# AN INVESTIGATION ON JUNIOR SECONDARY TWO STUDENTS' USE OF BAR-MODEL APPROACH IN SOLVING WORD PROBLEMS INVOLVING PERCENTAGE

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## Abstract
*The study investigated the effect of bar-model approach on junior secondary two students' in solving word problems involving percentages. The study employed a quasi-experimental of non-randomized pretest and post-test control group design. A sample of 98 JS2 students from mixed sex co-educational secondary schools in Bokkos Local Government Area, Plateau State was used. The sample was drawn from a population of JS2 students using convenient sampling technique. The experimental group was taught using bar-model approach while the control group was taught using conventional method. Two research questions guided the study. And three null hypotheses were tested in the study at 5% level of significance. Data was collected using students' numerical scores in the pretest and post-test, using word problems involving percentages. The instrument was validated by an expert in test measurement and evaluation and two mathematics lecturers from the University of Jos. The reliability of word problems involving percentage was computed using Kuder-Richardson ($KR_{20}$) formula and its reliability coefficient (r) was 0.90. The Research questions were answered using mean and standard deviation while the null hypotheses were tested using t-test at 5% level of significance. The result of the finding showed among others, that the students taught word problems involving parentage using bar model approach had higher mean scores in the post-test than those taught using conventional method. There was a significant difference between experimental and control group in favor of the treatment group. There was no significant difference in the performance of students based on school type after treatment. And there was no significant difference between male and female students' performance in word problems involving percentage after exposure to treatment. From the result of the finding, it was concluded that the bar-model approach is effective in teaching word problem involving percentage. It was recommended that mathematics teachers should integrate bar-model approach as an instructional approach in teaching word problems involving percentage.*

**Keywords**: Bar-Model Approach, Word Problem, Percentage, Problem Solving, School Type.

## Introduction
The bar-model approach is a problem-solving approach and is a systematic way of representing Mathematics Word Problem using pictorial rectangular bars. Problem solving is a skill that can be acquired through practice and training. But, the teaching of such skills which is supposed to reflect meaningful learning has been neglected in Primary and secondary schools today. Problem-solving is not and never a new skill for teaching mathematics word problems, however, it has gained importance as a result of the rising concern for the 21st century learning of mathematics especially mathematics word problem. As societal real world problems are getting more complex, students need to transfer and apply the knowledge and skills they acquire in school to real-life situations. According to the Programme for International Student Assessment (PISA) results from PISA 2012, Singapore scored the highest in the assessment for problem solving with the highest number of

top-performing students in problem-solving (Mei & Li, 2014 & Gurney-read, 2016). The results of the performance are due to Singapore's emphasis on the use of bar-model approach in its mathematics curriculum. Therefore, there is the need to implement various teaching approaches such as the bar-model approach that will enhance students' performance and understanding in mathematics word problems.

Majority of primary and Secondary school mathematics teachers are still using the conventional method in teaching mathematics, these methods involves and encourage rote learning, without greater understanding of the solution process to solve mathematics word problems. Some of these mathematics teachers are aware of the bar-model approach; however, they fail to include this method into their teaching approach as they are not well-informed of its efficacy, making them resort to familiar and comfortable formula approach (Madani & Tengah, 2018). This present study does not only intend to investigate the effectiveness of the bar- model approach on the performance of students, but it is also an alternative approach for solving mathematics word problems involving percentages at all educational levels.

Percentage, being a strong component that has problems in real world applications, it is a very vital topic in the school mathematics curriculum. The percentage problem is first introduced to pupils in primary four. The Curriculum is planned in such a way that percentage problems are taught at different levels up to Secondary Education. Studies have shown that the teaching and learning of percentage problems have several challenges to learners (Abdul, Tengah & Sa'aid, 2019). These challenges of solving word problems involving percentage are attributed to the students' inability to know the meaning of words and lack the understanding of the problem text. Madani and Tengah (2018) opined that greater understanding of percentage problems will arise from teaching through effective visual models such as the bar-model approach and the use of appropriate real life examples instead of the common and rigid rules.

