International Journal of Recent Advances in Multidisciplinary Topics
Volume 4, Issue 7, July 2023
https://www.ijramt.com | ISSN (Online): 2582-7839

Impact of Higher-Order Thinking Skills Module Method on Mathematics Students' Performance in Colleges of Education, North-Central Nigeria

Zinyahs Maris Zakka*
Chief Lecturer, Department of Mathematics, FCT College of Education, Zuba, Abuja, Nigeria

***Abstract*: The effectiveness of teaching fractions and word problems in mathematics classroom relies on the selection of suitable teaching and learning strategies by the mathematics teacher Fractions are been introduced both at primary , junior, senior secondary schools and higher institution of learning This study examined the impacts of Higher Order Thinking Skills (HOTS) module method among Nigeria Certificate in Education (NCE 2) Mathematics students' performance in Colleges of Education based on MAT 224: difficult problems in Junior Secondary School Mathematics faced by the mathematics teachers after their pre-service training in terms of Fractions and Words problems involving quadratic equations. A quasi-experimental research design was used in this study. The study used two Colleges of Education in North Central, which are Federal Capital Territory (FCT) College of Education, Zuba –Abuja, and Niger State College of Education, Minna. A population of 365 NCE 2 Mathematics students in these Colleges of Education are offering MAT 224: Junior Secondary School Content. A sample of 70 and 65 (135) NCE 2 mathematics students of the two Colleges of Education respectively was used in this study. Sample in FCT College of Education, Zuba, 70 NCE 2 Mathematics students (30 students were assigned as treatment group and 40 students were in control group). While for Niger State College of Education, Minna, 65 NCE 2 mathematics students (30 students were in treatment group and 35 students in control group) that participated in this study. The Data were collected and analysed using descriptive statistics and inferential statistics such as ANCOVA to answered the research questions and the hypotheses in the study. The results of the research questions showed that the performance test scores of both FCT COE Zuba and COE Minna students in the control group is higher in the post test when compare to the performance of the students in the treatment group. For the hypotheses, after adjusting the mean scores of students in both FCT COE Zuba and COE Minna.the results revealed that students in the treatment group showed significantly better performance scores as compared to those in the control group. Recommendations were made in the study.**

***Keywords*: Colleges of education, fractions, higher order thinking skills, mathematics students' performance, module method, word problems.**

1. Introduction

Mathematics plays important roles in the progress of civilization of any nation as such, it is made compulsory from primary to secondary levels of Education in Nigeria. In the world today, mathematical activities are literally in every field of human endeavour which plays a significate role in economic development of a country. This brings about scientific and technological advancement, and development. Therefore, students need nothing short of good performance in mathematics at all levels of schooling (Julius, 2018) [1].

Despite the importance of mathematics, it is the prerequisite for most of the subjects, poor performance in mathematics among students is an issue of concern in our Nigeria schools, colleges, and universities in and even in the developed countries alike. However, mathematics continues to be one of the most challenging subjects in schools as perceived by students. Students of mathematics in 21st century enter mathematics classrooms with a serious lack of fluency and reliability in numerical and algebraic manipulation and simplification, problem-solving, and negative attitude

A. Students Performance in Mathematics

The higher rate of poor performance of students in Nigeria has been a source of concern to researchers, educators, government and parents over the past years [2]. Parents and government are in total agreement that their investment in education is not yielding the desired dividend. The reports from the West Africa Examination Council Chief examiner indicates that the general performance of the candidates in mathematics for May/Jue 2018/ 2022 Examinations.

Students' performance in mathematics at the end of their school secondary education has not improved in the past decade [3]. Studies have showed that there is poor achievement in mathematics at national level by students in NECO/WAEC [1], [4], [5], [6].

The performance of Nigerian students in NECO and WAEC Mathematics is not at the satisfactory level, some factors that caused the failures are the teaching methods that did not apply and focus on HOTS as laid out in the curriculum.

B. Definition of Higher Order Thinking Skills (HOTS)

In mathematics education, HOTS is the ability to apply knowledge, skills and values in making reasoning and reflection to solve problems, make decision, innovate and able to create something and besides, HOTS is also part of the creative and

*Corresponding author: zakkamaris@yahoo.com

critical thinking. High-level thinking skills can be trained in the learning process in the classroom [7]. Therefore, to make the students to have the ability to think critically, then the learning process should provide a space for learners to find the concept of knowledge-based activities. Higher order thinking skills (HOTS) allows students to view concepts holistically and produce an effective thinker [8]. HOTS has become a top priority over recent years. Educators and employers are well aware of the importance of being able to really think, rather than just memorizing knowledge and procedures

C. Fractions Problems

A fraction is seen as a complex topic in mathematics. Studies have showed that students made mistakes in solving mathematical problems involving higher order thinking skills which are related to Number domain [9]-[11].

This, however, demonstrates that students are still weak in solving fraction problems which involves higher order thinking skills. and besides, the students are still lacking in mastering the basic knowledge of Fractions. Literatures showed that most students made mistakes in basic operations such as addition and subtraction of Fractions. For instance, when solving questions that involved addition of fractions, students assume the numerator and denominator are separate entities [12]. This condition is as a result of students having 'limited informal knowledge,

Students' lack the understanding of appropriate procedures to used. Fraction [12]. Therefore, there is need for preventive measures against problems faced by students in which should analyzing the level of students' understanding of relevant Fractions.

Despite the importance of fraction in everyday life activities, pupils have difficulty in learning fraction, when compared to other aspects of mathematics [13]. For students to solve arithmetic word problems, it is a complex task that requires individuals' students to activate their working memory resources, as well as the correct performance of the underlying executive processes involved in order to inhibit semantic biases or superficial responses caused by the problem's statement [14]. Mathematics teachers need to use relevant teaching methods in order to facilitate the students to learn Fractions.

D. Word Problems in Mathematics

Many students see mathematical word problem-solving as one of the most demanding tasks in mathematics [15]. because it involves both higher and lower order thinking skills. However, the higher order activities in word problem-solving are the main causes of cognitive overload among students. Difficulties in solving word problems in mathematics are one of the most common reasons for weak mathematics performance by the students and as well as poor mathematical literacy which has vital has implications for the students further education, employment opportunities, mental health and quality of life in our today's modern technological society [16].

Word problems is defined as a verbal description of problem in which one or more questions have raised the answer to which can be obtained by the application of mathematical operations to numerical data available in the problem statement [17]. Therefore, the word problems are based on real-life world applications situations [18] (Boonen, de Koning, Jolles, & van der Schoot, 2016). Word Problems in mathematics have significant roles in equipping learners with the basic knowledge, skills, and, understanding of problem-solving and mathematical modelling [19].

