



JOURNAL OF MATHEMATICAL SCIENCES EDUCATION

Vol. 4 No 1, Nov. 2016

A Journal of
NATIONAL MATHEMATICAL CENTRE, ABUJA.

Editor-in-Chief

PROFESSOR SYLVESTER E. ONAH

Director & Chief Executive
National Mathematical Centre
Abuja, Nigeria

ISSN: 2141-6826

Journal of the Mathematical Sciences Education, Vol. 4 No. 1

Contents

<i>Attraction and Retention of Mathematical Sciences Teachers in Nigerian Schools – The Real Deal</i> Azuka Benard Festus	513
<i>An Evaluation of Academic Performance of B.Sc (Ed) Mathematics and B.Sc. Mathematics Students in Nigerian Universities</i> Hassana Oseiwu Ali and Janet Kebbi A.	523
<i>Research, Statistics and Mathematics Educators in Nigeria: Effect Size Perspective</i> Adeniji, K.A.	533
<i>Perceived Difficulty Concepts in Mathematics by Senior School Students And Mathematics Teachers in Ilorin, Kwara State, Nigeria</i> Ameen, S.K. and Salman, M.F.	545
<i>Construction of Objective, Reliable and Standardization Test Items</i> Steve Dele Oluwaniyi	555
<i>On Coordinate Geometry of a Circle with Geogebra</i> Virtue U. Ekhosuchi and Augustine A. Osagiede	565
<i>Effects of Activity Based Instructional Strategy on Senior Schools Students Performance in Circle Geometry in Abuja, Nigeria</i> Durajaiye, D.S., Salman, M.F., Jekayinfa, O.J. and Okwuoza, S.O.	577
<i>Enculturation of 21st Century Learning Skills on Secondary School Students In Mathematics for the Digital Age</i> Martha Mimi Chianson, Solomon Ogebe Aligba and B.F. Azuka	591
<i>Fostering Entrepreneurship in Education: The Impact of Mathematics Laboratory Approach</i> Yomi Sunday, M. Alex Akanmu and Olubusuyi Fajemidagba	601

Perceived Difficulty Concepts in Mathematics by Senior School Students and Mathematics Teachers in Ilorin, Kwara State, Nigeria

BY

Ameen, S. K. and Salman, M.F
Science Education Department
Faculty of Education
University of Ilorin
Ilorin, Nigeria

Abstract

The Study Sought to find out the perceived Difficult Concepts in Senior Secondary School Mathematics Curriculum by teachers and students in Kwara State. The study involved a survey research type to be followed by sampling techniques in which four, research questions were raised. It sought for the level of perceived difficulty of mathematics concepts by students and teachers to learn and teach respectively in the senior school mathematics curriculum. The instrument for data collection was the researchers - designed questionnaire which was validated by two experts in Mathematics Education and an expert in measurement and evaluation. The test-retest reliability index of 0.78 was obtained. Data analysis was carried out using frequency counts and percentages. The results of the study showed that only six concepts were perceived to be difficult to teach by the teachers, while 12 concepts were perceived difficult to learn by the senior school students of the sampled schools. The level of perceived difficulty was higher by male teachers than their female counterparts. In the same vein, the male students also perceived the senior school mathematics concepts more difficult to learn than their female counterparts. It is therefore recommended among others that since senior secondary school mathematics teachers perceived only six concepts in the new mathematics curriculum to be difficult to teach, they should network with other teachers that have no difficulty with the concepts in order to improve their cognitive understanding of the identified difficult concepts and in return lead to better performance of their students.

In addition, the mathematics teachers should use different methods to teach the concepts as to reduce the failure rate in both internal and external examinations.

Keywords: perceived difficult concepts, mathematics curriculum, teaching, learners and metropolis.

Introduction

Perceived difficult concepts in the new senior school mathematics curriculum refers to contents in the new mathematics curriculum found difficult to teach by teachers and those found difficult to understand by learners and failed in internal and external examination. Such concepts include; Bearing, Differentiation and Applications, Integration and Application, Logical reasoning among others.

Mathematics is a diverse discipline that deals with data, measurements and observations from science with inference and proof and with mathematical models of natural phenomenon of human behavior and of social systems, everybody counts (1989). It knowledge contributes to the field of astronomy, chemistry, medicine, geophysics, oceanography, engineering and social sciences. Hence, Abimbola (2013) referred to mathematics as the prime instrument of science which reveals hidden pattern that helps in understanding the world around us. The daily activities such as finance, cooking, fabric making, construction, transportation, handcraft and so forth, uses mathematics subconsciously. Surprisingly, the advance mathematics contributes to the wealth of the country but often in an unseen and unadvertised way. Thus, the application of advance mathematics wouldn't have been appreciated without the understanding of the fundamental topics in primary (1-6) and secondary (jss 1-3, ss 1-3) school levels in order to prepare future mathematicians and mathematics educators.

