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Improving Students' Interest in Solving Algebraic Word Problems Using Aesthetic Value Approach

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Abstract: This study determined the effectiveness of Aesthetic Value Approach (AVA) in improving SS1 students' interest in solving algebraic word problems. It adopted a quasi experiment of non- equivalent control group design .A sample of 240 SS1 students from six intact classes randomly drawn from three coeducational secondary schools in Makurdi LGA of Benue State were involved in the study. An Interest Inventory on Algebraic Word Problem Solving (AWPSII) developed by the researchers was used for measuring students' interest. The reliability coefficient of AWPSII was 0.67. Mean and Standard deviation were used to answer the two research questions while ANCOVA was used to test the three null Hypotheses at $p<0.05$. The study, among other things, revealed that students taught algebraic word problems using Aesthetic Value Approach(AVA) showed significantly higher interest than those taught the same topics with Conventional Method($F_{1,0.239}$ = 157.085, $p<0.05$). Aesthetic Value Approach (AVA) favored male students more significantly than their female counterparts ($F_{1,0.239}$= 9.627, $p<0.05$). It was therefore recommended among others that teachers of mathematics should adopt Aesthetic Value Approach (AVA) in teaching mathematics concepts since AVA was found effective in improving students' interest in algebra.

Key words: Aesthetic value, algebraic word problem, interaction effect, mean interest, stimulating experience and students' interest

INTRODUCTION

Everybody has one complain or the other against the teaching or the learning of mathematics. Students complained that mathematics is dull, boring, difficult, useless, and too far obsolete in activities and too remote from life to interest them. The teachers complain of excessive workload and lack of facilities in the form of teaching aids and equipments. The Headmasters/Principals and Management complain that problems experienced in mathematics are caused by teachers who do not make students work hard enough/put adequate effort in teaching and learning of mathematics.

One is worried about these complaints knowing the consequences of such comments on the advancement of science, technology, economic and industrial development of the country. Mathematics is the bedrock for economic, scientific and technological advancement of any progressive nation. A nation that neglects this standard is heading to a ruin.

Available records show that researchers have tried to identify the possible causes/reasons for such complaints among students, teachers and managements. They have identified unsatisfactory performance of students (Obodo, 2004) in recent times as a result of using inappropriate teaching method, teachers' attitude, employment of unqualified mathematics teachers, lack of interest among students just to mention a few (Obodo, 2004; FME, 2004; Abakporo, 2005). Literature has showcased ceaseless/ relentless efforts made by researchers to address the root cause of this situation in mathematics for the betterment of the country on the side of teachers, students and management. Such research efforts include works of Harbor-Peters (2002), Iji (2005) and Okolo (2007).

Available records have shown that researchers have discovered series of teaching approaches like guided inquiry, target approaches (Harbor-Peters, 2002), use of logo (Iji, 2005) and ethnomathematics approach (Kurumeh, 2007) to alleviate students' problems, arouse their interest and hence facilitate better and higher performance. These efforts were made with the hope that improving their interest will facilitate better performance in mathematics. Yet a lot is still left to be done to stimulate students' interest. This must have been because teachers have failed to use those innovative approaches or they failed to use them properly. They must have failed to use these approaches either due to logistics or due to financial implications for the provision of essential materials needed for the teaching of mathematics.

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None of these researchers, had tried teaching mathematics using the inherent nature of mathematics as an esthetic subject. There is however a wide speculation that exposing students to the beauty (beautiful values), elegance and order inherent in mathematics, may uplift generate and arouse their interest, change their attitude towards mathematics thereby improving achievement (Kurumeh, 2007). A contrary view however is shared by some philosophers and anthropologists like –Russell, Whiteheads and Plato. They are of the opinion that mathematics is an abstract subject and therefore incapable of generating any aesthetic values which when exposed to learners would bring conflict in the classroom. These speculations are not backed up by any empirical evidence in which case therefore the exact role of infusion of aesthetic values into mathematics instruction on students' interest in mathematics is still in doubt. A major issue of academic concern at this point is; what would be the effect of Aesthetic Values Approach (AVA) on students' interest in mathematics. This study therefore is faced with the problem of evaluating effectiveness of AVA in relation to interest in mathematics, particularly algebraic word problems.

