

Assessment of Fraction Concept among Lower Secondary Students

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ABSTRACT

In the realm of secondary school mathematics, the concept of fraction serves as a pivotal foundation, laying the groundwork for a deeper understanding of numerical relationships and mathematical operations. Lack of understanding in fraction can affect to the students' performance. The aim of this research is to examines the students' performance and how the students implementing conceptual and procedural knowledge in the fraction test. The second aim in this study is investigates the relationship between Conceptual Knowledge (CK) and Procedural Knowledge (PK). A quantitative study approach been applied in this study. The sample size in this study were 132 of Form 2 students from Seberang Perai Utara, Malaysia involve in this study. The Conceptual Knowledge and Procedural Knowledge Test (CKPKT) has been distributed to students. Based on their test. The findings revealed that the students' performance in fraction depends on the understanding of conceptual and procedural knowledge. The study found that there is a significant relationship between those two types of knowledge. For this reason, a good practice will help the students to gain better performance in fraction.

Keywords: Conceptual Knowledge, Procedural Knowledge, CKPKT

1. INTRODUCTION

In terms of our daily activities, mathematics is important in life. Every subject in mathematics is crucial to our everyday life because it teaches us how to deal with numbers. Mathematics exists in various of form and it is very useful and important in our life which involved unintentionally. Fraction, decimal, and ratio make up another division in mathematics. Starting from elementary school until university, this topic of fraction must be studied. According to the textbook, a fraction is the number of equally sized things that makeup a whole [1]. Successful in studying fractions, will be giving students a better knowledge of division and can help the students to simplify large or tiny numbers into something that is easier to manage. This subject is known to be one of the hardest to learn and perform well on in math. Fraction is one of the mathematics topics that student's study in elementary school [2].

For the idea of fractions to be properly understood, two knowledges are needed. Conceptual knowledge is the first type of mathematical knowledge, while procedural knowledge is the second. Previous research uncovered the conceptual and procedural knowledge levels of students as well as the typical errors they made. They discovered that there is no clear connection between students' conceptual knowledge of mathematics and their mathematical performance [3]. But students who have a stronger conceptual knowledge perform better in mathematics than those who have a weaker conceptual grasp.

To help the students, more impactful methods must be used to improve their comprehension of fractions. However, the lack of mastering one of that knowledge can affect the student's achievement [4]. Not many studies have been made focusing on these two factors. The goal of this research on fraction concepts is to improve students' achievement in fractions in light of their conceptual and procedural knowledge. According to Lynda [5], students used both conceptual and procedural methods equally, although those who used conceptual methods had a little edge in achieving the proper answer. These two distinct types of information have an influence on how well students do mathematically. The current study's objective is to assess students' conceptual and practical knowledge of fractions.

II. METHODS

This study using a quantitative approach where the students will be given a test on Conceptual Knowledge and Procedural Knowledge Test (CKPKT) in order to identify the students' achievement in fraction concept. The test will be distributed to the secondary school students by selected sampling to find out their achievement in test about conceptual and procedural knowledge. The scores obtained from CKPKT will be analyzed to identify the students' difficulties in solving fraction problem. This will be analyzed by using qualitative approach where students will be interviewed based on their CKPKT scores. This study gives an in-depth analysis to find the students' achievement in fraction and to find the relationship between conceptual and procedural knowledge.

The target population for this study is from secondary school students, as they already learn fraction from primary school. This study used simple random sampling. The actual population for Form 2 students in this study in area Seberang Perai Utara is 4000 and the sample size should be 351 students. However, due to spread of Covid-19, not much school want to accept to do the research. So, the population and the sample size of students has become smaller. The number of sample size for this study is 132 Form 2 students in Seberang Perai Utara area which sufficient for a population size of 200. The number of sample size is small is also due to limited time to collect the data. Specifically, the sample consisted of students from SMK Bakti, SMK Tasek Gelugor and SMK Permatang Tok Jaya. That area also was chosen as the location was chosen as the area near the domicile of the researcher.