Curriculum is the medium through which educational institutions translate societal values into concrete reality. Daramola (2004) defined curriculum as part of the school academic programs specifically designed to provide planned and guided learning experiences. Alade (2005) sees curriculum as a programmed education prepared for definite group of learners within a time frame in order to achieve the intended learning outcomes. In the same vein, Odili (2006) defined curriculum as consisting of all the experiences that learners have under the auspices of the school whether planned for or not.

The objectives of Nigerian mathematics curriculum are primarily to guide and assist the teacher to plan and implement his/her teaching methodology with full regards to the learners' intellectual abilities and their individual differences; provide the learners with opportunity to ascertain progress at their own pace thereby, channeling their efforts into relevant activities. However, with the elaborate objective of mathematics curriculum, previous study shows that students have weakness in some topics, especially the concepts in the new mathematics curriculum. Metroplis in this study comprised of three local government in Kwarastate (Ilorin West, Ilorin South, and Ilorin East)

Statement of Problem

The perennial poor performance of students in both internal and external examinations in mathematics has been a concern for the mathematics educators' mathematicians and other uses of mathematics in Nigeria. Consequent upon the alarming rate of poor performance of students in Mathematics as attested to by Ameen(2013), Salman and Ameen(2014) and Ameen and Salman (2015), Kolawole, Oladosu and Ajetunmobi,(2013) and Kolawole(2013a), it is therefore necessary for mathematicians, mathematics educators, curriculum experts, to search for a holistic solution to the problem. Attempts had been made in this regard such as the work of Azuka, Jekayinfa, Durojaiye and Okwuoza(2013) whose study was on the identification of difficulty levels of topics in the new senior secondary school mathematics curriculum as perceived by mathematics teachers of federal unity schools in Nigeria, therefore the present study sought to and found out the levels of perception of the new senior secondary school mathematics curriculum by both mathematics teachers and students in Ilorin Kwara state needs to be critically determined and which calls for this study.

Research Questions

The following research questions were generated to guide the study:

1. What are the perceived difficult concepts in the new senior secondary school mathematics curriculum to teach by the mathematics teachers?
2. What are the perceived difficult concepts to learn by the senior school students in the new curriculum?
3. Does the gender of mathematics teachers determine their perceptions of difficult concepts in the new mathematics curriculum?
4. Does the gender of students determine their perception of the difficult mathematics concepts?

Method

The study employed a descriptive survey type. The population for the study comprised mathematics teachers teaching at the senior secondary school level and students at the senior secondary school level in Ilorin metropolis of Kwara State, Nigeria. One hundred (100) mathematics teachers were randomly selected from each of the three local governments in the metropolis. The instrument used for the study was researchers-designed questionnaire. The instrument was validated by two experts in mathematics education from the University of Ilorin, Ilorin, Kwara state, Nigeria. The test-retest reliability procedure was used to determine the reliability index of 0.78. A total of one hundred (100) questionnaires were administered to the mathematics teachers and two hundred (200) were distributed to the students and only ninety five (95) copies were completed and returned by the teachers while one hundred and ninety-six (196) copies were completed and returned by the students and used for the analysis. Percentage was used to analyze the data. The minimum mark used to determine the degree level of

...the concepts as 50%. Therefore, items having 50% and above are considered difficult while those below are considered not significant.

Results

Table 1: Perceived difficult concepts to teach in the new senior secondary school mathematics curriculum by the teachers

CONCEPT TOTAL	PERCIEVED			
	D	ND		
BEARING	61	34	95	
64.21%	35.76%			
DIFFERENTIATION & APPLICATIONS	73	22	95	
76.84%	23.16%			
INTEGRATION & APPLICATIONS	74	21	95	
	77.89%		22.1%	
LOGICAL REASONING	69	36	95	
72.63%	37.89%			
FINANCIAL MATHEMATICS	48	47	95	
50.53%	49.47%			
GEOMETRICAL CONSTRUCTIONS	59	36	95	
	62.11%		37.89%	
COORDINATE GEOMETRY	50	45	95	
52.63%	47.37%			
TRIG RATIO OF ANGLES	46	49	95	
48.42%	51.58%			
MODULAR ARITHMETIC	45	50	95	
47.37%	52.63%			
WORD PROBLEMS	54	41	95	
56.84%	43.16%			
PLAN & CIRCLE GEOMETRY	49	46	95	
51.58%	48.42%			
PROBABILITY	39	56	95	
41.05%	58.94%			

MATRICES	44	51	95
	46.32%	53.68%	
LONGITUDE & LATITUDE	48	47	95
	50.53%	49.47%	

Table 1 contains six concepts that were perceived difficult to teach by the senior secondary school teachers with the highest percentage is Integration & Applications (77.89%), followed by Differentiation & Applications (76.84%), Logical Reasoning (72.63%), Bearing of 64.21% followed by Geometrical Constructions (52.11%), and Word Problems (56.84) been the least perceived difficult.