According to [20] learning of mathematics word problems that are related to algebraic concepts are greatly affecting students' cognitive and affective factors. Mathematics word problems are areas whereby many students have learning difficulties [21], [17]. However, mathematical word problems are intended to help learners to apply mathematics beyond the classroom in solving real-life-World Problems [19].

Therefore, Word Problems require students to understand and adequately apply previously learned basic algebraic concepts, principles, rules and/or techniques. Therefore, students fail to write required mathematical algebraic symbolic operations. Higher-order thinking skills (HOTS) therefore, important for solving word problems, and in order to improve students' competency in problem-solving, the students most engaged in solving the non-routine word problems [22]. These non-routine Word Problems are regarded as word problems involving HOTS in this study.

E. Module Method

The concept of modular method has been used in educational software to upgrade the pedagogical skills in the teaching and learning of mathematics [23]. Higher Order Thinking Skills module method is an instrument to promote HOTS among NCE 2 Mathematics students, on the topics of fractions and Word Problems. The module consists of topics such as Fractions and Word Problems.

Modules are practical pedagogical methods that a teacher uses in the process of delivering skills and knowledge. Studies have showed that module improved higher order thinking of students solving mathematics problems [24]-[32]. Hence, the design of this modular teaching module should be carefully and systematically developed. Therefore, the module is to improve creative thinking skills based on problem learning [33].

This study focused on NCE 2 Mathematics students of two Colleges of Education in North Central (FCT College of Education, Zuba –Abuja, and Niger State College of Education, Minna) group of second year students taken MAT224 course on the topic of Fractions and Word Problems for some certain reasons these include; (a) Analysis of the students quality of answers in MAT 224 on these topics Fractions and Word Problems from period of four years from 2019, 2020, 2021, and 2022 found that students could not answer questions correctly in these topics of Fractions and Word Problems. The students were not proficient in solving Fractions and Word Problem questions. (b) There is no module for the topics of Fractions and Word Problems in NCE 2 MAT 224 Curriculum and finally, (c) The students have already experienced the learning of these topics in a conventional classroom practice. Therefore, there is a need for selection of suitable sample to experience the topics taught using module approach.

F. Problem Statement

Students poor performance in Mathematics is a worldwide issue, in as much, the students errors in fractions and word problems have been associated with poor performance in Mathematics. Many high school students find mathematics difficult in general, and especially with word problems. Repeatedly, the students are unable to give correct answers to the word problems [46]. Therefore, solving word problems is one of the skills that students are not prepared for when entering Algebra 1[47]. In addition, most of the students always try to avoid word problems or simple want to use a formula to solve problems without understanding the context of the problems [48]. In order for the students to solve the words problems, they must take Words Problems and convert them to mathematical expressions before they will then be able to solve the problems [46].

Fraction is an important aspect of numeracy in primary school mathematics and it refers to a number that represents a measure of the relationship between two quantities, these two quantities provide information about the parts, the units and the whole [12]. Despite the importance of fraction, it is a concept in mathematics that still poses a lot of challenges to both teachers and pupils in primary schools in Nigeria [12].

Therefore, fractions are difficult-to-learn and difficult-to-teach concepts that present ongoing pedagogical challenges to the mathematics education community [12]. These difficulties begin early in the primary years [49] and therefore, persisting throughout the middle school, then into secondary and even tertiary education [50]. Fractions are seemed to be one of the three most difficult topics to teach and learn in primary school mathematics curriculum in Nigeria.

Previous work on teachers' mathematical knowledge has contributed to our understanding of the important role of teachers' knowledge in teaching and learning. However, one aspect of pre- service teachers' mathematical knowledge on fractions and Word Problems has received little attention. Therefore, this study looked at various approaches and teaching strategies to provide students with the ability to master Mathematics course such as MAT 224: Junior Secondary Schools Mathematics Contents based on fractions and words problems involving quadratic equations using HOTS.

G. Purpose of the Study

The study aims to examine the difference in students' performances by using HOTS modules on the topics fraction and words problems involving quadratic equations of NCE 2 Mathematics students in two Colleges of Education in North Central Nigeria. Specifically, the study was based on the following objectives:

1. To determine the difference in FCT College of Education, Zuba students' performance test scores (post delayed test) between the treatment and control groups while controlling the pre-test scores on the topic fractions and words problems involving quadratic equations.
2. To determine the difference in Niger State College of Education, Minna students' performance test scores (post delayed test) between the treatment and control groups while controlling the pre-test scores on the topic fractions and words problems involving quadratic equations.

H. Research Questions

The following questions were raised to guide the conduct of the study:

1. Is there a difference of FCT College of Education, Zuba students' performance test scores (post-delayed test) between the treatment and control groups while controlling the pre-test scores on the topics fractions and words problems involving quadratic equations?
2. Is there a difference of Niger State College of Education, Minna students' performance test scores (post-delayed test) between the treatment and control groups while controlling the pre-test scores on the topics Fraction and Words Problems involving quadratic equations?

I. Hypotheses of the Study

Two hypotheses were postulated as a follow up of the research questions:

$H0_1$: There is no significant difference in the means of FCT College of Education, Zuba students' performance test scores (post-delayed test) between treatment and control groups while controlling pre-test scores on the topics fraction and words problems involving quadratic equations

$H0_2$: There is no significant difference in the means of Niger State College of Education, Minna students' performance test scores (post-delayed test) between treatment and control groups while controlling pre-test scores on the topics fractions and words problems involving quadratic equations.

2. Literature Review

The latest study by [11] investigated the effect of incorporating higher order thinking skills (HOTS) in a school-based assessment on mathematics achievement among students. The study employed a mixed-method research design and a sample size of 158 students and three mathematics teachers were used in the study. standard based curriculum for secondary schools was used to determined the students' proficiency in mathematics by using questionnaire and interview which incorporation of HOTS in standard based curriculum for secondary schools. descriptive and regression analysis showed that 11.9% of the mathematics score was achieved through contribution of incorporating HOTS in SBA, while 7.7% was contributed by SBA mastery level in mathematics. Nevertheless, students' maturity and misconceptions about mathematics are some of the challenges in implementing higher order thinking skills in standard based assessment. However, some of the challenges in applying higher order thinking skills in standard based assessment had a positive effect on teachers' pedagogical approach in which they can make new strategy in order to meeting the needs of students and teach topics in another ways

In the recent past, [9] determined the effectiveness of

Thinking Blocks in order to help students solve fraction problems involving higher order thinking skills. They researchers incorporating a pre-post quasi-experimental design, in which the students were divided into two groups. The experimental group (n = 32) were exposed to treatment to improve higher order thinking skills. While, the other group acted as a control group (n=22) and were taught in a conventional way. Samples in this study were Form One students in Johor. The instrument consists of twelve higher order thinking questions used for identifying the level of higher order thinking skills. The data were analysed using inferential statistics. The result indicates that the control group and the experimental group showed a statistically significant improvement on higher order thinking skills group compared. In conclusion, teachers should consistently practice the strategies of higher order thinking, this my led to highly develop and nurture higher order thinking skills among students when learning.

