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MISCONCEPTION AS A FACTOR AFFECTING PERFORMANCE OF DIPLOMA STUDENTS IN SOLVING FRACTIONS

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Abstract

This study investigated the misconception of fraction among diploma students. It tested diploma one students of computer, studying at AD Rufa'i College of Education Legal and General Studies, Misau. These students were targeted, because they have just left secondary schools and are expected to have been taught the concept of fraction. The study checked transfer of misconception of fraction to tertiary level of education. The total population of the study is one hundred and seventeen students. Purposive sampling technique was used to select ten good students based on their semester results, with the help of their Head of Department. The study uses qualitative research design, in which achievement test was conducted on fractions to see the processes used by the students in solving the fractions. The test questions were selected from Joint Admission and Matriculation Board (JAMB) examinations' passed questions. Moreover, after going through the students' answer sheet, five students were selected for a verbal interview, to explain their reasoning while answering the test questions. The study used constant comparison method to analyze the data collected. The findings of this study shown that, students transfer misconceptions of fraction to tertiary level and these misconceptions affect their performances in solving fractions. The findings also revealed that the misconceptions resulted from misunderstanding of the basic definition of fractions, lowest common multiples, and order of operations.

Keywords: Diploma Students, performance, Factor, Misconception, Fraction.

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Introduction

Fraction is a basis for decimals, rational numbers, algebra, and more advanced mathematical concepts and is useful in calculating discount and sharing (Lee & Boyadzhiev, 2020). However, despite the fact that fraction is being taught as a topic at different levels of secondary schools in Nigeria, yet students reveal misconception while solving problems related to it. Many documents have been reported in literature discussing about the misconception of student in understanding the fraction. For example Almeda et al (2013), argued that many students still have difficulty in understanding fractions even when they already have reached high school. Abdul Ghani and Maat (2018) also reported that students misconceive the order of operation in solving fractions resulting in committing mistakes when adding fractions with different denominators.

Moreover, in their attempt to report students errors in fractions, Azurah Mohd Johar et al., (2014) opined that, students disregard the concept of association and often use the same rules in the four basic operation (addition, subtraction, multiplication and division), with the same procedures. This report added to many of the students' errors found in the literature that have caused them to be unable to determine the correct concept for solving fraction problems. Misconception will lead pupils to not mastering fractions, thus making this subject less favourable (Trivena et al , 2017). This relates to Wong and Evans (n.d.) in Domingo (2004) who reported that conceptual understanding of fractions involves the declarative and procedural knowledge and has taken place when students see the connections between the concepts and procedures and can give logical reasons for these concepts and procedures. When adding algebraic fractions, learners often produce errors and reveal misconceptions as a result of short cuts that they perceive as easier methods of adding the fractions instead of following the apparent long and cumbersome algorithmic correct method of adding fractions (Dhlamini & Kibirige ,2014). Additionally, it is seen that many studies that reported the students' misconceptions on fractions presented the identified misconceptions. For example, Alghazo and Alghazo (2017) suggested that the majority of college students in Saudi Arabia hold common misconceptions about fractions and mathematical calculations involving fractions. According to him, students often think that all fractions are always part of 1 and never greater than 1, and use cross multiplication to solve multiplication problems involving fractions. In this study therefore, the aim was to examine and uncover the extension of these misconceptions to tertiary levels of education in Nigeria. Accordingly, it was aimed to determine the tertiary level students' errors and the underlying causes of misconception in relation to fractions and operations with fractions.

Statement of the problem

There is an utmost need to develop high thinking skills among Nigerians students.

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To achieve this development, fraction is one of the areas to focus on with the view to improve students' mathematical competency. To support this argument, Gould, et al (2006) contended that teachers and researchers typically describe the teaching and learning of fractions as a challenging area in the mathematics curriculum. Hence, there is need to research into what brings about the low performance to remedy the situation for future progression.

Unfortunately, despite the reports pointing at the alarming situation in the teaching and learning of fractions, little or no research is conducted in Nigeria to address this problem. This reason compels the researchers to carry out investigation into the nature of the misconceptions with fractions among students of diploma. The study aimed to investigate how fractions were understood by this specific group of students in order to get insight into their mathematical understanding, and also see whether students transfer misconception of fraction to higher levels of learning. This knowledge, helped the researchers got an in-depth understanding of the problem which would be communicated to teachers on the urgent attention needed to reverse the situation. It is hoped that the findings of this study may also guide students themselves to develop effective learning strategies that help them to achieve in other mathematics courses.