Table 2: Perceived difficult concepts to learn in the senior secondary school curriculum

CONCEPT	PERCEIVED		TOTAL
	D	ND	
BEARING	116	80	196
59.18%	40.82%		
DIFFERENTIATION & APPLICATIONS	150	46	196
76.53%	23.47%		
INTEGRATION & APPLICATIONS	154	42	196
78.57%	21.43%		
LOGICAL REASONING	128	68	196
65.31%	34.69%		
GEOMETRICAL CONSTRUCTIONS	152	44	196
	77.55%	22.45%	
WORD PROBLEMS	113	83	196
	57.65%	42.35%	
PLAN & CIRCLE GEOMETRY	113	83	196
	57.65%	42.35%	
FINANCIAL MATHS	139	57	196
	70.92%	29.08%	

COORDINATE GEOMETRY	151 77.54%	45 22.45%	196
MODULAR ARITHMETIC	121 61.73%	75 38.27%	196
MATRICES	109 55.61%	87 44.39%	196
LONGITUDE & LATITUDE	102 52.04%	94 47.96%	196

It was could be from table 2 that the senior school students perceived 12 concepts to be difficult to learn in the senior school mathematics curriculum with the highest difficulty in integration and applications (78.57%) and the least in longitude and latitude.

Table 3: Distribution of perceived difficult concepts to teach based on teacher's gender

SEX	FREQUENCY COUNT	PERCENTAGE (%)
Male	66	69.5
Female	29	30.5
Total	95	100.0

Table 3 indicated that male teachers perceived the identified concepts more difficult to teach (69.5%) than their female counterparts (30.5%). This shows that male teachers perceived the concepts more difficult to teach than their female counterparts.

Table 4: Distribution of perceived difficult concepts to learn based on students gender

SEX PERCENTAGE (%)		FREQUENCY COUNT
Male	103	52.6
Female	93	47.4
Total	196	100.0

The analysis in table 4 indicated that male students also perceived the senior secondary mathematics concepts in the curriculum to be more difficult to comprehend than their female counterparts.

Discussion and Results

The result indicated that the teachers perceived Bearing, Differentiation& Application, and Integration & Application, Logical reasoning, Geometrical constructions and Word problems to be difficult to teach in the senior secondary school mathematics curriculum. It could be inferred from tables 1 and 2 that six concepts were perceived to be difficult by the mathematics teachers to teach while twelve concepts (Bearing, Differentiation& Application, Integration& Application, Logical reasoning, Financial mathematics, Geometrical construction, Coordinate geometry, Modular arithmetic, Word problem, Plan& circle geometry, Matrices and Longitude& latitude) were perceived difficult to learn by the students. This shows that the mathematics teachers need to improve on their pedagogy in order to reduce the level of difficulty in all the identified concepts and also reduce the failure rate of students in both internal and external examinations. The implication of this result is that senior school students have serious issues with understanding certain concepts in the mathematics curriculum and which could be responsible for their poor performances in internal and external examinations conducted by various examination bodies such as WAEC, NECO, and NTTB among others.

Recommendations

Based on the findings of the study, the following recommendations are therefore made:

1. Mathematics teachers should consult different materials such as textbooks and the internet to seek for better understanding of the concepts to improve their knowledge on the difficult concepts in order to improve their level of cognitive domain and in return lead to better understanding of their students on the identified concepts.
2. 85.71% of the concepts were perceived very difficult to learn by sampled senior school students. The mathematics teachers should find ways of teaching these concepts in such ways that students will understand them better so as to reduce the failure rate in both internal and external examinations. The mathematics teachers should endeavor to improve their methodological skills as well as their knowledge in the difficult concepts.
3. The male teachers should intensify effort to improve their understanding of the perceived difficult concepts while special attention should be given to male students than their female counterparts to learn the perceived difficult concepts.
4. Enough time should be allocated to mathematics lessons in schools so that mathematics teachers can have enough time to explain the perceived difficult concepts in the curriculum to the students.
5. The male mathematics teachers should endeavor to update their knowledge on the concepts of the senior mathematics curriculum so as to be able to stand the challenges in the new mathematics curriculum.
6. Teachers should be encouraged to update their knowledge on regular basis through organized seminars and workshops organized by ministries of education and Professional Association.

References

Abimbola I.O. (2013) Philosophy of Science for Degree Students. Ilorin. Bamtex Printing and Publishing Enterprises

Alade, I.A. (2005). *Rudiments of Curriculum Studies*. Ibadan: Suflo Publications.