Aesthetic Value Approach is minds-on, hands-on and students' and activity – centered approach which could reduce the students' problem of failure in mathematics to a manageable rate. This is the vehicle through which the teacher leads his students in pursuit of educational objectives (Ohuche and Ali, 1989). It is a mode of teaching that allows the learner to experience knowledge and reality in a way different from scientific approach. It allows students to experience the essence of mathematics with greater interest from a different perspective. It maximizes how one could experience and interpret the world mathematically (Eisner, 1985). This approach gives mathematics its beauty and elegance .It uses the aesthetic value, beauty and elegance which are the qualities of mathematics to expose topics to the learners in a mathematics classroom (Okolo, 2007). With this approach, the aesthetic experience which students lack in today's classroom could be returned. Such experiences include joy with greater enthusiasm and interest of participating in solving mathematics problems, artistic nature, satisfaction, order, beauty/ test of beauty and pleasure. This approach leads students to discover mathematics and mathematics topics while engaged in arts enriched program activities (Armshead, 1996; Kurumeh, 2006).

According to Eisner (1985), AVA is fundamental to the activities of a mathematician for it provides coherence to mathematical knowledge, thus increasing learners' appreciation, interest and understanding of mathematics. It is a motivator that moves students to a topic of study, challenges the doctrine that textbook information is sacred. It is a way of seeing the big picture of mathematics topics and promotes more meaningful learning with stimulated interest. It provides a reward for learning that would be more sustaining than satisfaction from test scores namely the joy of learning. It motivates students' learning and enjoyment in mathematics. The test of beauty, joy, pleasure and satisfaction exposed by this approach, generate, stimulate and arouse students' interest in solving mathematics problems especially those of algebraic word problems. This type of interest generated is very lasting that the previous idea that mathematics is abstract is reduced to minimal or almost completely wiped away. The aesthetic joy and satisfaction felt by students give value to mathematics problem solving. Its experience demystifies mathematics, stimulates and arouses students' interest and makes mathematics accessible to all learners. Success for all learners of mathematics requires recognition that learners can and should engage in the interesting activities of mathematics especially the type that can be provided by this AVA. Its enjoyable activities stimulate, arouse and sustain a lasting interest in the learner in mathematics so that they become very enthusiastic in attempting mathematics tasks leading to better, higher and improved performance.

Mathematics and teachers of mathematics hold the key to national development. Yet, the same mathematics has one of the highest failure rates in all public examinations right from common entrance examination into Junior Secondary School, to Senior School Certificate Examination (SSCE), to National Examination Council (NECO) examination and Universities Matriculation Examination (UME). This is because students are afraid of mathematics, and are not interested in studying it since they believe that mathematics is difficult to understand , coupled with the fact that it is not handled properly in classroom by the teachers. The researchers believe that, if students are given the opportunity to experience mathematics aesthetically during mathematics lesson, their interest will be aroused, stimulated and kindled in studying mathematics and in solving mathematics problems. The interest which this approach will generate will lead to students working harder, spending more time and energy solving mathematics problem since people spend time in things that interest them. When the generated interest is sustained, "mathematics phobia" and sense of difficulty in mathematics will vanish leading to greater positive productivity in mathematics examinations. It is against this background and to address these issues that this study is carried out.

The purpose of this study is to determine the effectiveness of Aesthetic value Approach (AVA) on students' interest in Solving Algebraic Word Problems and determine students' interest in Solving Algebraic Word Problems using Aesthetic Value Approach (AVA) on the basis of gender

The following research questions guided the study:

1. What is the difference in mean interest score of the experimental (AVA) and control groups of students taught Algebraic Word Problem?

2. What is the difference in mean interest score of male and female students taught Algebraic Word Problem using Aesthetic Value Approach (AVA)?

The following research hypotheses formulated were tested at $p<0.05$.

- There is no significant difference in the mean Interest scores of students taught algebraic word problem using Aesthetic Value Approach (AVA) and those taught algebraic word problem solving using Conventional Method
- There is no significant difference in the mean interest score of male and female students taught algebraic word problem using Aesthetic Value Approach (AVA).
- There is no significant interaction effect of methods and gender on mean Interest scores of students in algebraic word problem using Aesthetic Value Approach (AVA).