In a study, [34] identify levels of students' higher order thinking skills in solving fraction word problems. The study used a sample of 48 students of Year 5 from two schools that participated in the study. Questionnaire was used in the study which consisted of 12 Fraction higher order thinking skills questions. A descriptive statistical analysis was used to measure the students' existing capabilities. The results revealed that the current ability of Year 5 pupils in answering HOTS fraction word problems are at poor level which is 75 % followed by 20.84 % at satisfactory level and 2.08 % are respectively at good and excellent levels.

In a most recent study, [35] determined the problem-solving ability of field independent (FI) and field dependent (FD) students in solving HOTS story problems at a junior school in Malang, Indonesia. This study used qualitative research in which. tests and interviews to collect data. Data analysis of this study include data collection, reduction, presentation, and concluding. The findings show that FI and FD students understand the problem. The results also revealed that there is no difference between the two; but both FI and FD students are good at understanding the problem. FI students plan solutions well and can correctly create mathematical models, while FD students have difficulty developing mathematical models. In this case both FI and FD students have something in common: they are not quite right in the final solution.

In their research, [10] examined the effect of training in math metacognition on fractional mathematics among primary school pupils in Nigeria. A quasi-experimental research design was used with a post-test only control group design. The two intact classes were randomly selected and assigned to treatment and control conditions. A sample size of Sixty primary six pupils were used in the study. Two research questions and three null hypotheseswere used to guided the study. Data collected were analyzed using mean, SD (standard deviation) and ANOVA (analysis of variance). The findings showed that training in mathematics metacognitive strategy has improved pupils' achievement in fractional mathematics. The results also indicate that there is a significant gender difference in the achievement of pupils in fractional mathematics. With these results, there is a good understanding of fractions which is the requisite to excellence in school mathematics. The researcher is of the view that there should be training in mathematics metacognitive strategy should be introduced in teacher preparation in order to remedy the prevalent mathematics fear and failure in Nigeria.

In the same vein, [36] examined the responses of 350 fourth- and fifth-grade teachers in the USA to four multistep fraction word problems, and also explored the manifestations of teachers' strategic competence for word problems. Their findings indicate how teachers dealt with known and unknown quantities in their mathematization of word problems. The results of the study provide evidence for the critical nature of strategic competence as another dimension needed to understand and describe teachers' mathematical knowledge.

Furthermore, [37] assessed the mathematical content knowledge of 194 prospective teachers about fraction word problems faced by students at the Primary Education stage, based on the Mathematics Teachers Specialized Knowledge (MTSK) model. They also explored their knowledge and identified the associated error to fraction word problems (one-step and multistep) in which the fraction has a meaning as an operator. The results showed that Pre-service teachers have some difficulties in solving multistep problems. The findings also show a weak prior mathematical content knowledge and as a consequence.

In another manner, [38] conducted a secondary data analysis on a dataset of N = 1282 undergraduate students solving six mathematical word problems from the Programme for International Student Assessment (PISA). The findings indicate that verbal skills were the most consistent predictor of successful word problem solving in these tasks, arithmetic skills only predicted the correct solution of word problems containing calculations

Researchers have conducted studies on the effect of inquiry-based instructional strategy towards mathematics learning around the world. [12] determined the effects of inquiry-based instructional strategy enriched with origami activities and the moderating effect of gender on pupils' achievement in fraction in Oyo State, Nigeria. The study adopted Quasi-experimental research design using a 2x2 factorial matrix. The sample consists of 55 boys and 33 girls from two randomly selected public primary schools. Two intact classes were randomly assigned to experimental and control groups. The instruments used was pupils' achievement test in fraction and teachers' instructional guides. The study used analysis of covariance, for the analysis of the data collected. The findings indicate a significant main effect on pupils' achievement in fraction and there was no significant main effect on gender.

In addition,[39] investigates how children and even adults largely fail to incorporate real-world knowledge into mathematical word problems. They observed that the realistic word problems may reflect problem solving ability independent of general academic ability, and therefore may be an ability worth fostering.

In the most recent study, [18] explored the direct and indirect relationship between students' attitude towards, and

performance in mathematics word problems (MWTs), mediated by the active learning heuristic problem solving (ALHPS) approach. Attitude towards Mathematics Inventory-Short Form (ATMI-SF) tools were used for data collection A quantitative approach with a quasi-experimental pre-test, post-test, and non-equivalent control group study design was adopted. A sample of 608 of 11th-grade Ugandan students consists of (291 males and 317 females) from eight secondary schools (both public and private) participated. The results revealed a direct significant positive relationship between students' performance and their ATLPWTs.

Similarly, [40] investigated the perspectives of Norwegian early childhood educators on mathematics and higher-order thinking. Thematic analysis of the connection between mathematics and children's higher-order thinking skills was performed based on semi-structured interviews with ten educators in three different early childhood education and care (ECEC) centres. The findings suggest that educators, recognizing mathematics as vital for ECEC, associate mathematics with problem-solving, an aspect of higher-order thinking skills highlighted in the research literature. The educators identified many opportunities for working with mathematics in daily activities, in accordance with the Norwegian tradition in recent years. These findings provide insights into how mathematics can e support early childhood educators'

Several studies have been conducted to investigate the errors of students in solving the HOTS type problem in the application of trigonometry around the globe.[41] investigated the errors of students in solving the HOTS type problem in the application of trigonometry. The study used qualitative descriptive research design. The subjects of the study are 189 students from three Vocational High Schools in Gunungkidul Regency, Indonesia, using stratified cluster random sampling technique. To collect the data in the study observations, tests, and interviews were used Data analysis techniques include data reduction, triangulation of data that was compared with data result of observation, test, and result of interviews. The results of the analysis show there were three types of errors, namely error type I (understand the meaning of the problem), error type II (applying the concept), and error type III (calculating). The cause of student error type I. This may be due to lack of understanding the meaning of the problem to make mathematical modelling and due to confusion for the use of concepts and formulas. While Error type III is due to students were not precise in the calculations or in a hurry to solve the problem.