Research Questions

- **Does fraction remain a challenging area to diploma one students?**
- **Do students transfer misconception of fraction to tertiary level of education?**
- **How the misconception affects students' performance in solving fractions?**

Methodology

The methods used in conducting this research are explained below

Research Design

The study used qualitative case study design, in which achievement test and interviews were used to collect the data.

Population and Sample of the Study

The study used the population of one hundred and seventeen students of diploma, studying computer science at A.D. Rufa'i COELEGS Misau. Purposeful sampling was used to select ten good students based on their first semester results to constitute the sample. To get the manageable number for the interview, the study employed the use of theoretical sampling strategy when analyzing students' answers to the test and selected five students.

The order of operation

The order of operation (BODMAS) rule defines the correct sequence in which operations are to be carried out in a given mathematical expression to find its correct value. The table below shows the interpretations

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ACRONYM	INTERPRETATION
B	**Bracket**
O	**Of**
D	**Division**
M	**Multiplication**
A	**Addition**
S	**Subtraction**

Instruments for Data Collection

The achievement test consists of five questions on fraction and the semi-structured interview were the instruments used to collect data of the study. The distribution of questions can be seen under the table of findings, below.

Findings

The test scripts were marked and the results were collected for data analysis. The recorded data from the interview was transcribed and compared with the students' answers to test questions.

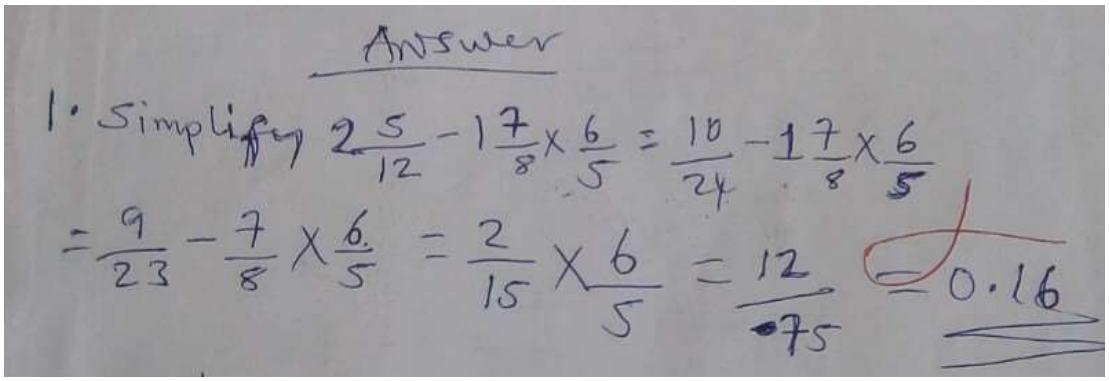
The questions analysis on the basis of Concept and their Misconceptions

Question	Concept	Misconception
1. $2\frac{5}{12} - 1\frac{7}{8} \times \frac{6}{5}$	Simplifying the fraction involving subtraction rule and multiplication rule	Students could not convert mixed number to improper fractions and did not care to follow BODMAS
2. $\frac{\frac{1}{10}\times\frac{2}{3}+\frac{1}{4}}{\frac{1}{2}\div\frac{3}{5}-\frac{1}{4}}$	Evaluating of fractions that involve multiplication rule, addition rule, division and subtraction rule, respectively.	- Students cross multiply the fractions instead of multiplying -inability to add and subtract fractions
3. $\frac{3}{5} \div (\frac{2}{7} \times \frac{4}{3} \div \frac{4}{9})$	Simplification of fractions comprising the division rule and multiplication rule.	There is problem on BODMAS and also inability to divide fractions
4. $\frac{\frac{3}{8}\div\frac{1}{2}-\frac{1}{3}}{\frac{1}{8}\times\frac{2}{3}+\frac{1}{3}}$	Evaluating fractions that involve division rule, subtraction rule, multiplication rule and addition rule, respectively.	-Dividing the first numerator by the second before subtracting the third numerator. - Doing the same to the denominators

		-Students failed to consider the difference in the denominators
5. $\left(\frac{3}{4}\ of\ \frac{4}{9} \div 9\frac{1}{2}\right) \div 1\frac{5}{19}$	Simplifying the fractions having 'of' rule first and then division rule.	-Students misconceived the presentation -Inability to convert mixed number to improper fraction -Unable to divide fractions

The samples of students' misconception according to the type of mistake committed.