MATERIALS AND METHODS

This study is quasi-experimental in nature. It was non-equivalent Pretest, Posttest Control group design. There was no randomization of subjects since this may disrupt school organization, hence, intact classes were randomly assigned to experimental and control groups, respectively.

The target population of this study was the SS1 students (2007/2008 session) in Makurdi Local Government Area (LGA) of Benue State, Nigeria. This population was also limited to only public and private co-educational secondary schools in this LGA. There are all together 42 Co-educational secondary schools in this LGA of Benue State (Ministry of education), Nigeria. From these 42 Co-educational Schools, only schools that have a minimum of two streams in SS1 classes and not less than 35 SS1 students per stream were selected for the study. To select the sample for this study, a simple random sampling technique was adopted. The sample size for this study comprised 240 SS1 students drawn from three out of the 42 co-educational schools in Makurdi LGA of Benue State. A total of six intact classes were used for this study.

In each school selected, two intact classes were drawn randomly and assigned to the experimental and control groups using simple balloting. The experimental group was taught algebraic word problem solving using Aesthetic Value Approach (AVA) while the Control group was taught the same topic using Conventional Approach (CA).

One research instrument (an Interest Inventory) and two lesson plans prepared by the researchers were used for this study. The research instrument, by name Algebraic Word Problem Solving Interest Inventory (AWPSII) was used to measure students' Interest before and after the teaching as Pre- test (Pre-AWPSII) and Post-test (Post-AWPSII) respectively. The two lesson plans were made up of:

- Conventional lesson plan
- Experimental lesson plan prepared by the researcher for teaching the experimental groups respectively.

The Interest Inventory instrument, Algebraic Word Problem Solving Interest Inventory (AWPSII) consisted of 20 out of 35 multiple choice questions that survived validation. To develop AWPSII, the researchers selected topics in algebraic processes from SS1 scheme of work for the session and prepared the table of specification (test blueprint) to guide the development. The 60:40 ratio for Higher Order processes and Lower Order ability processes recommended by National Policy on Education (Obodo, 2004) for senior secondary classes was taken into consideration while preparing the test blueprint. This AWPSII was used for the study as pretest and post test before and after the experiments, respectively to measure students' Interest. The Pre-AWPSII was used to ascertain the level of students' algebraic Interest before the treatment, while Post-AWPSII was used to determine the extent of students' algebraic interest after the treatment. The Pre-AWPSII and Post-AWPSII are the same in content but differs in arrangement and structure.

The lesson plans for the experimental group was prepared by the researchers based on Aesthetic Value Approach (AVA). This took into consideration all the variables, statements, expressions and elements of aesthetics, beauty and pattern found in algebraic processes. While lesson plans for the control group was written in the conventional way of preparing lessons. The lesson plans for both the experimental and control groups retained the same contents. They were based on algebraic word problem solving contents for SS1 that were taught during the period covered by this study.

The Interest Inventory-AWPSII, the lesson plans and the test blueprint were all face and content validated by three experts in measurement and evaluation and three experts in mathematics education. They were instructed to check for the language level, relevance, ambiguity, plausibility, vagueness and content coverage of the instruments for this study. Their criticisms, advice, suggestions and recommendations were used to modify AWPSII and the lesson plans. At the end of validation, 20 out of 35 initial questions survived which was finally used for the study. The reliability of AWPSII was determined using Kuder-Richardson (21). The reliability coefficient of internal consistency of AWPSII was 0.67. This is high enough considering the nature of the instrument (Ali, 2006).