Ameen, S. K. (2013). Comparative effects of two problem-solving models on Nigerian Secondary School Students performance in Mathematics Word Problems. An unpublished Ph.D Thesis, University of Ilorin, Ilorin.

Ameen, S. K.&Salman,M.F. (2015).Students' Mathematical Language Proficiency As Predictor of their Performance in Mathematics" Bearing" Word Problems.(ABACUS). *The Journal of the Mathematical Association of Nigeria*.1(40),77-82.

Azuka, B.F; Jekayinfa, O; Durojaiye, D; Okwuoza, S.O.(2013) *Difficulty Levels of Topics in the New Senior Secondary School Mathematics Curriculum as Perceived by Mathematics Teachers of Federal Unity Schools in Nigeria*.National Mathematical Centre, Abuja, Nigeria.*Journal of Education and Practice*. ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)Vol.4, No.17, 2013.www.iiste.org

Daramola S.O (2004). Philosophical foundation in science teaching in I.O

Abimbola and A.O. Abolade. Fundamental principles and practice of instruction (79- 81).

Everybody Counts (1989). A report to the nation on the future of Mathematics Education.Resource prepared by the Center for the Study of Mathematics curriculum-2004

Kolawole,E.B.,Oladosu,C.I.&Ajetunmobi,O.(2013).Comparability of Effectiveness of Problem-Solving Methods onLearners'Performance in Mathematics.Unique *Journal of Education Research*,1(2),12-19
<http://www.uniqueresearchjournal.org/UJER>

Kolawole,E.B.&Ajetunmobi,O.(2014).Kolawole's Problem-Solving(KPS)Method as a Panacea for Mathematical Problem and an Antidote to Mass Failure in Mathematics Examinations.ABACUS.*The Journal of the Mathematical Association of Nigeria*.1(39),159-176.

Odili, G.A. (2006). *Mathematics Education in Nigeria Secondary schools: A teaching perspective*. Lagos:Rex Charks&Patric Limited..



abacus

THE JOURNAL OF THE MATHEMATICAL
ASSOCIATION OF NIGERIA

VOLUME 1 NUMBER 1
MATHEMATICS EDUCATION SERIES
SEPTEMBER 2014

Sponsored by "E.T.F. Grant 2010"

COMPARATIVE EFFECTS OF TWO PROBLEM-SOLVING MODELS ON SENIOR SECONDARY SCHOOL STUDENTS' PERFORMANCE IN MATHEMATICS WORD PROBLEMS

SALMAN, M. F. & AMEEN, S. K.

Department of Science Education, University of Ilorin, Ilorin.

ABSTRACT

The study adopted pre-test, post-test, quasi experimental design. A total of 180 senior secondary two purposively selected from six secondary schools in Ilorin metropolis took part in the study. The instrument used for data gathering in the study was Mathematics Performance Test (MPT) designed by the researchers. The findings of the study showed that there was a significant difference between the performance of the experimental and the control groups. Gender had no significant influence on the performance of the students exposed to the instructional models. Subject combination of students had significant effect on the performance of students exposed to the Polya's problem-solving model with the science students having the highest mean gain score followed by the commercial students while the Art students had the least mean gain score. Mathematics teachers should take time to teach mathematics language in Bearing before teaching the actual concept to enhance better performance of students. Mathematics Teachers and Mathematics textbook authors should endeavor to employ Polya and Bransford and Stein problem solving models among others to enhance meaningful learning in mathematics.

INTRODUCTION

Mathematics is viewed as the science of structure, order, number, space and quantity (Odili, 1990). This definition connotes that all sciences draw their inspirations from Mathematics. Therefore, it can be inferred that mathematics is the language of all sciences. As important as Mathematics is, literature indicates that a considerable number of students lack adequate understanding of mathematical concepts and skills leading to high failure rate in the subject (Wasike, 2006). Mathematics problem-solving, in particular, requires specialized skills which are practical and which involves a unique linkage between mathematics, communication and the environment. Mathematical expressions must be properly and accurately understood in order to reduce the mistakes committed by students while solving mathematics word problems in general and word problems on bearing, in particular. (Ameen, 2007).

Funkhouser (1992) defined problem-solving as a multiple step process where the problem-solver must have had relationship with past experiences (schema) and the problem at hand and then set up a solution. In order words, students need to learn this process if they are to deal successfully with problems in real life situations and those that they may come across in schools. Therefore, models have been advanced for the teaching and learning of problem-solving. Some of the models are those of Polya (1957) Bingham (1958), Simon and Newell (1972) and Bransford and Stein (1984).