Furthermore, there are several other studies that investigate the used of HOTS base on module approach on pupils' performance in mathematics. [31] investigated the use of HOTS-based module approach on the performance of primary school pupils. The module was developed systematically using ADDIE model with adaptation on Cognitive Apprenticeship Model (CAM) as the framework to enhance Higher Order Thinking Skills (HOTS) among year five pupils. In this study, a quasi-experimental, nonrandomized control group, pre-test-post-test and post delayed-test design was conducted on two intact groups. The study was conducted in two national schools located in the rural area, in one of the states in Malaysia. Two primary schools were used for better effects of using HOTS-based module in teaching and learning mathematics. In school1, sample of 76 pupils (38 pupils in the treatment group and 38 pupils in the control group), while for school2, 51 pupils (28 pupils in the treatment group and 23 pupils in the control group) were employed in this study. The instrument used in this study were twelve items problem solving test on the topic of Measurement and Geometry that were developed by the researcher. Th study used analysis of covariate (ANCOVA). The findings indicated that there no significant difference in the post test and post delayed test for both schools. The study also showed that HOTS in mathematics is still new in Malaysia, even though module approach was used especially for those pupils in rural area. Teachers and pupils in rural area school need more time to be familiar and practice using HOTS. It was recommended that HOTS-based module approach should be continued in teaching and learning Mathematics in next future

In a similar study, [27] examined the difference in students' performances in terms of measurement and geometry between urban and rural schools. This study used a quasi-experimental research design. A sample of 63 students from urban school and 51 students from the rural school. The study employed a pre-test, post-test, and post-delayed test to measure the students' performance. The treatment group utilized the Higher Order Thinking Skills (HOTS) based Module framed Cognitive Apprenticeship Model (CAM). The analysis of covariance showed that there is a significant difference between the post-test and post-delayed tests for the urban school. This finding revealed that the HOTS approach in teaching mathematics was more effective than the conventional teaching approach for students in an urban school. However, the result of rural schools showed that there is no significant difference in both tests. This result revealed that teachers and students from rural schools need more time to familiarize and practice the use of the HOTS approach. Hence, continuously using this approach in teaching and learning in the future should be recommended.

In a study, [42] described students' higher order thinking skills in solving the problem of generator function. The Higher Order Thinking Skills (HOTS) of this study consisted of logic and reasoning, analysis, evaluation, and creation skills. The study used descriptive research by using qualitative approach. The sample of the study were three students of mathematics education department of Hasyim Asy'ari University, one student with high ability, one student with medium ability, and one student with low ability. Test, scoring rubric, and interview were used to collect data as instrument of the study. The data were analysed by adopted the data reduction, data interpretation, and conclusion making and were triangulated. The result shows that one student does the skills of logic and reasoning, analysis, evaluation, and creation not very well in solving the problem of generator function. This mean that the students are in the medium level of high order thinking skills. While the other, two students cannot do the skills of logic and reasoning, analysis, evaluation, and creation well in solving the problem of generator function, therefore, they are in the low

level of high order thinking skills.

For the assessment of gender difference performance in word Problems, [43] who assessed the gender difference in the performance of Grade Five elementary students from the rural region in solving word problems involving measurement formulae and higher-order thinking skills. The sample of this study comprised 109 students from three types of elementary schools, namely National School (NS), Chinese National-Type School (CNTS) and Tamil National-Type School (TNTS) located in the rural region of Penang, Malaysia. The findings of this study indicate that there is no significant difference between the mean scores of the male and female students in the rural region of Penang, but both genders were found to perform poorly in solving measurement formulae word problems involving higher order thinking skills. This implies the needs to shift the focus of mathematics teaching from procedural fluency to mastery of mathematical reasoning as well as problem solving skills to promote rural students' higher-order thinking skills.

Other study by [14] who conducted a study with 135 students of Secondary Obligatory Education. Each student solved 5 verbal arithmetic problems: which consisted of 2 problems that include mathematical operation (add/subtract) and the verbal statement of the problem coincide, and 3 inconsistent problems, that required inverse operation of the verbal terms. The study employed measure of reading comprehension, visual–spatial reasoning and deductive reasoning The findings show that the relationship between arithmetic problems and cognitive measures, as well as the ability of these problems to predict academic performance. Regression analyses confirmed that arithmetic word problems were the only measure with significant power of association with academic achievement in both History/Geography ($\beta = 0.25$) and Mathematics ($\beta = 0.23$).

In a study, [44] examined the effect of constructivist approach on pre- service teachers' mathematics achievement and the difficulties they encounter in translating and solving word problems. A quasi-experimental research design was employed with 120 sample of pre-service teachers used in this study. A diagnostic pre-test and post-test questions and a questionnaire were used as instrument to collect data for the study. The questionnaire was used to examine the difficulties pre-service teachers encounter during translating and solving word problems. The test items were also used to determine the effect of the constructivist approach on pre-service teachers' mathematics achievement. The findings of the study showed that students' conceptual understanding and performance in word problems was largely improved after instructions based on the constructivist approach. The study also revealed that majority of the pre-service teachers appealed more to the constructivist approach than the traditional method.

[45] investigated the impact of personalizing mathematical Word Problems using individual student interests on student problem-solving performance. Ten Word Problems were selected randomly from a mathematics textbook to create a series of two assessments. Both assessments contained problems exactly as they appeared in the textbook and problems that were personalized using student interests based on student completed interest inventories. The study used fourth-grade students' scores on the non-personalized and personalized problems were compared to investigate potential achievement differences. The results showed no significant increase in student achievement when the personalization treatment was used regardless of student reading ability or word problem type ($t = -.10$, $p = .46$).

3. Research Methodology

A. Research Design

This study employed quasi-experimental research design using NCE 2 mathematics students in two Colleges of Education, North Central Nigeria, designating one as the experimental group and the other one as the control group. The two Colleges of Education in the study are Federal Capital Territory (FCT) College of Education, Zuba –Abuja, and Niger State College of Education, Minna. The research design is the pretest-posttest control group design as showed in Table 1 which is the research design model used in this study.