School type refers to ownership of school. This can be viewed as a controlled force in terms of the administration of school and could be categorized into public and private schools. Yusuf and Adegun (2014) found that there were no significant differences in the performance between private and public school pupils, while Okon and Achibong (2015) found that private schools performed significantly higher than public schools in social studies. On the contrary, Munanu (2015) found that there were no significant differences in the performance of public and private schools in Economics. Hence, the drive to investigate whether student's Performance in word problem using bar-model approach will differ. Over the years there have been series of investigations to determine the difference in Mathematics Performance among students in Public and Private, rural and urban primary funded schools, and this had yielded inconclusive findings. For example, Lubienski and Lubienski (2014) found that Public Schools Performed better in Mathematics than private schools, while the National Assessment of Education progress (NAEP, 2012) found that Private Primary Schools Performed better than Public Schools in Mathematics Word Problems.

The influence of gender variations on Student's Performance in Mathematics word problems is still a major controversy among researchers. This is as a result of conflicting results from gender related studies. Some researchers found significant differences in favour of females (Mohammad & Binji, 2017) while Areelu (2014) found significant differences in favour of males. On the other hand, Nasiru and Binji (2016) found that males and females are the same in Mathematics Performance. This inconsistency in the test of Performance between males and females in

Mathematics, calls for the need for further investigation in the use of bar-model approach to find out if Students performance will be affected by their gender at the Junior Secondary Two level.

**Statement of the Problem**

The Performance of students in Mathematics, especially Mathematics Word Problems has been fluctuating. The performance has not been encouraging to meet the demand of Mathematics application in real life. This will adversely affect the growth and development of the nation especially in the aspects that require Mathematics skills.

The learning of Mathematics Word Problems has been bedeviled by several challenges, some of the challenges include: inappropriate methods of teaching utilized by Mathematics teachers, studen'ts inability to comprehend Mathematics Word Problems due to large amount of words used, students develop apathy when Mathematics Problems are in word form and this de-motivate them. These challenges have affected students understanding of Mathematics Word Problems. These challenges, since it has not been properly handled have affected the vision 20-20-20 of the nations' objectives such as: Poverty alleviation, value re-orientation, job creation, wealth creation, economic and finances, management, business enterprises, information technology, Agriculture and natural resources. All these national objectives cannot be achieved without basic Mathematics skills by Nigerian students.

Efforts have been put in place by researchers (Locke, 2016., Agbo-Egwu & Fiase, 2018., Abdul., Tengah., & Said, 2019), Mathematical Association of Nigeria (MAN), Science Teachers Association of Nigeria (STAN), National Mathematical Centre (NMC) using different approaches in order to improve students' Performance in Mathematics, especially Mathematics Word Problems, but these efforts have not yielded desired results for the attainment of national objectives. For example, MAN and STAN have been organizing conferences, seminars, symposia over the years across the nation. And the national Mathematical center have run Mathematical improvement project (MIP) throughout the nation. All these efforts have yielded little results. Besides this, Mathematics Word Problems are challenging for students because reaching correct answers involve processes and skills beyond basic arithmetic. It is also a topic in the Mathematics curriculum that students at the Primary and Secondary Schools fear and achieve below average (Ameen, 2013 & Tamica, 2015). Reasons for the poor Performance has been attributed to teachers' non-usage of appropriate teaching approach and lack of understanding the context of the Mathematics Word Problem (UBEC ASSESSMENT, 2013). The apathy and dislike students generally have for Mathematics are due to the mishandling of the teaching of Mathematics, especially Mathematics Word Problems at the early stages of Primary School Education.

Similarly, little effort has been made towards using bar-model approach to solve word problems involving percentages. Most of the studies conducted on this topic were conducted outside the shores of Nigeria. The few ones conducted in Nigeria used Senior Secondary School Students as participants and did not apply the bar-model approach to teach Word Problems involving percentages. The studies reviewed that used bar-model approach, used mostly students with Mathematics disabilities as participants. It is on the basis of this that the researchers intend to investigate the effectiveness of bar-model approach to solve word problems involving percentages. The broad question for this study therefore is: To what extent does bar-model approach improve JS2 students' Performance in Mathematics Word Problems involving Percentages in Bokkos Local Government Area of Plateau State.

## Aim and Objectives of the Study

The aim of the study was to explore the effectiveness of the bar-model approach to solve word problems on percentages. Specifically, the study was set to achieve the following objectives:

(i) To determine the effect of the bar-model approach onJS2 student's Performance in Word Problems involving Percentages.
(ii) To determine school type differences in the Performance of JS2 Students in Word Problems involving Percentages.

## Research Questions

The following questions were answered in the study;

(i) What are the mean differences of JSS2 Students taught Word Problems involving Percentages in the Experimental and Control groups after exposure to the bar-model approach?
(ii) What is the difference in the Performance Mean Scores of Junior Secondary School Two Students in Public and Private Schools taught Mathematics Word Problem involving Percentages in the Experimental and Control group after exposure to bar-model approach?