1. Students inability to convert mixed number to improper fraction who also have problem with order of operation



The above mistake was committed by six (6) students who demonstrated their inability to convert mixed numbers to improper fractions. They also failed to consider the order of BODMAS in their solutions, resulted in making a lot of errors. From the script, it can be seen that the student multiplied the whole number of the first fraction by numerator and denominator of the same fraction in his attempt to make improper fractions. He then subtracted the second whole number from the new numerator he obtained, before subtracting the second numerator from the first. The student also subtracted the second denominator from the first before multiplying the result by the third fraction. Additionally, the interview result shown that the respondent failed to understand the concept of fraction, as he repeated the mistake in the remaining questions when asked to explain his thought during the test. Two of the remaining four respondents were able to obtain the correct improper fractions, but failed to take into cognizance the rule of order of operation. This misconception drags them to incorrect solutions. It can be concluded here therefore that; only two respondents were able to solve this question, correctly.

2. Students cross multiplication of the fractions instead of multiplying and their failure to add and subtract fractions, correctly.

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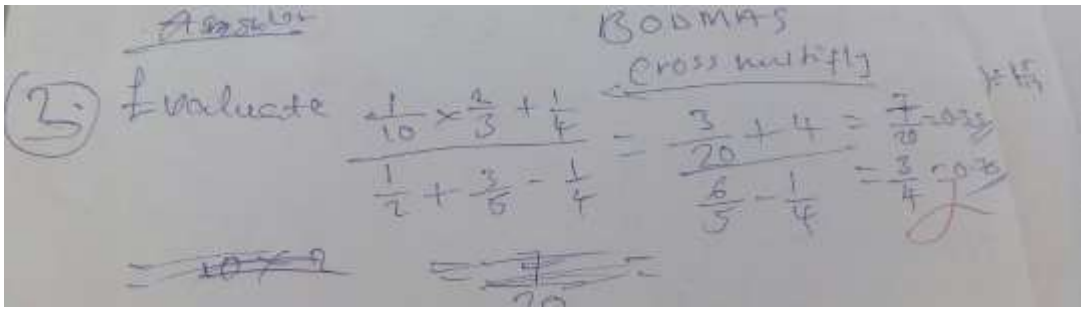
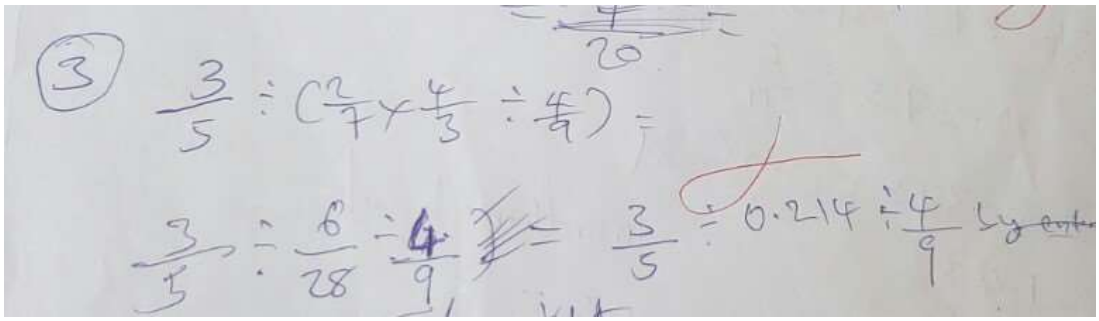


The mistake here was done by three students who cross multiplied fractions instead of multiplying them. One can see from the above student's script that he could not solve the question correctly. Instead of multiplying the two fractions above, the respondent cross multiplied them. He then added the denominator of the next fraction to the result he obtained. He mistakenly did the same thing to the fractions below the dividing line, ignoring the difference in operations. In this place, he subtracted the numerator of the second fraction from that of first and did the same to the denominators. The interview results revealed that these mistakes occurred because the students misconceived multiplication of fractions. They expected that multiplication in fraction is different from that of whole number. The students were also confused by the concepts of adding and subtracting fractions with different denominators and the addition of whole numbers. This shows that they did not understand the meaning of fractions and thought that the numerator and denominator were made up of different groups of place value. Although, five students multiplied the fractions as expected, they erroneously made additions and subtraction. The correct answer to this question was reached by two students, only.