Table 1
The pre-test-post-test control group design

COE, Zuba	Hot – based module	O_1	X_1	O_2	O_3
	Control group	O_1		O_2	O_3
COE, Minna	Hot – based module	O_1		O_2	O_3
	Control group	O_1	X_2	O_2	O_3

Where,
X_1: Treatment group COE, Zuba
X_2: Treatment group COE, Minna
O_1: Pre-test
O_2: Post-test
O_3: Delayed – Post-test

B. Population of the Study

A population of 365 NCE 2 mathematics students in these two Colleges of Education offering MAT 224: Junior Secondary School content were considered as the population of the study. The two Colleges of Education in North Central Nigeria include; Federal Capital Territory (FCT) College of Education, Zuba –Abuja, and Niger State College of Education, Minna.

C. Sample of the Study

The samples used in this study were selected using simple random sampling technique for selection of the two Colleges of Education. From each College of Education, experimental groups were selected which represented the large population of the two Colleges of Education, North Central Nigeria. A sample of 70 and 65 (135) NCE 2 mathematics students of the two Colleges of Education respectively were used in this study. The sample in FCT College of Education, Zuba, 70 NCE 2 mathematics students (30 students were assigned as treatment group and 40 students were in control group). While for Niger State College of Education, Minna, 65 NCE 2 mathematics students (30 students were in treatment group and 35 students in control group) that participated in this study.

D. Instrumentation of the Study

In this study, three tests (pre-test, post-test, and post delayed test) were administered to measure the students' performances in fraction and Word problems during the treatment. The test questions were on the topics of fraction and word problem which consisted of 24 subjective questions the test questions were based on higher-order thinking skills

E. Research Procedures

In the study, pre-test was conducted on all groups in order to obtained difference between the treatment and control groups of the study. The aim of the pre-test in the study was to determined whether or not the means of both groups are significantly different and to provide baseline values regarding the constructs measured in the study. The covariate analysis used the pre-test, and the treatment group used the Higer Order Thinking Skills based Module, while the control group used conventional teaching approach. The post-test measured the students' performance after they used the higher-order thinking skills -based Module in 14 weeks. The researcher then conducted a post-delayed test after the two weeks of the intervention. In the context of this study, delayed effect refers to the impact of treatment observed after some time. This is because the students have learned about higher-order thinking Skills during the treatment sittings. After the researcher conducted the pre-tests on both groups, the mathematics lectures started adopting the HOTS approach for the treatment group and the conventional teaching approach for the control group

F. Method of Data Analysis

In this study, descriptive and inferential statistics were used. The descriptive statistics was used in order to describe the distribution of students in the treatment groups and control groups, while the inferential statistics such as ANCOVA was used to answer the Hypotheses of the study.

4. Results & Analysis

This section presents results and analysis that is connected to the research questions and hypotheses of the study.

Research Question 1: Is there a difference of FCT College of Education, Zuba students' performance test scores (post-delayed test) between the treatment and control groups while controlling the pre-test scores on the topics fractions and words problems involving quadratic equations.

The data in Table 2, shows the mean and standard deviation of FCT COE, Zuba students performance test in both groups. Therefore, the performance test scores of students in the control group is higher in the post test (M = 24.72, SD= 4.642) equated to the performance of the students in the treatment group (M = 12.47, SD =4.884). Also, the control group is higher in the post-delayed test (M =14.42, SD = 4.081) as equated to the treatment group (M =13.43, SD = 4.054).

Research Question 2: Is there a difference of Niger State College of Education, Minna students' performance test scores (post-delayed test) between the treatment and control groups while controlling the pre-test scores on the topics Fraction and Words Problems involving quadratic equations?

Table 3 presents the mean and standard deviation of COE Minna students performance test in both groups. The performance test of the students in the control group is higher in post- test (M = 14.46, SD = 4.644) compared with the performance of the students in the treatment group (M = 12.27, SD = 2.645). whereas, the control group performance is higher in the post-delayed test (M = 10.65, SD = 4.258) compared to the performance of students in the treatment group (M = 10.13, SD = 3.546).

A. Hypotheses of the Study

$H0_1$: There is no significant difference in the means of FCT College of Education, Zuba students' performance test scores (post-delayed test) between treatment and control groups while controlling pre-test scores on the topics fraction and words problems involving quadratic equations.

Table 4
Levene's test of equality of error variance of post-test and post-delayed test of COE Zuba students test scores

Tests	F	df1	df2	Significant
Post-test	0.534	1	68	0.614
Post- Delayed test	2.647	1	68	0. 196

In Table 4, Levene's test was used and the result shows that the levene's test for the post-test [F (1, 68) = 0.534, p = 0.406 > 0.05] which is not significant. Again, the Levene's test for the post -delayed test [F (1, 68) = 2.647, p = 0. 196 > 0.05] which is not significant. This mean that the null hypothesis is retained. This implies that students in COE Zuba that are exposed in both approaches did not differ in their performance in post-delayed test in fractions and Word Problems involving quadratic equations.

Table 2
Descriptive statistics of post-test and post-delayed test scores of students in COE, Zuba

Tests	Group of students in COE Zuba	Mean	Std. Deviation	N
post-test	Treatment	12.47	4.884	30
	Control	24.72	4.642	40
post-delayed test	Treatment	13.43	4.054	30
	Control	14.42	4.081	40

Table 3
Descriptive statistics of post-test and post-delayed test scores of students in COE Minna

Tests	Group of students in COE, Minna	Mean	Std. Deviation	N
post-test	Treatment	12.27	2.645	30
	Control	14.46	4.644	35
post-delayed test	Treatment	10. 13	3.546	30
	Control	10.65	4.258	35

Table 5
Tests of between-subject effects of post-test and post-delayed test scores in COE Zuba

Tests	Type III Sum of Squares	Df	Mean Squares	F	Sig.
post-test	624.313	1	624.313	28.632	.000
post-delayed test	72.470	1	72.470	3.743	.042

Table 7
Tests of between-subject effects of post-test and post-delayed test scores in COE Minna

Tests	Type III Sum of Squares	Df	Mean Squares	F	Sig.
post-test	41.524	1	41.524	4.326	.083
post-delayed test	52.375	1	52.375	3.420	.154

Table 5 indicates the adjusted mean scores of the pre-tests of COE Zuba students, there was a significant difference in the mean post-test scores between the treatment and control groups [F (1,68) = 28.632, p = .000 < .05]. This implies that students in the control group scored significantly better compared to those in the treatment group. Once more, there is a significant difference between the two intervention groups in the post-delayed test scores in the students performance test [F (1,68) = 5.6755, p = .042 < .05]. This result revealed that students in the treatment group showed significantly better performance scores as compared to those in the control group.

$H0_2$: There is no significant difference in the means of Niger State College of Education, Minna students' performance test scores (post-delayed test) between treatment and control groups while controlling pre-test scores on the topics fractions and words problems involving quadratic equations.