## Hypotheses

The following null hypotheses were stated and tested in the study at a 5% level of significance;

(i) There is no significant mean difference between the Performance of JSS2 Students taught Word Problems involving Percentages in the Experimental and Control groups after exposure to treatment.
(ii) There is no significant difference in the Performance Mean Scores between Public and Private Junior Secondary School Two Students in Mathematics Word Problem involving Percentages after exposure to bar-model approach.
(iii) There is no significant difference between the Mean Performance Scores of Male and Female Students in the Experimental and Control group after exposure to the bar-model approach.

## Literature Review

Solving word problems using diagrammatic representations has four major components of the intellectual development process in Problem-solving these are; representing, planning/monitoring, executing, and self-regulating (Madani & Tengah, 2018). This is in line with the four phases for Problem-solving proposed by Polya (1957), which are; (i) Understand the problem, (ii) Devise a plan; (iii) Carry out the plan, (iv) Look back to check whether the answer is correct. Problem representation involves a Problem solver building a Model which represents the situation described in the Problem in order to understand the given Problem, including the initial state, goal state and the operations in between the two states (Baysal, 2019 & Bao, 2016). Problem representation has been described as a useful approach for enhancing the Mathematics Performance of Students with Mathematics difficulties (Jitendra & Star 2012, Zang & Xin, 2012). Empirical studies on applying Mathematics representation in solving Problems to enhance students' Performance with learning Problems and those at risk of Mathematics difficulties were evaluated (Jitendra & Star, 2012). Maputol (2019) conducted a study on the use of bar-models in solving mathematical problems; its effects on academic performance. The aim of the study was to evaluate the effects of bar-models in solving mathematical problems on the academic performance of the freshmen students of college of science and technology institute Tagbilaran. The findings showed that the use of bar-model as an approach in solving Mathematics Problems was more effective compared to the Conventional approach and improved students' Performance

in Mathematics. It was recommended in the study that Mathematics teachers should apply bar-model to teach and Solve Mathematics Problems involving ratio, fractions etc. The reviewed work is related to the present study because it involves the application of bar-model to enhance Performance of Students in Mathematics. However, the reviewed work was conducted in college of Technology and Allied Science of Bohol Island state university. The present study will be conducted in Bokkos Local Government Area, Plateau State. The reviewed work used college students as participants, but the present Study will use Primary Five Pupils as Participants. The design of the reviewed work was a randomized Solomon four group design. The present study will use a quasi-experimental design using intact classes. The reviewed work did not specify the sampling technique, but the present study will use convenience sampling technique to select Participating Schools for the study. From the foregoing review, the two Studies are not the same and therefore there is the need to conduct the present study in order to fill the research gap of the reviewed work. A result of the works evaluated indicates that Mathematics representation such as the bar-model approach is the best approach for solving Word Problems involving Percentages. For all learners at different levels, the ability to think through Mathematics representation is an important skill to acquire in learning Mathematics Word Problem involving Percentages (Jitendra & Star, 2012). However, without effective teaching and learning, Mathematics representations may not be rewarding and meaningful to the learners.

The Bar -model approach was first introduced by the Singapore Ministry of Education to help students, who had difficulties in basic numerical skills and were not able to perform well in Solving Word Problems, and this was a National Problem in the 1980'S (Mei & Li, 2014). The Bar Model approach is a Systematic Method of representing Word Problems using Pictorial rectangular "bars" in order to help students visualize the relationship in Mathematics Word Problem before moving to the abstract stage, where numbers, notation and symbols are used (Cavendish, 2013, Bao, 2016, Morin etal, 2017, Madan & Tengah, 2018, Prahmana et al, 2018, Abdul et al, 2018, Baysal, 2019 & Thompson, 2019). The revised Brunei's Framework Mathematics Curriculum for Year 7 and 8 advocates the use of diagrams in the learning experience as a Pedagogical Consideration for some of the Mathematics topics (Curriculum Development Department, 2011). The Bar- model approach has been used as a Problem Solving approach and part of the Secondary Mathematics Textbooks for Junior Secondary one and two. Specifically, the Bar-model approach is included in the topic Percentages in the Primary and Secondary Mathematics Textbooks for Junior Secondary Two, despite this inclusion, majority, if not all Primary and Secondary School Mathematics Teachers have neglected the use of this approach in their instruction. For this present study, the Bar-model approach introduced in the intervention lessons was adapted from Junior Secondary Two Mathematics Textbook.