The use of problem-solving models enhances the teaching, learning and performance of students in mathematics word problems involving bearing. Therefore the researcher employed two problem-solving models with more emphasis on teaching the technical terms in bearing on the performance of students in mathematics. The first model involved in the study is the Polya problem-solving model comprising four stages: (1) understanding the problem (2) devising a plan that will lead to the solution (3) carry out the plan (4) looking back. The second model involved is the Bransford and Stein problem-solving model which comprises five stages (1) identification of the problem (2) defining and representing the problem (3) exploiting possible strategies (4) acting on those strategies (5) looking back. The stage II of Polya problem-solving is further broken-down into stages II and III, by Bransford and Stein respectively in his model. The choice of Bransford and Stein problem-solving model as the second model use to find out whether the five stages enhance better performance of students in solving bearing word problems in Mathematics.

Statement of the Problem

One of the goals of Mathematics teaching and learning is to develop the ability to recognize a problem and apply the knowledge of Mathematics to obtain the solution to the problem. Reports from Chief Examiners of the West African Examinations Council (WAEC) and Mathematics Educators have affirmed students' poor performances in Mathematics problems at the Junior and Senior Secondary School levels. Also, the works of Ameen (2007&2013) respectively affirmed that Word problems involving bearing has been identified as a topic students perceived difficult. Thus, the present study focuses on the comparative effects of two problem-solving models on students' performance in mathematics word problems.

Purpose of the Study

The main purpose of the study was to examine the comparative effects of two problem-solving models of Polya and Bransford and Stein on Students' performance in Mathematics Word Problems. Specifically, the study examined the comparative effects of;

- (1) Bransford and Stein (1984) and Polya (1957) instructional models on students' performance in mathematics word problems involving bearing.
- (2) Bransford and Stein (1984) and Polya (1957) instructional models on the performance of male and female students in mathematics word problems involving Bearing.
- (3) Bransford and Stein (1984) and Polya (1957) instructional models on the performance of science, Art and Commercial students in mathematics word problems involving Bearing.

COMPARATIVE EFFECTS OF TWO PROBLEM- SOLVING MODELS ON.....

Research Questions

In this study, answers are provided to the following research questions:

- (i) What are the comparative effects of Bransford and Stein (1984) and Polya (1957) problem-solving models on the performance of students exposed to the treatment and their counterpart in the control group in solving Mathematics Word Problems involving Bearing?
- (ii) Is there any difference between the performance of male and female students taught with Bransford and Stein (1984) model?
- (iii) Is there any difference between the performance of male and female students taught with Polya (1957) model?
- (iv) Will there be any difference between the performance of Science, Arts and Commercial students taught with Bransford and Stein (1984) model?
- (v) Is there any difference between the performance of science, Arts and Commercial students taught with Polya (1957) model?

Research Hypotheses

The following research hypotheses are tested in the study.

1. There is no significant difference in the performance of students taught with Bransford and Stein (1984) and Polya (1957) problem – solving models and their counterpart in the control group.
2. There is no significant difference in the performance of male and female students exposed to Bransford and Stein's (1984) instructional model in Mathematics word problems involving Bearing.
3. There is no significant difference in the performance of male and Female students exposed to Polya (1957) instructional model in Mathematics Word Problems involving Bearing.
4. There is no significant difference in the performance of Science, Arts and Commercial students taught with Bransford and Stein (1984) instructional model in Mathematics Word Problem- involving Bearing.
5. There is no significant difference in the performance of science, Arts and Commercial students taught with Polya (1957) instructional model in Mathematics Word Problem involving Bearing.

Research Methodology

This study employed a quasi-experimental design (non-randomize, non-equivalent, pre-test, post-test control group design). The choice of this design is considered appropriate when the true experimental design is not possible. The Mathematics Performance Test (MPT) which contains six essay items on bearing word problems was adapted from the West African Senior School Certificate Examinations while two instructional packages were prepared by the researchers and used as treatment for the study. The Mathematics Performance Test was administered to senior secondary 2 students drawn from six equivalent co-educational secondary schools in Ilorin metropolis of Kwara State. The Mathematics performance test was used as the pre-test

and post-test. The research instrument had been tested for validity and reliability by the West African Examinations Council since the instrument was a set of past questions from the senior secondary school Certificate Mathematics Examinations past Questions and also revalidated by the expert in the field of mathematics education at the university of Ilorin. The computed reliability value is 0.67.

The instructional packages were lesson plans prepared by the researchers based on the two problem-solving models of Bransford and Stein (1984) and Polya (1957), the conventional method and the teaching of the technical terms in bearing word problems. These instruments are:

- Polya Problem - solving instructional model (PM)
- Bransford and Stein instructional model (BSM) and
- Lesson plan for the teaching of the technical terms in bearing word problems.

Data Analysis and Results

The research questions that have no equivalent hypotheses were answered using descriptive statistics while the hypotheses were tested using Analysis of covariance (ANCOVA). The Scientific Package for Social Sciences (SPSS) programme of version 17.00 was used to analyze the data.