Table 6
Levene's test of equality of error variance of post-test and post-delayed test of COE Minna students test scores

Tests	F	Df1	Df2	Significant
Post-test	0.534	1	63	0.614
Post- Delayed test	2.647	1	63	0. 196

Data in Table 6 is the Levene's test which was employed and the result revealed that Levene's test for post-test [F (1, 63) = 0.432,34, p = 0.326 > 0.05] whereas the Levene's test for post delayed test [F (1, 63) =1.835, p = 0. 175 > 0.05] which it is not significant. This mean that the null hypothesis was retained. This implies that students in COE Minna that are exposed in both approaches did not differ in their performance in post-delayed test in fractions and Word Problems

Data in Table 7 shows the adjusted mean scores of the pre-tests for students in Niger State College of Education, Minna, (COE Minna) there was no significant difference in the mean post-test scores between the treatment and control groups [F (1,63) = 4.326, p = .083 > .05]. Therefore, $H0_2$ is accepted. This imply that students in both groups did not differ in the post-test. Again, there was no significant difference between the two intervention groups in the post-delayed test scores in the performance test [F (1,63) = 3.420, p = .129 > .05]. This result revealed that students exposed to both approaches did not differ in their post-delayed test. This result revealed that students in the treatment group showed significantly better performance scores as compared to those in the control group.

B. Discussion of the Findings

This study investigated the impact of higher-order thinking skills module method on mathematics students' performance in Colleges of Education, North-Central Nigeria (NCE 2) on the course MAT 224: Junior Secondary School Content based on the topics Fractions and Word Problems involving quadratic equations which pre-service teachers and students find difficult to tech as such, students do not perform well on these topics without using higher order thinking skills as a strategy.

The two Colleges of Education in North Central Nigeria have experienced and qualified mathematics teachers that are capable of handling tasks provided in Higher Order Thinking Skills based Module method. Here, students are requiring to use their conceptual knowledge to solve HOTS problems in fractions and Word Problems.Therefore, mathematics teachers experienced and competent will indirectly or directly increase their confidence in teaching mathematics

The result of post-test in the control group at COE Zuba revealed that students had significantly better performance scores when compared to those of the treatment group. Whereas, the result indicted that students in the treatment group in COE Zuba had noticeably better performance scores as compared to those in the control group in the post-delayed test

The study also compared two teaching approaches using HOTS module and conventional teaching approach in teaching and learning year 2 mathematics students in two Colleges of Education

The results indicated that there was no significant difference in mathematics performance for both groups in COE Zuba and COE Minna in neither post-test nor post-delayed test.

In contrast, the result of the post-test and the post-delayed test of the students from COE Minna indicate that there was no significant difference in the mean scores of the topic Fractions and word Problems performance. This result is in line with the study of [31]. However, these findings are consistent with the results of previous studies by [31],[28] which showed different performance in the score after using HOTS module.

The findings of this study indicated that students' learning could facilitate within embedded activities in social contexts by exploring and applying CAM through HOTS-based Module which is in agreement with the results of [31], [28]

In this study, the conventional teaching approach is similar to other scholars [31, 28]. Teaching and learning mathematics using HOTS based module method should be emphasized on student-centered in as much it tends to be uncomfortable when used for the first time However, it can be overcome with time and this approach needs lots of commitments from the mathematics teacher

The results of the finding indicate that there is significant difference in the students' performance in fraction and words

problems which is in agreement with the finding of [10] which shows that there is a significant difference in the mean fractional achievement of pupils that received mathematics metacognitive training when compared with those that did not.

[38] reiterates that mathematical word problems have the potential to address cognitive skills beyond mere calculation, but that this potential is very distinct in each word problem. The results of this study show that there a need for training teachers in mathematics metacognitive strategy that will improves greatly the students performance in fraction and Word Problems in mathematics.

It is difficult to convert traditional teaching to new approach. Therefore, fractions and word problems could be easily solved by using heuristics. Word problems may differ with regard to the cognitive skills which required to solve them correctly.

C. Summary of Findings

This section presents the summary of findings of both the research questions and hypotheses in the study. The results of the research questions showed that the performance test scores of FCT COE Zuba students in the control group is higher in the post test when compare to the performance of the students in the treatment group. Also, the control group is higher in the post-delayed test as equated to the treatment group. Similarly, the performance test of COE Minna students in the control group is higher in post- test compared with the performance of the students in the treatment group whereas, the control group performance is higher in the post-delayed test when compared to the performance of students in the treatment group. For the hypotheses, after the adjusting the mean scores of students in both FCT COE Zuba and COE Minna.the results revealed that students in the treatment group showed significantly better performance scores as compared to those in the control group.

D. Implication of the Study

This study is directly encouraging mathematics lecturers in Colleges of Education, Nigeria to prepare and equip themselves with critical and creative thinking skills which would enable them to use effectively pedagogy which include Higher Order Thinking Skills to tech Mathematics. In. addition, the lecturers should have the ability to incorporate real-life problems into mathematics question and provide various activities that will be seen as the teaching strategies to improve students' interest in learning mathematics. The study will also promote students' problem-solving skills, and encourage students in shaping their thinking. By implication, this study will prevent misconceptions in students understanding, perception and confidence.

5. Conclusion

In this study, notwithstanding many teachers and students still cannot understand different parts of mathematics skillfully. It is therefore necessary for mathematics teachers to make a significant improvement in their teaching approaches. For instant, Fraction is one of the topics contained in the Number domain and word problem which need higher order thinking skills in mathematics.

In addition, to solving word problem in mathematics it is a process which involves multistep skills and strategies to translate the problem into mathematics equation Measures need to be taken to ensure that mathematics teachers are ready to implement HOTS in their mathematics classrooms as soon as they begin to embark on the educational field.The implementation of the HOTS approach should start at the primary school level and therefore, the mathematics teachers and students should have positive beliefs in learning this new approach in order to improve their mathematics performance.

Effective pedagogy is very important for students to develop HOTS. It will able them to improve their performances in mathematics. Therefore, mathematics teachers should include higher-order thinking hots to engage all their students when planning a lesson.

A. Limitations

The research used a Quasi-experimental research design. The data of this study were subjected to descriptive statistics and inferential statistics such as ANCOVA analysis. This study is limited respondents of 135 NCE 2 students of Niger State

College of Education, Minna and FCT College of Education, Zuba –Abuja 65 and 70 respectively. In this case, possibly, different results may be expected from NCE 2 students from other Colleges of Education in Nigeria. In conclusion, the duration of this study was limited to 14 weeks. A longer-term of instruction may provide a different result.