There are two main types of Bar Model, (i) the part-whole model and (ii) the comparison model. Part-whole model is used to solve problems involving addition and subtraction. The model can be used to solve a mathematics problem that include:

(i) given a part and a part, students add the parts to find the whole.

Fathyau made 686 biscuits. He sold some of them. If 298 were left over, how many biscuits did he sell? ← 686 →

| Number sold | Number left |
|---|---|
| 388 | 298 |

(ii) given the whole and a part, students subtract the part from the whole to find the other part.

Fatima saved $184, she saved $63 more than Jane. How much did she save?

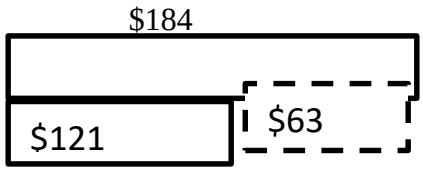


**Figure 1: Illustration of Comparison Model**

Comparison model is used to compare two quantities. Like the part-whole model, comparison model is used to solve problems involving addition and subtraction and other complex comparison problem. The comparison model is particularly useful in solving ratio and percentage problems. In this study, both the part-whole and comparison model are employed as word problems involving percentages.

**Methodology**

This study adopted a quasi-experimental research design. Specifically, the study used the non-equivalent pre-test-post-test control group research design in which intact groups were assigned to the experimental and control groups. In this study, there was no random assignment of participants to experimental and control groups. This design was appropriate for this study because the random assignment of students to the groups was not possible as the researchers used the normal school arrangement (intact classes) to apply the treatment. The design was used in the study because of its importance in educational research. The model of the design in this study as described by Awotunde and Ugodunluwa (2004) is symbolized as follows:

| Group | Pre-test | Treatment | Post-test |
|---|---|---|---|
| Experimental | $0_1$ | X | $0_2$ |
| Control | $0_3$ | | $0_4$ |

**Fig. 2: Illustration of the non-equivalent control, group, pre-test- post-test design**

Where $0_1$ and $0_3$ represent the pre-test while $0_2$ and $0_4$ represent the post-test for the experimental and control groups. And X represents the treatment while the broken line indicated no random assignment to the experimental and control groups (Awotunde & Ugodulunwa, 2004)

The Population of the study comprised of all co-educational Junior Secondary Two Students in Bokkos Local Government Area, Plateau State. The study involved convenience sampling of Participants from Junior Secondary Two Students, consisting of 98 mixed-sex co-Educational Students in three co-educational Secondary School in Bokkos Local Government Area, Plateau State. Quantitative data were collected from students' numerical scores in the pre-test and post-test, presented and analyzed using descriptive and inferential statistics. Pre-test provided information on students' prior knowledge and performance in solving word problems involving percentages prior to the intervention lessons, while post-test examined whether there is an improvement in students' scores after the intervention lessons. The student t-test for independent sample was used to analyze any significant difference between the means of the two tests. The pre-test and post-test used pencil and paper written test to assess the student's performance in percentage word problems. Question items on word problems involving percentages were adapted from mathematics textbook for junior secondary two. There were 25 objective questions in total and each question is allocated 4 marks, thus the total marks for all correct answers are 100 marks. The post-test contained same questions as in pre-test but re-shuffled before the main study. The reliability test of the written test was conducted to Junior Secondary Two Students which comprised of 30 Students who were not involved in the main study. The Analysis of the reliability test was computed using Kuder-Richardson ($K\text{-}R_{20}$) formula and yielded a reliability value of 0.90 which indicated that the test items were adequate for the intended purpose. The items used in the test were also validated as adequate for the intended participants by experts in test measurement and evaluation and mathematics lecturers of the University of Jos. The intervention lessons for the study consisted of twenty lessons, focusing on introduction and application of Bar-model approach on word problem involving percentages. The lessons were designed in a sequence of increasing difficulties and hence, Students were expected to enhance their understanding in each lesson so that they will be able to proceed to the next. The bar-model was implemented in the classroom through three stages: concrete, pictorial and abstract stage. Physical objects were used in the first stage to model mathematics concepts. In the second stage, diagrams were drawn to represent specific quantities of an object, while the third stage was implemented using symbols and notations of mathematics concepts. The lesson intervention lasted for four weeks.