The instrument used is a set of tests, named as Conceptual Knowledge and Procedural Knowledge Test (CKPKT) that consists of two parts. The instrument used is a set of tests, named as Conceptual Knowledge and Procedural Knowledge Test (CKPKT) that consists of two parts. Part B consist of 10 questions of Conceptual Knowledge (CK) question. The test is developed according to different concepts and representation of fraction which are: (1) meaning of fractions, (2) comparison of fractions, (3) part-whole, (4) addition and subtraction, (5) multiplication and division and (6) rules of operations in order to measure students' conceptual knowledge of fractions. While Procedural Knowledge (PK) question in Part C consist of 7 questions to test students' PK on how they answer the fraction question. In PK, the students answer is analyzed by four different type of fraction concept which are: (1) comparison of fractions, (2) addition and subtraction, (3) multiplication and division and (4) rules of operations.

III. RESULTS AND ANALYSIS

A. Research Question One: What is the student's achievement for conceptual and procedural knowledge in Fraction Concept?

Regarding the student's achievement for conceptual and procedural knowledge in fraction concept, firstly, a descriptive analysis on conceptual and procedural question has been done. An analysis on students test answer was done in order to calculate the mean and the standard deviation for each question in Conceptual Knowledge Test (CKT) and Procedural Knowledge Test (PKT).

Table 1: Score for Conceptual, Procedural and Total Score

	N	Mean	Std. Deviation
TotalScore_Conceptual	132	5.68	3.57
TotalScore_Procedural	132	3.33	2.54
Total_Score	132	9.01	5.00
Valid N (listwise)	132		

TABLE 1 shows the Descriptive Analysis for TotalScore_Conceptual, TotalScore_Procedural and Total_Score for both tests. TotalScore_Conceptual variable has been computed from item 1 until item 10 in Conceptual Knowledge Test (CKT). The mean test score for TotalScore_Conceptual was 5.68 with a standard deviation 3.57. That suggest that, there are students with diverse levels of achievement. While the mean test score for TotalScore_Procedural variable has been computed from item 1 until 7 in Procedural Knowledge Test (PKT) was 3.33 with the standard deviation 2.54. This indicate that in procedural knowledge, the mean represents the average score achieved by the students was below the midpoint of the scale. The students' achievement for conceptual can be seen from Table 4.3. Based on Table 4.3, the mean of Total_Score for Conceptual Knowledge Test and Procedural Knowledge Test (CKPKT) was

9.01 which was above the average score achieved by the students with 5.00 standard deviations.

Table 2: Students Grade for CKPKT

		Frequency	Percent
Valid	B	22	16.7
	C	17	12.9
	D	19	14.4

	E	74	56.1
	Total	132	100.0

TABLE 2 shows the number of students with grade for the total score of Conceptual Knowledge Test (CKT) and Procedural Knowledge Test (PKT). Among these three schools, the table shows that there are no students get A for this CKPKT. The highest-grade students achieve is B which are 22 students (16.7%) manage to score in this test. Follow by 17 students score grade C with 12.9%, 19 students get D with 14.4%. All these students manage to pass the test. There are huge numbers of students who failed the test. There are 74 students with 56.1% failed to pass the test that given to them.

Table 3: Achievement based on Concept Fraction (Conceptual Knowledge)

	Fully Construct		Partially Construct		Failed to Construct	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Meaning of Fraction	10	7.6	25	18.9	97	73.5
Comparison Fraction	16	12.1	10	7.6	106	80.3
Part-Whole	20	15.2	61	46.2	51	38.6
Addition and Subtraction	2	1.5	2	1.5	128	97.0
Multiplication and Division	18	13.6	29	22.0	85	64.4
Rules of Operation	28	21.2	25	18.9	79	59.8

Figure 1: Fraction Concept for Conceptual Knowledge (CK)