The information regarding HOTS in this study was limited to MAT 224: Junior Secondary School Content base on the topics Fraction and Word Problems involving quadratic equations. Therefore, the results of this study cannot be generalised to all NCE 2 mathematics students in all Colleges of Education in Nigeria.

B. Recommendations

The researcher recommended that the use of the same scope and treatment of the Higher Order Thinking Skills based on Module method limited to this study should include the following;

- Using different topics both in senior secondary schools and tertiary institution mathematics.
- Using different Colleges of Education (NCE 2) in another Geopolitical Zone Nigeria.
- Using different subtopics both in primary and junior secondary schools mathematics.
- Using different research methodology.
- The school mathematics teacher needs training that will focuses on school mathematics that would improve their mathematical content and knowledge.
- Mathematics teacher education programs should ensure it addresses and provide an effective teaching-learning process.

Acknowledgment

This study was funded by Tertiary Education Trust Fund (TETFUND), through the Institutional Based Research (IBR) scheme of College of Education, Zuba- Abuja Nigeria.

References

[1] O. U. Julius Impact of Motivation on Secondary School Students' Achievement in Mathematics. *International Digital Organization for Scientific Research,* IDOSR journal of experimental sciences*,* 3(1), 55-66 2018.

[2] S. Chand, K. Chaudhary, A. Prasad & V. Chand Perceived Causes of Students' Poor Performance in Mathematics: A Case Study at Ba and Tavua Secondary Schools.

[3] L. A. Aiken Attitudes towards mathematics. Review of Educational Research, 40, 551-591, 2010.

[4] N. Zakaria, E.D Dogo, & C. A Kukwi, Trend Analysis of Student's Performance in Mathematics at Credit Level in West African Senior Secondary Certificate Examination From 2011-2018 In View of Vision 20:2020 and Beyond. *International Journal of Research,* Volume 06, Issue 10, 2019.

[5] A. O. A. Awofala, & A. O. Lawani Increasing Mathematics Achievement of Senior Secondary School Students through Differentiated Instruction *Journal of Educational Sciences,* 4(1), 1-19, 2020.

[6] J. A. Abah, K. K. Ogugua, & V. L Okoh Impact of Intrinsic Motivation on Junior Secondary School Students' Academic Performance in Mathematics despite Family Background in Ohimini Local Government Area of Benue State, Nigeria. Village Math Educational Review (VER), 3(1), 72-96, 2022.

[7] I. W. Widana Higher Order Thinking Skills Assessment (HOTS). JISAE: Journal of Indonesian Student Assesment and Evaluation, 3(1), 32-44. 2017.

[8] M. Mahmad, M. Yee, T. Tee, & N. Azid, Higher order thinking skills and teaching style in mathematics primary school: a review. International Journal of Education and Pedagogy, 3(1), 1-21, 2021.

[9] N. L. Z. Abidin, A. Abdullah, N. D. Abd Halim N. H Ibrahim, M. Mokhtar, J. Surif, & N. M. Zaid Thinking blocks: solving fraction problems involving higher order thinking skills. *Man In India,* 97(17): 121-132, 2017.

[10] V. C. Onu M. Eskay J. N. Igbo, N. Obiyo, O. Agbo Effect of Training in Math Metacognitive Strategy on Fractional Achievement of Nigerian Schoolchildren. US-China Education Review B 316-325 2012

[11] N. Azid, R. Ali, I. Md., El Khuluqo, S. E Purwanto, & E. N. Susanti Higher order thinking skills, school-based assessment and students' mathematics achievement: Understanding teachers' thoughts. *International Journal of Evaluation and Research in Education,* 11(1), 290-302, 2022.

[12] J. Ndalichako Analysis of Pupils' Difficulties in Solving Questions Related to Fractions: The Case of Primary School Leaving Examination in Tanzania. *Creative Education,* 4, 69-73. 2013.

[13] A. Tella, & F. A. Sulaimon Improving pupils' achievement in fraction using inquiry-based instructional strategy enriched with origami activities. *Indonesian Journal of Science and Mathematics Education,* 5(3), 285-296, 2022.

[14] G. Duque de Blas, I. Gómez-Veiga, & J. A. García-Madruga Arithmetic Word Problems Revisited: Cognitive Processes and Academic Performance in Secondary School. *Educ. Sci.*2021,*11*(4), 155; 2021.

[15] A. Ahmad, H. B. Zaman, S. S. Salim, & R. Zainuddin "MINDA: A cognitive tool for solving mathematical word problems," *2010 International Symposium on Information Technology*, Kuala Lumpur, Malaysia, 2010, pp. 1-5.

[16] M. Kavkler, L. Magajna, & M.K Babuder Key factors for successful solving of mathematical word problems in fifth-grade learners health psychology report · volume 2(1), 2014.

[17] L. Verschaffel, S. Schukajlow, J. Star, & W. van Dooren Word problems in mathematics education: a survey. ZDM - Mathematics Education, 52(1), 1–16. 2020.

[18] A. J. H.Boonen, B. B.de Koning, J. Jolles, & M. van der Schoot Word Problem Solving in Contemporary Math Education: A Plea for Reading Comprehension Skills Training. Frontiers in Psychology, 7. 2016.

[19] R. Wakhata, S. Balimuttajjo, & V Mutarutinya. Relationship between Students' Attitude towards and Performance in Mathematics Word Problems, 2023.

[20] N. Pongsakdi, E. Laakkonen, T. Laine, K. Veermans, M. M. Hannula-Sormunen, & E. Lehtinen, The Role of Beliefs and Motivational Variables in Enhancing Word Problem Solving. Scandinavian Journal of Educational Research, 63(2), 179–197. 2020.

[21] M. P. Goulet-Lyle, D. Voyer, & L. Verschaffel, How does imposing a step-by-step solution method impact students' approach to mathematical word problem-solving? ZDM - Mathematics Education, 52(1), 139–149. 2020.

[22] M. Suseelan, C. M. Chew, & H. Chin Higher-order thinking word problem-solving errors made by low- performing pupils: Comparative case study across school types in Malaysia. Current Psychology, 2022.

[23] A. N. Isaacs, A. M. Walton, & S. A Nisly Interactive web-based learning modules prior to general medicine advanced pharmacy practice experiences. American journal of pharmaceutical education, 79(3):1-6. 2015.

[24] I. Lestari, S. R. Yuliati; E. L. Wati, Herlina; & L. Zakiah Math learning module model to stimulate critical thinking skills for elementary school students. *AIP Conference Proceedings*, 2331, 020034, 2021.