## Results and Discussion

**Research Question One:** What are the mean differences of JSS2 students taught word problems involving percentages in the experimental and control groups after exposure to treatment? The performance scores of students of the experimental and control group are used to answer this research question.

**Table 1: Mean and standard deviation of students' performance between the experimental and control groups before and after treatment**

| Group | N | Mean | SD | Mean diff. |
|---|---|---|---|---|
| Experimental | Before 47 | 38.44 | 8.51 | 18.83 |
| | After 47 | 57.27 | 11.38 | |
| Control | Before 51 | 35.76 | 9.39 | 13.83 |
| | After 51 | 49.59 | 10.21 | |

The result of the analysis from table 1 shows that the experimental group had mean of 38.44 and SD of 8.51 before exposure to treatment and mean of 57.27 and SD of 11.38 after exposure to treatment while the control group had a mean of 35.76 and SD of 9.39 before exposure to treatment and mean of 49.59 and SD of 10.25 after exposure to treatment. The experimental group had mean difference of 18.83 more than that of the control group of 13.83. The result shows that the experimental group that was exposed to bar-model approach performed higher than the control group.

**Research Questions Two:** What is the difference in the performance mean scores of junior secondary school two student's in public and private schools taught mathematics word problem involving percentages in the experimental and control group after exposure to bar-model approach? In order to answer this research question, the students' performance scores based on private and public schools was used.

**Table 2: Mean and standard deviation of the experimental and control group based on school type, public and private**

| School type | N | Mean | SD | Mean diff. |
|---|---|---|---|---|
| Public school | Before 47 | 36.79 | 9.27 | 17.79 |
| | After 47 | 54.58 | 12.29 | |
| Private school | Before 51 | 35.85 | 9.67 | 20.29 |
| | After 51 | 56.14 | 12.78 | |

The result of the analysis from table 2 shows that public schools had had mean of 36.79 and SD of 9.27 before treatment and mean of 54.58 and SD of 12.29 after treatment. Private schools had mean of 35.85 and SD of 9.67 before treatment, and mean of 56.14 and SD of 12.78 after treatment. The public school had mean difference of 17.79 while private schools had 20.29 which is higher than that of public schools. The result indicates that private schools performed higher than public school.

**Hypotheses Testing**

**Hypothesis One:** There is no significant mean difference between the performance of JS2 students taught word problems involving percentages in the experimental and control groups after exposure to treatment. To test this hypothesis, the data on students' performance in mathematics word problems involving percentages after exposure of the two groups to different treatments was used.

**Table 3: Independent t-test analysis of the experimental and control group after exposure to different treatments**

| Group | N | Mean | SD | df | P-Value | Sig. |
|---|---|---|---|---|---|---|
| Experimental | 47 | 57.27 | 11.83 | | | |
| | | | | 96 | 0.002 | 0.05 |
| Control | 51 | 49.59 | 10.21 | | | |

The result of the analysis from table 3 shows that the calculated P-Value of 0.002 is less than the significant level of 5%. The result implies that the null hypothesis was not retained; hence we conclude that there is a significant difference in the performance means scores between the

experimental and control group in favour of the experimental group after exposure to bar-model approach.

**Hypothesis Two:** There is no significant difference in the performance mean scores between public and private junior secondary two students in mathematics word problem involving percentages after exposure to bar-model approach.

To test this hypothesis, the data of students in public and private schools was used.

**Table 4: Independent t-test analysis of public and private schools exposed to bar-model approach**

| School type | N | Mean | SD | df | P-Value | Sig. |
|---|---|---|---|---|---|---|
| Public school | 29 | 61.61 | 9.88 | 45 | 0.053 | 0.05 |
| Private school | 18 | 52.66 | 12.99 | | | |

The result of the analysis from table 4 revealed that the P-Value of 0.053 is higher than the significant level of 5%. This means that the null hypothesis was retained. Hence there is no significant difference in performance mean scores between public and private primary schools after exposure to treatment. Therefore, school type has no effect on students' performance in mathematics word problem performance test after exposure to treatment.

**Hypothesis Three:** There is no significant difference between the mean performance scores of male and female students in the experimental and control group after exposure to bar-model approach.

Independent t-test was used to test this hypothesis and the result is presented.