Research Question 1:

What are the comparative effects of Bransford and Stein and Polya problem-solving models on the performance of students exposed to the treatment and their counterparts in the control group in Mathematics Word Problems involving bearing?

Hypothesis 1: There is no significant difference in the performance of students taught with Bransford and Stein (1984) and Polya (1957) problem-solving models and their counterpart in the control group.

The test for significance of the hypothesis is at α - level of 0.05. In Table 1, the analysis indicated that the p-value is zero which is less than 0.05. This indicated that there was a significant difference between the three post-test scores of the students taught using the three (3) instructional models. It could be concluded that there was a significant difference in the performance of students taught with Bransford and Stein, Polya and the conventional method. The models have significant effects in view of the improved performance of the students in posttest in mathematics word problems involving bearing. The multiple comparison test of Scheffe post-hoc analysis was carried out to determine the actual source of the difference that existed among the three instructional methods. The direction of the difference was in favour of students exposed polya instructional strategy.

COMPARATIVE EFFECTS OF TWO PROBLEM- SOLVING MODELS ON.....

Table1:
ANCOVA Computation on effects of two problem-solving models on students' performance in Mathematics Word Problems involving Bearing

Sources	Type III sum of square	Df	Mean square	F	Significant
Corrected Model	1326.4339	2	663.217	23.261	0.000
Intercept	46948.050	1	46948.050	1646.642	0.000
Method	1326.433	2	663.217	23.261	0.000
Error	5046.517	177	28.511		
Total	53321.000	180			
Corrected Total	6372.950	179			

R Square =0.208 (Adjusted R Squared = 0.199)

Table 2 shows that post-test mean score of Polya, and Bransford and Stein is - 2.92 at 0.013 significant level. Since 0.013 is less than 0.05 level of significance, it implies that significant difference in performance of students exist between the two instructional models. Also, respectively between Bransford and Stein and the other methods, Polya and the conventional method showed that there exist a significant difference, this was based on the p-value of 0.13 and 0.001 which was less than $\alpha = 0.05$. Also, the post-test mean scores of 2.92 and 6.63 indicated significant difference between Polya and Bransford and Stein, and the conventional method respectively when compared with the P-value of 0.013 and 0.000 which are less than 0.05 level of significant. lastly, the post-test mean score differences of -3.72 and -6.63 between conventional method and Bransford and Stein, Polya method difference, with suggested P-value of 0.001 and 0.000 level at 0.05 level of significance. In conclusion, the table indicated that students exposed to the Polya model performed significantly better followed by those exposed to the Bransford and Stein model and those exposed to the conventional method had the least performance.

Table 2
Test for significant difference between the post-test mean scores on exposure to Stein, Polya and the conventional methods.

Instructional Method	Instructional Method	Post-test mean score difference	Standard error	Significance
Bransford and Stein	Polya	-2.92*	0.975	0.013
	Conventional	3.72*	0.975	0.001
Polya	Bransford and Stein	2.92*	0.975	0.013
	Conventional	6.63*	0.975	0.000
Conventional	Bransford and Stein	-3.72*	0.975	0.001
	Polya	-6.63*	0.975	0.000

Research Question2: Is there any difference between the performance of male and female students taught with Bransford and Steins (1984) Model?

Hypothesis 2: There was no significant difference in the performance of male and female students exposed to Bransford and Steins (1984) instructional model in Mathematics Word Problems Involving Bearing.

R Square = 0.809 (Adjusted R square = 0.802).

From the table 3, the p-value 0.790 was obtained and was greater than $\alpha = 0.05$ therefore, hypothesis two was not rejected. This indicated that there was no significant difference between the performance of male and female students taught with Bransford and Steins' model in the Word Problems involving Bearing Mathematics.

COMPARATIVE EFFECTS OF TWO PROBLEM- SOLVING MODELS ON.....

Table 3:
ANCOVA computation on the effect of gender on Bransford and Stein's instructional model on the performance of student's in Mathematics Word Problems Involving Bearing.

Source	Type III sum of Squares	Df	Mean Square	F	Significance
Corrected Model	987.634*	2	493.817	120.831	0.000
Intercept	4771.629	1	4771.629	1167.561	0.000
Pre-test	986.733	1	986.733	241.442	0.000
Gender	0.291	1	0.291	0.71	0.790
Total	17391.000	60			
Corrected Total	1220.583	59			

R Square=0.809 (Adjusted R Square=0.802)

Research Question 3: Is there any difference between the performance of male and female students taught with Polya (1957) model?

Hypothesis 3: There was no significant difference in the performance of male and female students exposed to Polya (1957) instructional model in Mathematics Word Problems involving Bearing.