2.Misunderstanding of order of operation and students' in ability to divide fractions



From the look of the script above, it can be understood that the respondent did not understand the order of operation. This type of mistake was exhibited by four respondents. It is seen that the student just negate the bracket without any reason for doing so. This indicates lack of knowledge of order of operation which led to wrong

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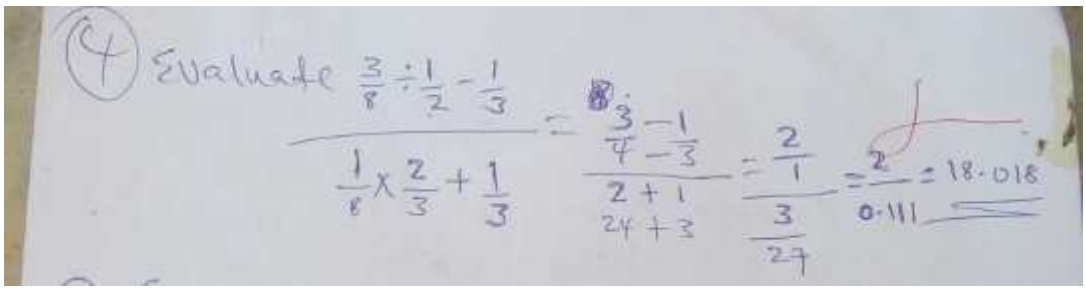
answer. The student is also among those respondents that cross multiplied fractions, instead of multiplying them. How to divide the fractions was also difficult to him. The responses from the student during interview indicate that he does not know the meaning of bracket in the expression and does not know how to use BODMAS. Moreover, four out of the remaining six respondents treated the fractions in the bracket separately, but were confused in dividing the fractions. They too failed the question. Finally, two students exhibited conceptual understanding of the question, though one of them made a computational error in his final answer.

4.Students' failure to consider the difference in the denominators when adding and subtracting the fractions



This mistake was committed by five students who failed to conceive how to divide fractions. From the script above, it is clearly seen that the student just divided the numerator of the first fraction by the numerator of the second, before subtracting the third numerator. This is done to the fractions above the dividing line. To the fractions below the dividing line, the student multiplied the two fractions correctly, but added the result to the third fraction, failing to consider difference in the denominators. This revealed lack of knowledge of fraction. During the interview, this student stated that irreducible fractions have to be simplified using calculator, which suggests his misconception of finding the simplest fraction and that notion forced him to use calculator when reaching irreducible fraction toward the end of his solution. According to him, numerators of the fractions are directly related and should be treated separately from the denominators. Three of the remaining five respondents considered changing division operation to multiplication without inverting the next fraction. They also cross multiplied the two fractions below the dividing line which resulted to incorrect answers. The correct answer to this question was obtained by two respondents, only.