**Table 5: Independent t-test analysis of male and female Students exposed to bar-model approach**

| Group | N | $\bar{x}$ | SD | Df | $t_{cal}$ | p-value | Sig. |
|---|---|---|---|---|---|---|---|
| Male | 25 | 58.81 | 12.30 | 45 | 0.98 | 0.333 | 0.05 |
| Female | 22 | 55.40 | 11.83 | | | | |

The result of the analysis from table 5 shows that the P-Value of 0.333 ($d_f$ 45, t=0.98) is higher than the significant level of 0.05. Therefore, the null hypothesis was retained. This implies that there are no significant differences in the performance mean scores between male and female Students after exposure to bar-model approach. Hence, gender has no significant effect on Students' performance after exposure to treatment.

**Discussion of Findings**

The purpose of the study is to investigate junior secondary two students' use of bar-model approach in solving word problems involving percentages in Bokkos, Plateau State, Nigeria. Findings from research question one reveals that students exposed to bar-model approach achieved higher than those that were not exposed to bar-model approach. This finding is in agreement with the finding by Bao, (2016), Koleza, (2016), Morin, Watson, and Lester (2017),

Madani, Prahmana and Tengah, (2018), Abdul, Tengah and Said (2019), Thompson (2019) and Baysal (2019) who found that bar-model method of teaching mathematics improves students' performance than conventional method. The implication for this finding is that secondary school teachers need to employ the bar-model approach in teaching so as to improve students' performance in mathematics word problem at the secondary school level.

Findings from research question two reveals that private school students performed better than public schools after exposure to treatment. This finding is in agreement with Kolawole and Ajetunmobi (2014) who found that private school's students performed better than public schools in mathematics and algebra and contrary with findings by Scoville (2012) who observed that most private schools lack quality teachers because of poor salaries paid to the teachers which in turn affect the performance of both teachers and students. The implication of this finding is that public secondary school teachers should use teaching approaches such as the bar-model in order to help public secondary school students gain significantly in mathematics word problem. Findings from hypothesis one reveals that the experimental group performed significantly higher than the control group after exposure to bar-model approach. This is also in agreement with the findings by Bao, (2016), Koleza, (2016), Morin, Watson, and Lester (2017), Madani, Prahmana and Tengah, (2018), Abdul, Tengah and Said (2019), Thompson (2019) and Baysal (2019) who found that students who are exposed to bar-model approach performed significantly higher in algebraic word problem. The implication of this finding is that when students are exposed to bar-model approach it will help to improve their performance in mathematics word problem involving percentages. Findings from hypothesis two shows that there is no significant difference in the performance mean scores between public and private secondary school students after exposure to treatment. This finding is tandem with the findings by Kolawole and Ajetunmobi (2014), Yusuf and Adegun (2014), and Munanu (2015) who found that school type does not affect students' performance in mathematics word problem and all school subjects. The finding contradicts the finding of Okon and Achibong (2015) who found that private school perform better than public and also contradict the finding of Lubienski and Lubienski (2014) who found that public school perform better. The implication of this finding is that whether a school is a public or private is not the case but the methodology used in teaching is the basis for measuring students' performance in a school subject.

Finally, findings from hypothesis three shows that there is no significant difference between male and female students' performance in the experimental and control groups after exposure to treatment. The finding is in line with the finding by Timayu, Salman and Issau (2017), Iji, Okoronkwo and Anyor (2017), Fajemidagba and Suleiman (2012), Agbo-Egwu and Fiase (2018), Bot (2012), Ging, Mohammed and Usman (2019), Fennema and Carpenter (2018), Adigun (2018) and Boonen, Konning, Jolles and Menno (2016) who state that students' gender does not affect performance of students' in mathematics word problems. The implication of this finding is that gender does not have any effect in student's performance in mathematics word problem involving percentage.

## Conclusions and Recommendations

In conclusion, therefore, this paper highlighted the importance of problem solving as it relates to science and technology in national development, and of selecting appropriate teaching approach for the teaching of word problems involving percentage for better understanding. The findings of the paper revealed that the bar-model approach is a very viable approach for teaching percentages for better performance.

In order to significantly reduce the recurring problem of poor performance of Students' in mathematics (word problems involving percentages), the following recommendations are made: the findings from the study have provided empirical basis for suggesting that:

(i) Mathematics teachers are to be encouraged to expose their pupils' to the use of bar-model approach as an approach for solving problems involving percentages through meaningful teaching.

(ii) Teacher training institutions should emphasize the need to elicit pupils' performance through the use of bar-model approach in learning word problems leading to percentages. This approach encourages activity based method and is problem-solving in nature.

(iii) Authors of mathematics textbooks should be encouraged to include the bar-model approaches in solving word problems involving percentages in their books for better enhancement by the pupils.

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