[25] P. Lestari, Mardiyana, & I. Slamet The need analysis of mathematics module based on problem-based learning to improve reasoning ability. *Journal of Physics: Conference Series,* 1776(2021), 012025, IOP Publishing.

[26] J. P. Purwaningrum, S. Muzid, T. Y. E. Siswono, & M. Masriyah Local wisdom-oriented learning module to improve mathematical creative thinking ability of dyscalculia students. Linguistics and Culture Review, 5(S2), 1035-1044. 2021.

[27] R. Rochsun & R. D. Agustin. The development of e-module mathematics based on contextual problems. European Journal of Education Studies, vol. 7, No. 10, 2020.

[28] N. N. Ibrahim, A. F.M. Ayub, & A. S. Yunus Impact of Higher Order Thinking Skills (HOTS) Module Based on the Cognitive Apprenticeship Model (CAM) on Student's Performance *International Journal of Learning, Teaching and Educational Research,* 19(7);246-262, 2020.

[29] M. N Pratiwi, & Suparman, Mathematical Module Design to Improve Creative Thinking Skills Based On problem-based Learning. *international journal of scientific & technology research,* volume 8, issue 10, October 2019.

[30] R. Ramdani, A. Syamsuddin, & S. Sirajuddin, Development of Mathematical Module-Problem Solving Approach to Train Student's Reflective Thinking *Pedagogical Research,* 4(4) 2019.

[31] N. N. Ibrahim, A. F. M. Ayub, A. S. M Yunus, R. Mahmud, & K. A. Bakar, Effects of Higher Order Thinking Module Approach on Pupils' Performance at Primary Rural School *Malaysian Journal of Mathematical Sciences,* 13(2): 211-229 2019.

[32] H. T. Novintya, & Suparman, Mathematics-Based Development Module Problem-Based Learning Model to Improve Critical Thinking Ability. *International Summit on Science Technology and Humanity (ISETH 2018) Integrating Knowledge for Future Sustainable Development,* 2018.

[33] M. N Pratiwi. & Suparman Mathematical Module Design to Improve Creative Thinking Skills Based On problem-based Learning. *international journal of scientific & technology research,* volume 8, issue 10, October 2019.

[34] L. N. M. Nair, & M. Puteh, Students' Ability in Solving Higher Order Thinking Skills (HOTS) Fraction Word Problems. *International Journal of Academic Research in Business and Social Sciences,* 9(6), 1016–1020 2019.

[35] T. Santoso, M. D. P. Putra, G. A. Sandy, & D.P. Utomo Mathematics Problem Solving Analysis on Higher Order Thinking Skills Based on Story Questions. *International Journal of Learning Reformation in Elementary Education,* 1(01), 42-53, 2022.

[36] Y. Copur-Gencturk & T. Doleck Strategic competence for multistep fraction word problems: an overlooked aspect of mathematical knowledge for teaching. *Educational Studies in Mathematics,* 107:49–70, 2021.

[37] M. M.d.; López-Martín, C. G. Aguayo-Arriagada, M. D. M García López, Preservice Elementary Teachers' Mathematical Knowledge on Fractions as Operator in Word Problems. Mathematics, 10, 423, 2022.

[38] A. R Strohmaier, F. Reinhold, S. Hofer, M. Berkowitz, B. Vogel-Heuser, & K. Reiss, Different complex word problems require different combinations of cognitive skills. *Educational Studies in Mathematics,* 109:89–114, 2022.

[39] C. L. Fitzpatrick, D. Hallett, K. R. Morrissey, N. R. Yıldız, R. Wynes, & F. Ayesu, The relation between academic abilities and performance in realistic word problems. Learning and Individual Differences.

[40] E. Pollarolo, T. H. Skarstein, I. Størksen & N. Kucirkova Mathematics and higher-order thinking in early childhood education and care (ECEC). Norwegian Centre for Learning Environment and Behavioural Research in Education, University of Stavanger, Norway. 20(2),70–88 2023

[41] M. D. Dewanto, B. Budiyono, H. Hasih Pratiwi, Students' Error Analysis in Solving the Math Word Problems of High Order Thinking Skills (HOTS) Type on Trigonometry Application. Proceedings of the 1st Annual International Conference on Mathematics, Science, and Education

(ICoMSE *Series: Advances in Social Science, Education and Humanities Research,* 2017.

[42] D. Rahmawati, G. Amintoko, & S. Faizah Higher Order Thinking Skills of Mathematics Education Department Students of Hasyim Asy'ari University in Solving the Problem of Generator Function in Discrete Mathematics Lecture Novia, *In Proceedings of the International Conference on Mathematics and Islam (ICMIs 2018),* pp. 260-264, 2020

[43] M. Suseelan, C. C. Meng, C. Huan, W. T. Yew, T. H. Lian, A. Z Khairani, & P. Singh Gender Difference of Rural Grade Five Students' Performance in Solving Word Problems Involving Measurement Formulae and Higher-Order Thinking Skills. *Turkish Journal of Computer and Mathematics Education,* 12(6), 5561-5572, 2021.

[44] S. Gabina, I. A. Donkoh, Z. Puotier, & D. A. Wiafe Pre-Service Teachers' Performance in Solving Word Problems in Mathematics in the Colleges of Education in Ghana: Effect of Constructivist Approach *Education Journal,* Volume 3, pp. 37-48, 2020.

[45] E. T. Bates, & L. R. Wiest. Personalization of Mathematical Word Problems on Student Performance. *The Mathematics Educator,* vol. 14, no. 2, 17–26, 2004.

[46] E. C. Elliott. Why Word Problems are Hard for High School Math Students: Problem Formulation and Disciplinary Literacy Senior Theses. 586. https://scholarcommons.sc.edu/senior_theses/586, 2023.

[47] T. B. Hoffer, L. Venkataraman, E. C. Hedberg, & S. Shagle Final report on the national survey of algebra teachers for the national math panel, 2007.

[48] D. Meyer Math class needs a makeover [Video]. TED. https://www.ted.com/talks/dan_meyer_math_class_needs_a_makeover/transcript?language=en (2010, Mar. 6).

[49] Empson, & L. Levi, Extending children's mathematics: Fractions and decimals: Innovations in cognitively guided instruction. Portsmouth, NH: Heinemann. 178-216, 2011.

[50] G. Orpwood, L. Schollen, G. Leek, P. Marinelli-Henriques, &. H. Assiri College Mathematics Project. Ministry of Education and the Ontario Ministry of Training, Colleges and Universities. Toronto: Seneca College of Applied Arts and Technology, 2011.