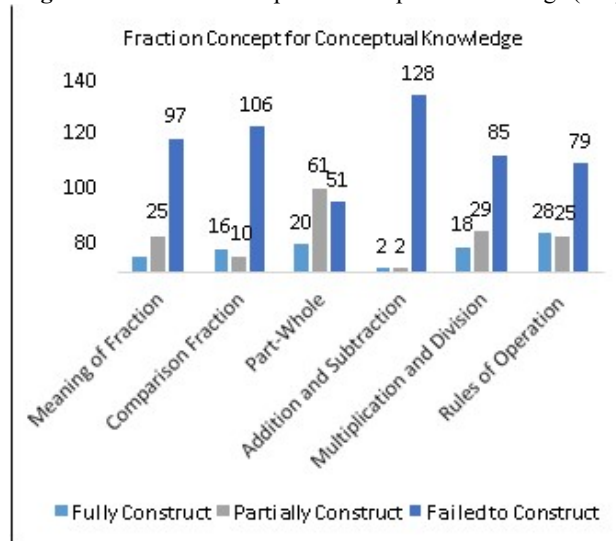


TABLE 3 above describe the number of students who manage to construct the test about the conceptual knowledge. The comparison of fraction concept has been analysed as in TABLE 3. For every fraction concept, most of students failed to construct the test. As seen in the table, for meaning of fraction concept, the number of students failed to construct is 97 (73.5%). Next, for comparison of fraction, number of students failed to construct is also highest with 106 students (80.3%). However, for part-whole, students manage to partially construct the test with the number of students 61 (46.2%). For addition and subtraction is the highest average of students who failed to construct with 128 students with 97%. Multiplication and division and rules of operation both have the highest number of students that failed to construct the test with 85 (64.4%) and 79 (59.8%) of students respectively.

TABLE 4: Achievement based on Concept Fraction (Procedural Knowledge)

	Fully Construct		Partially Construct		Failed to Construct	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Comparison Fraction	38	28.8	0	0	94	71.2
Addition Subtraction	19	14.4	53	40.2	60	45.5

Multiplication and Division	38	28.8	37	28.0	57	43.2
Rules Operation	51	38.6	0	0	81	61.4

Figure 2: Fraction Concept for Procedural Knowledge (PK)

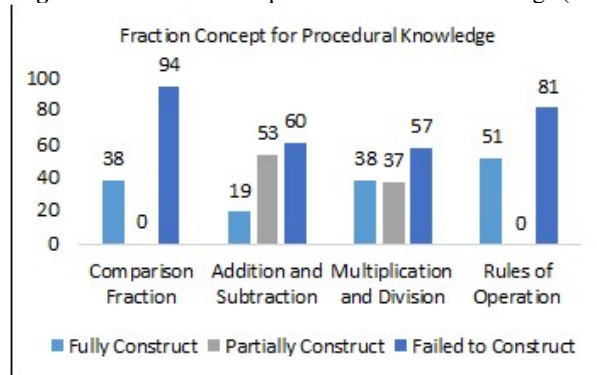


TABLE 4 above shows the number of students divided by the average for four fraction concepts in procedural knowledge. For comparison of fraction in procedural knowledge, majority of students do not manage to construct the question. 94 (71.2%) of students compared to the one who manage to fully construct which is 38 students (28.8%). For addition and subtraction, 60 students (45.5%) failed to construct the questions while 53 students partially construct and 19 manage to fully construct the question. Another than that, 57 students (43.2%) failed to construct the question about multiplication and division. Followed by the rules of operation concept where 81 of students (61.4%) failed to construct the question given.

B. Research Question Two: Is there any significant relationship between procedural and conceptual knowledge?

This section analyses the relationship between conceptual knowledge and procedural knowledge. In order to determine the relationship between conceptual knowledge and procedural knowledge in this study, correlation test has been done between these two variables in SPSS.

H_0 : There is no significant relationship between conceptual knowledge and procedural knowledge in fraction concept

H_1 : There is a significant relationship between conceptual knowledge and procedural knowledge in fraction concept

Table 5: Relationship between Conceptual Knowledge (CK) and Procedural Knowledge (PK)

		TotalScore_ Conceptual	TotalScore_ Procedural
Pearson Correlation		1	.320**
TotalScore_ Conceptual	Sig. (2-tailed)		.000
	N	132	132
TotalScore_ Procedural	Pearson Correlation	.320**	1
	Sig. (2-tailed)	.000	
		N	132
**. Correlation is significant at the 0.01 level (2-tailed).			

