questions. Regarding the test of students' mastery of fractions, among multiple-choice questions, question number 3 was answered correctly by most of the students, which were 80% and followed by question number 5 which were 72%. Question number 3 relates to the addition of ordinary fractions and question number 5 is about the subtraction of decimals. Then, question number 10 received the least correct answers (16% of students) and followed by question number 2 (18% of students). Question number 10 focuses on the rational numbers, while question number 2 relates to the comparisons of fractions, including ordering fractions from the smallest to the largest. In relation to the essay question, there were 54.2% of students who got the scores from their answers. This question focuses on the addition of mixed numbers and decimals. Therefore, generally, regarding the fraction topics taught in

junior high schools, students mostly mastered the addition and subtraction of fractions, especially the addition of ordinary fractions and the subtraction of decimals.

On the other hand, rational numbers and comparison of fractions, especially in ordering some fractions were the topics least mastered by students. One of the factors that contribute to lack of understanding of fractions is that the students did not understand the relationship between the size of the denominator and the size of the fraction; consequently, they applied strategies used for ordering the whole numbers in fractions [9]. Students' abilities in ordering fractions could be improved. Using multiple representations in learning fractions could be the most effective strategy to strengthen students' understanding. Using fraction circles and the fraction charts, for example, might be effective to promote understanding about the concept of ordering fractions [9].

In regards to multiple choices in the test of the prerequisite topics, question number 6 was the most correctly answered by students (86%) and then followed by question number 3 (76%). The question number 6 focuses on the addition of decimals while the question number 3 relates to the subtraction of mixed numbers and ordinary fractions. Meanwhile, question number 1 was least correctly answered by students (34%) and followed by question number 8 (38%). Question number 1 is about the comparison of fractions; that is, ordering fractions from the smallest to the largest. Question number 8 relates to the percentages. In term of the essay question, there were 57.4% of students who obtained scores from their answers. The question relates to the addition and subtraction of fractions. To sum up, in general, the prerequisite topics mostly mastered by the students were the addition and subtraction of fractions, especially the addition of decimals and the subtraction of mixed numbers and ordinary fractions. Whilst, the prerequisite topics barely mastered by students were the percentages and the comparison of fractions, mainly in ordering some fractions.

In contrast to this finding, the previous studies reported that the division of fractions was often considered as the most mechanical and difficult topic in elementary schools [21-23]. This contradiction indicates that the comparison of fractions also has to be considered as one of the most difficult topics in fractions. Therefore, it is necessary to investigate further about the factors that contribute to this issue and the effective strategies to deal with this problem. In conclusion, based on the analysis results, the students mastered fractions related to the addition and subtraction of fractions. Nevertheless, the students still lacked understanding of the comparison of fractions, mostly in ordering the fractions, rational numbers and percentages.

4. Conclusion

The findings of this study showed that the students' mastery of fractions and their abilities on the prerequisite topics in the 7th grade of a junior high school in Banda Aceh did not reach MLMS. Moreover, there was a significant relationship between students' mastery of fractions and their abilities on the prerequisites. Further research is necessary to explore factors that influence students' difficulties in understanding fractions and to find learning models that help improve students' understanding of fractions.

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