From table 4 the p-value of 0.889 was obtained and greater than $\alpha = 0.05$. This implies that hypothesis three was not rejected, meaning that there was no significant difference between the performance of male and female students exposed to the Polya model in solving mathematics Word Problems Involving Bearing.

Table 4: ANCOVA Computation of gender for Polya (1957) instructional model in Mathematics Word Problems Involving Bearing

Source	Type III sum of square	Df	Mean square	F	Significance
Corrected Total	3247.33	59			
Connected Model	1646.272	2	823.136	29.305	0.000
Intercept	4519.557	1	4519.557	160.902	0.000
Pre-test	1625.372	1	1625.372	57.865	0.000
Gender	0.551	11	0.551	0.020	0.889
Error	1601.052	57	28.089		
Total	2567.00	60			

R square = 0.507 (Adjusted R squared = 0.490).

R square = 0.810 (Adjusted R square = 0.799).

Research Question 4: Will there be any difference between the performance of science, Art and Commercial students taught with Bransford and Stein's (1984) model.

Hypothesis 4: There was no significant difference in the performance of Science, Art and Commercial students exposed to Bransford and Stein's (1984) instructional model in Mathematics Word Problems involving Bearing.

The p-value of 0.898 was obtained. Therefore, the hypothesis was not rejected. This indicates that there was no significant difference in the performance of the Science, Commercial and Art students using Bransford and Stein problem- solving model.

COMPARATIVE EFFECTS OF TWO PROBLEM- SOLVING MODELS ON.....
ANCOVA computation of student's performance based on the subject combination exposed to Bransford and Steins (1984) instructional model.

Sources	Type III sum of squares	Df	Mean square	F	Significances
Corrected model	988.2141	3	329.414	79.397	0.000
Intercept	3104.352	1	496.608	119.694	0.000
Pre-test (Covariate)	486.600	1	496.608	0.108	0.898
Error	232.342	56	4.149		
Total	17391.000	60			
Corrected Total	120.583	59			

R square = 0.810 (Adjusted R square = 0.799).

Research Question 5: Is there any difference between the performance of Science, Arts and Commercial students taught with Polya (1957) model.

Hypothesis 5: There was no significant difference in the performance of Science Arts and Commercial students exposed to Polya (1957) instructional model in Mathematics Word Problems Involving Bearing.

From the above table, the p-value of 0.000 was obtained. Therefore the hypothesis was rejected. This indicated that there was a significant difference in the performance of the Science, Commercial and Arts using Polya model.

Table 6:
ANCOVA Computation of Students performance based on the subject combination exposed to Polya instructional model

Sources	Type III sum of Square	Df	Mean Square	F	Significant
Corrected model	2140.266 ^a 4707.057	3	710.089	35.598	0.000
Intercept	653.033	1	4707.057	235.971	0.000
Pre-test (Covenanter)	484.546	1	653.033	32.735	0.000
Class	1117.067	2	242.272	12.145	0.000
Error	25674.000	56	19.948		
Total		60			
	3247.333				
Corrected Total		59			

R Squared = 0.656 (Adjusted R squared = 0.638).

SUMMARY OF THE MAJOR FINDINGS

Findings from the study are as follows:

1. Students exposed to Polya problem-solving model performed better in Mathematics Word Problems involving bearing than their counterparts exposed to Bransford and Stein model.
2. Students in the polya group also out performed students in Bransford and Stein, and the conventional groups.
3. Gender of the students exposed to the three models and their counterparts in the conventional group had no influence on their performance in mathematics word problems involving bearing.
4. Students' subject combination had significant effect on the performance of students exposed to Polya instructional model with the science students out performing their counterparts in commercial and Arts.
5. Students' subject combination had no significant effect on the performance of students exposed to Bransford and Stein model.
6. There was no interaction effect between the instructional models based on gender.

COMPARATIVE EFFECTS OF TWO PROBLEM- SOLVING MODELS ON.....

DISCUSSION OF THE FINDINGS

The findings of the study showed that Students taught using Polya's problem-solving instructional model performed better in the Bearing post-test administered than their counterparts taught using Bransford and Stein problem-solving model. This shows that the Polya problem-solving model is the most effective method of instruction out of the three instructional models used in the study. This finding was in line with the findings of Galadima (2002) and Suleman (2010)

The experimental group taught using Bransford and Stein model was the next group that performed higher in Bearing post-test administered, while the control group that was taught using the conventional method had the lowest performance. In the administered Bearing pre-test instrument, the sampled students for the study could not interpret the concepts involving language (technical terms) in bearing correctly, which could be responsible for the students' poor performance in the pre-test administered to them. For instance, some of the students scored zero in the pre-test.