5. Misconception of the expression 'of' in the fraction and students' inability to divide fractions

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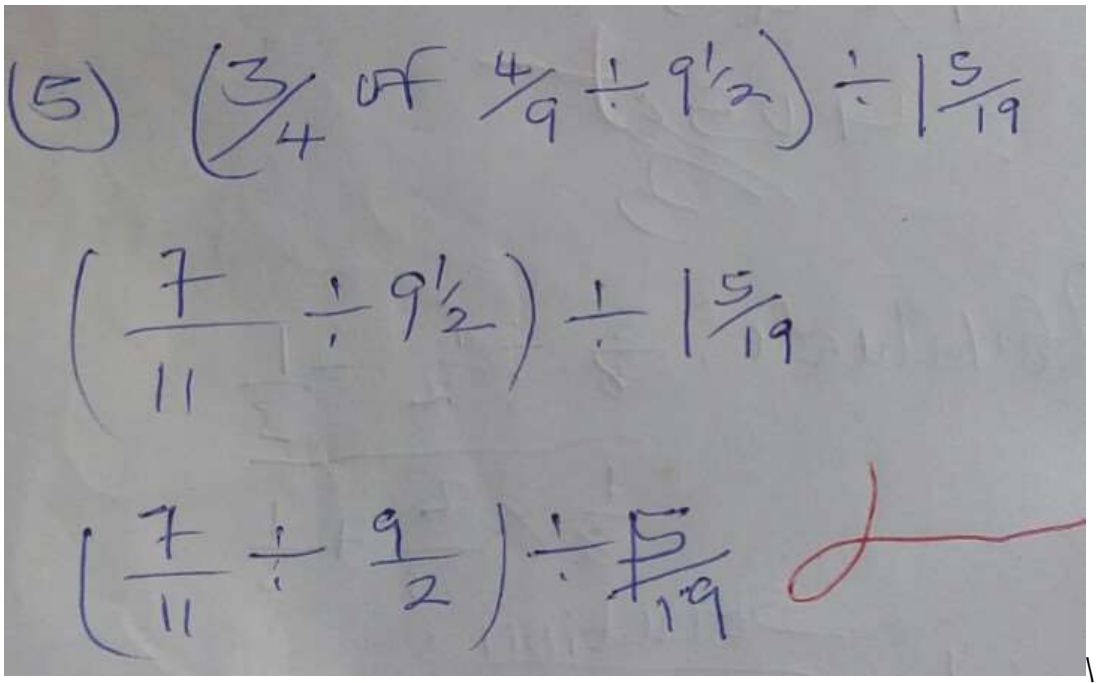

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Deduced from the test results, three respondents left this question untouched and explained during the interviews that they did not know the meaning of the expression 'of' in the question, as such they could not start the solutions. Two out of the remaining seven conceived the expression as command for addition, that was why the added the first two fractions. These too did not consider difference in the denominators of the two fractions. However, other three respondents understood the meaning and did the multiplication, but failed in dividing the fractions. To conclude here also, only two respondents solved this question correctly.

Discussion

The data gathered by this study on the mistakes made by students in solving fractions and the misconceptions they revealed were presented. Deduced from the analysis of data, the students made some mistakes that suggest misconceptions in fraction. The findings revealed that many students at diploma level still do not understand the meaning of fraction, since they did not understand concept of the order of BODMAS in solving fractions. From the data analysis, there were five mistakes done by the students.

The first mistake was that, they did not understand the concept of converting mixed number to improper fraction. The expectation was to multiply the whole number by denominator and add the result to the numerator to make the new numerator leaving the original denominator unchanged. Example, $2\frac{5}{12} - 1\frac{7}{8} \times \frac{6}{5} = \frac{2\times12+5}{12} - \frac{1\times8+7}{8} \times \frac{6}{5} = \frac{29}{12} - \frac{15}{8} \times \frac{6}{5}$. But some of the students (40%) erroneously multiplied the whole number by

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denominator and also by numerator. Example, $\frac{2\times5}{2\times12} - \frac{1\times7}{1\times8} \times \frac{6}{5} = \frac{10}{24} - \frac{7}{8} \times \frac{6}{5}$, while some of them (20%) multiplied the whole number by numerator only. For example, $\frac{2\times5}{12} - \frac{1\times7}{8} \times \frac{6}{5} = \frac{10}{12} - \frac{7}{8} \times \frac{6}{5}$. The finding of Wong and Evans (2011), supported this by stating that the multiplication of numerators and denominators is a common mistake made by learners.

The second mistake was that of cross multiplication in place of multiplication. For example, the students were expected to multiply the fraction as $\frac{\frac{1}{10}\times\frac{2}{3}+\frac{1}{4}}{\frac{1}{2}+\frac{3}{5}-\frac{1}{4}} = \frac{\frac{1}{15}+\frac{1}{4}}{\frac{1}{2}+\frac{3}{5}-\frac{1}{4}}$ but, some of them (30%) cross multiplied as as $\frac{\frac{1}{10}\times\frac{2}{3}+\frac{1}{4}}{\frac{1}{2}+\frac{3}{5}-\frac{1}{4}} = \frac{\frac{3}{20}+\frac{1}{4}}{\frac{1}{2}+\frac{3}{5}-\frac{1}{4}}$. The
Findings of Alghazo and Alghazo (2017) contended that the majority of college students in Saudi Arabia hold common misconceptions about fractions and mathematical calculations involving fractions. They went further to report that students think that all fractions are always part of 1 and never greater than 1, and also use cross multiplication to solve multiplication problems involving fractions.