TABLE 5 shows the correlation analysis between conceptual and procedural. In this test, Pearson's r value is 0.320. 0.320 indicates a moderate correlation. As the r value is a positive number, it indicates the moderate positive correlation which means that students who score in conceptual test also score in procedural test even though it is not extremely strong relationship. 2-tailed significance value in this analysis is <.000 which means that this correlation is statistically significant. It can be concluded that there is a significant correlation between total score in conceptual test and total score in procedural test. Thus, we reject the null hypothesis.

IV. DISCUSSIONS & CONCLUSION

A. Student's achievement for conceptual and procedural knowledge in Fraction Concept

The total score for Conceptual Knowledge Test (CKT) is 16 and the total score for Procedural Knowledge Test (PKT) is 8. In scoring in Conceptual Knowledge Test (CKT), students need to understand the concept of fraction. It is because conceptual understanding is a key component in mathematics if the students want to understand mathematics in depth (Andamon and Tan, 2018). While the idea of procedural understanding is based on the

steps and rules to get the goal. The achievement of the students is based on three categories which are total score of Conceptual Knowledge Test (CKT), Procedural Knowledge Test (PKT) and total addition between score Conceptual Knowledge Test (CKT) and Procedural Knowledge Test (PKT). Referring to TABLE 1, the student's performance on Conceptual Knowledge and Procedural Knowledge Test (CKPKT) was not reach the maximum score. For Conceptual Knowledge Test (CKT), the students only manage to get maximum score of 13.50 (84.37%) while for Procedural Knowledge Test (PKT), students manage to get the full mark with 8 (100%). Furthering with combining both score Conceptual Knowledge Test (CKT) and Procedural Knowledge Test (PKT), the maximum score by the students was only 19 out of 24 marks.

Followed by further analysis in TABLE 2, the students score has been analyzed by using grade A until E. It is easier to find the number of students who pass the test and the one who failed to pass the test. According to TABLE 2, none of the students scored A in CKPKT, and majority of the students with 74 (56.1%) numbers of students failed in this test. This is due to several reasons which are firstly, students do not have enough time to finish answering the question. The time given for answering the CKPKT is only an hour.

To make it clearer, the students' achievement has been divided to six fraction concepts for conceptual knowledge and four fraction for procedural knowledge. Based on the TABLE 3 shows that the concept that most of students failed to construct in conceptual knowledge is addition and subtraction concept of fraction. According to Ndlichako, [6], they were handling the numerators and denominators of fractions addition problems as separate entities as they lack the understanding of appropriate procedures to solve the question. For procedural knowledge, based on TABLE 4, most of the students are unable to answer comparison fraction. This is due to misconception on how to compare the equivalent fraction. A study by Erol [7], which was conducted to determine the strategies of students in comparing fractions discovered that the students use out of box strategies that are not taught by the teachers. However, even the answer was correct but the reasoning of choosing the answer was wrong. This is supported by Gould [8] in his studies that students even get the right answer even though they had a faulty reasoning.

B. The relationship between procedural and conceptual knowledge

In the present findings, it was found that there was a weak positive correlation between students' performance in conceptual and procedural knowledge of fractions. In the Pearson correlation test, the r value is 0.320 ($p < .000$) which means that students who score in conceptual test are also able to score in procedural test or students who score low in conceptual knowledge also will get lower score in procedural knowledge. This finding was supported by previous research who obtained the same result as this research study which pointed that conceptual knowledge and procedural knowledge are both important in learning fraction as it related to each other [4]. It indicates that the findings in this study address that these two types of knowledge should be balance in order to improve the student's performance in understand fraction better.

This finding also consistent with the previous research finding by Ormeci, [9] which the result from the study obtain that one type of knowledge was related to another type of knowledge except for the previous study obtain a large positive correlation between those two knowledge compared to this recent study. This is also in line with the study from Schneider and Stern, [10] where the result obtain from the study revealed that conceptual knowledge is a valuable for students' procedural knowledge. However, the second outcome of this study also found that the children do not have any specific procedural knowledge that help them to acquire conceptual knowledge. Which means that this study contradicts with the recent studies.

According to Qetrani and Achtaich, [11], the correlation test that has been done in their study obtain that students who scores in procedural knowledge do not necessarily have a rich of conceptual knowledge. Based on the previous study, the students lack of conceptual understanding as they do many similar tasks of procedures instead of concept. This tells that it is not necessarily that every relationship will get positive relationship.

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