In this study, three instructional models were employed to teach bearing word problems in mathematics. Findings showed that the two problem-solving models of Polya, and Bransford and Stein are effective models of teaching than the conventional method. Further, the study revealed that there was significant difference in the performance of male and female students taught using the two problem-solving models of Polya, and Bransford and Stein in Bearing post-test. The finding conform with the findings of Salman (1998), Galadima (2002), Olawoye (2006) and Suleman (2010). Therefore, both males and females benefited from Polya, Bransford and Stein models of problem-solving.

Also, the performance of science, Art and Commercial Students taught using the two problem-solving models of Polya, and Bransford and Stein in the post-test on bearing is significantly different with the Science students performing best followed by Commercial and Arts respectively. Therefore, the students' subject combination had effect on their performance in bearing word problems. This finding is in agreement with the findings of Salman (1998).

CONCLUSION

The findings of the analyzed results showed that problem-solving models of instructions could enhance students' academic performance better in bearing word problems than the control group. It could be concluded that the Polya and Bransford and Stein models of problem-solving with more emphasis on teaching the technical terms improved students' performances in Mathematics Word Problems Involving Bearing. This implies that problem-solving models explored in this study appeared to have improved students to retain the learned materials. Also, gender had no influence on the performance of students taught using the instructional model of Bransford and Stein. The findings also revealed that subject combination (Science, Arts or Commercial) of Students had significant effects on the performance of students taught using polya instructional strategy while it has no effect on the performance of students taught using Bransford and Stein model in words problem involving bearing in mathematics.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made :

1. Polya problem-solving model should be used by mathematics teachers to teach Mathematics Word Problems Involving Bearing in Nigerian Secondary Schools because it enhances students' performance when solving bearing word problems.
2. The Mathematics teachers should take time to teach Mathematics language in Bearing before teaching the actual concept because it enhances better transformation of the word expression into mathematical expression.
3. Teachers should place more emphasis on the use of the instructional models for Arts and Commercial Students when using various problem-solving models to enhance better performance of all students in solving word problem involving bearing.
4. Mathematics Textbook authors should endeavor to employ Polya and Bransford and Stein problem-solving models in their solved examples to enhance understanding, meaningful and correct interpretation of bearing problems in word expression into mathematical expression.
5. Regular workshops, seminars and symposia on use of instructional models in general and polya and Bransford and Stein in particular should be organized by the ministry of education and other stakeholders for secondary school mathematics teachers in other to enhance their methodological skills.

REFERENCES

- Ameen, S. K (2007). *Effect of Mathematical Language Instruction on Senior Secondary School Students' performance in Bearing Word Problems in Mathematics*. An unpublished M. (Ed) Thesis, University of Ilorin, Ilorin.
- Ameen, S. K. (2013). *Comparative effects of two problem-solving models on Nigerian Secondary School Students performance in Mathematics Word Problems*. An unpublished Ph.D Thesis, University of Ilorin, Ilorin.
- Bransford J. & Stein B. (1984).The ideal problem-solving. A guide for improving thinking learning and creativity, New York W. H Freeman Deb (2003) problem-solving strategies. Retrieved on 7th March, 2007.<http://math.about.com/cs/tetprep/rs.htm>.
- West African Examinations' Council (1999). *Chief Examiners' Report May/June Yaba Lagos, Nigeria*.
- West African Examinations' Council (2006). *Chief Examiners' Report May/June Yaba Lagos Nigeria*.

COMPARATIVE EFFECTS OF TWO PROBLEM- SOLVING MODELS ON.....

- Funkhouser, C. P. (1990). The effect of problem-solving software on the problem-solving ability of secondary school students'. *Dissertation Abstracts International* 5(71) 23.
- Galadima, I. (2002). The Relative Effects of Heuristic Problem-Solving Instruction on Secondary Students Performance on Algebraic Word problem(.ABACUS). *Journal of Mathematical Association of Nigeria* 27 (, 57-65.1)
- Odili, G. A. (1990). An evaluation of Mathematics skill of Junior Secondary School Students in Rivers State Schools. *ABACUS. (Journal of the Mathematical Association of Nigeria, 20 (1) 11-17.*
- Olawoye, F.A. (2006). *The Relative Effect of Polya and Schoenfeld Problem- Solving Instructional Strategies on Senior Secondary Student's Performance in Mathematics in Ilorin.* Unpublished ph.D Thesis. University of Ilorin, Ilorin.
- Polya, G. (1957). *How to solve it.* Princeton (2nd edition). N.J. Princeton University press.
- Salman, M.F. (1998). *Effects of Mathematics Language as Advance Organizer on Senior Secondary School Students. Performance in Mathematics word problems.* Unpublished ph.D Thesis. University of Ilorin, Ilorin.
- Suleiman, B. (2010). *Effects of Polya, Gick and Bransford and Stein problem-solving models on students' performance in Statistics Word Problems.* Unpublished Ph.D. Thesis University of Ilorin, Ilorin.