The third mistake committed by the students includes inability of the students to add or subtract fractions with different denominators. For example, the students were expected to make addition and subtraction of the fractions $\frac{\frac{1}{15}+\frac{1}{4}}{\frac{1}{2}+\frac{3}{5}-\frac{1}{4}}$ as $\frac{\frac{4+15}{60}}{\frac{10+12-5}{20}} = \frac{\frac{19}{60}}{\frac{17}{20}}$, but eight students (80%) computed as $\frac{\frac{2}{19}}{\frac{3}{3}}$ showing lack of conceptual understanding of what addition and subtraction of fractions meant. This finding replicates that of Ghani and Maat, (2018) who argued that mistake was often committed by pupils when adding two fractions with different denominators .

The fourth mistake done by the students relates to order of operation (BODMAS). For instance, the students were expected to simplify the fractions $\frac{3}{5} \div (\frac{2}{7} \times \frac{4}{3} \div \frac{4}{9})$ as $\frac{3}{5} \div (\frac{8}{21} \div \frac{4}{9}) = \frac{3}{5} \div \frac{6}{7} = \frac{7}{10}$, but many of them made the mistake of simplifying the fractions as

$\frac{3}{5} \div \frac{2}{7} \times \frac{4}{3} \div \frac{4}{9} = \frac{63}{10}$.
This revealed the students misconception of order of operation that totally led them to wrong answers. In line with this finding, Aksoy and Yazlik (2017) contended that students

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are not using the modeling on the operations with fractions because of that most of the mistake and misunderstandings are about operations with fractions.

The students' number five mistake showing their misconception of fraction involves, inability to remember stance of the expression 'of' in the order of operation (BODMAS) which stopped them from attempting the question $\left(\frac{3}{4}\ of\ \frac{4}{9} \div 9\frac{1}{2}\right) \div 1\frac{5}{19}$. Moreover, two students assumed it to be command for addition. Some learners have perceptual difficulties in mathematics which distort their understanding of symbols, signs and words (Ametepeh , 2018). According to this argument, learners with perceptual difficulties may mix up operational signs such as addition and multiplication and also have difficulties in understanding BODMAS concept.These results suggests that most of them ' had a low level of easiness in solving questions related to "Multiplication", "Division" and "Of/ Exponent".

Conclusion

Although students misconception of fraction have been attributed to many factors, this study is consistent with the findings of Lee and Boyadzhiev (2020) , who contended that common misconceptions of students were associated with a lack of understanding of basic definition of fractions, least common denominators/least common multiples, and order of operations. Existing in the literature is the notion that students have low attaining levels in mathematics than in other subject. There is the belief that poor knowledge or misconceptions of BODMAS is among the contributing factors to this low level of mathematics attainment. Olivier cited in Osei, (1998) maintains that misconceptions play a very important role in the learning and teaching. According to him misconceptions form part of the pupils' conceptual structure that will interact negatively with new concepts. For it is believed that students cannot build more advanced knowledge from misconceived understanding (Setati, 2002). Going by the findings of this study, it can be impeccably argued that fraction is a challenging area not only to primary and secondary school students in Nigeria, but also to tertiary levels' students. It became apparently clear here that out of ten students selected, only 20% demonstrated conceptual understanding of the concept of fraction. The remaining 80% performed poorly, despite that they were taught the concept at different levels, including the final level of just graduated secondary schools. The widespread misconception of conversion of mixed number to improper fraction among the students, misconception of addition and subtraction of fraction and cross multiplying fractions in place of multiplication point to a horrible nature of students' level of mathematical attainment. The findings of the study also show the need for urgent attention to the concept of fraction in primary and secondary schools in order to ease the difficulties students face in dealing with the

concept and prevent transferring the problem to tertiary levels. It is advisable that teachers should carefully select instructional activities capable of averting the trend, so that learning can be effectively improved. It will be beneficial to develop a measure that focuses on improving better conception of fraction. Educators should always make search for information and knowledge to solve any misconception that arises when teaching the fraction. The teachers are also in better place to detect their students' mistakes in order to get idea that helps in describing and selecting the teaching technique pertinent of overcoming this problem and preventing further repetition of these mistakes.

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