In conducting this study, two intact classes were randomly selected from each of the three schools used. These classes were randomly assigned to experimental and control groups by balloting. Before the treatment commenced, both the subjects in the experimental and the control groups were administered the Pre-AWPSII and the

paper collected instantly. This test was marked and the results kept for further analysis. The actual teaching started the following day. The teaching of Algebraic Word Problem to both the experimental and the control groups took place in different schools within the same session. The normal 40 min lesson period was used. The regular mathematics class teachers were used as research assistant in each of the schools and were supervised by the researchers. These teachers were given training on what they were expected to do for one week. In the experimental group, the teachers tried in exposing the aesthetic values and the beauty found in algebra and in algebraic processes to the students. This actually aroused their interest greatly in the lesson that at the end of each class, students were unwilling to end the lesson each time. Their participation in group discussion was highly commendable. The study lasted for four weeks of five periods of 40 min per lesson. At the end of twenty lessons taught, the interest inventory was administered as Post-AWPSII to both subjects of experimental and control groups. The AWPSII was collected and used for analysis. The training of the teachers and the use of the regular mathematics teachers were all in attempt to avoid experimental bias.

Data collected using AWPSII was analyzed according to research questions asked and hypotheses formulated. Mean and standard deviation were used to answer the research questions while analysis of covariate (ANCOVA) was used to test the null hypotheses at $p<0.05$.

RESULTS

Results of data analysis due to the outcome of this study are presented below according to research questions and associated hypotheses.

It is observed from Table 1 that before the commencement of the treatment, the subjects for the experimental and control groups had different mean interest score (14.42 and 16.13, respectively), showing that they were at different levels of Interest in algebraic word problem. The experimental group students' post-interest (Post-AWPSII) appeared to have a much higher mean interest score (64.43) than their control counterparts who scored 42.29. This seems to suggest that the students taught using Aesthetic Value Approach (AVA) appeared to have higher mean Interest score than their control group counterparts. This difference in mean interest scores between the experimental and the control groups is significant at $P<.05$ as seen from Table 2 in favor of Aesthetic Value Approach (AVA). Hence, the null hypothesis of no significant difference in mean Interest scores is rejected,

Table1: Mean interest scores and standard deviation of experimental and control groups in pre- and post-AWPSII.

Teaching Method	Type of Test	Sex	N	Mean	SD
Conventional					
	Pretest	Male	60	13.40	07.01
		Female	60	15.44	10.23
		Total	120	14.42	08.23
	Posttest	Male	60	43.80	15.54
		Female	60	40.80	15.35
		Total	120	42.29	15.43
Experimental					
	Pretest	Male	60	17.60	10.61
		Female	60	14.65	11.61
		Total	120	16.13	11.11
	Posttest	Male	60	68.62	9.06
		Female	60	60.23	12.87
		Total	120	64.43	11.86

From the result of the data analysis in Table 1 and 2, it is revealed that male students had higher mean interest score (68.62) than their female counterparts (60.23) in posttest experiment. Both male and female students had high mean Interest scores in Post-AWPSII. The difference in their mean Interest score seems to favor the males using Aesthetic Value Approach (AVA). This difference in gender was found to be significant at $p<0.05$. This led to the rejection of the null hypothesis of no differential effect on gender.

There is interaction between method and gender (method*gender) though this interaction is not statistically significant at $p<0.05$ as observed from Table 2 measured using students' mean interest score in algebraic word problem. Based on this then, the null hypothesis of no significant interaction between method and gender is not rejected at $P<0.05$.

DISCUSSION

The result of data analysis and testing of hypotheses in Table 1 and 2 showed that statistically significant difference existed in the mean interest scores of experimental group and control group in the Post-AWPSII using ANCOVA. This significant difference is in favor of

Table2: ANCOVA results on students' post Interest scores (POSTAWPSII)

Source of Variation	Sum of Squares	DF	Mean Squares	F	Sign.	Decision P<.05
Corrected Model	31780.217	4	7945.054	43.657	.000	S
Intercept	156572.397	1	156572.397	860.349	.000	S
Pretest	5.733	1	5.733	.032	.009	S
Method	28587.236	1	28587.236	157.084	.000	S
Sex	1751.962	1	1751.962	9.627	.002	S
Method*Sex	435.460	1	435.460	2.393	.123	NS
Error	42766.967	235	181.987			
Total	757854.000	240				
Corrected Total	74547.183	239				

NS=Not Significant S=Significant at P<.05.

the experimental group. This finding is in agreement with the suggestion made by Okolo (2007), who suggested that the use of this approach to teach mathematics topics would go a long way to capture students' interest thereby resulting in improved achievement and interest. Moreover, Eisner (1985) believes so much that when students are made to enjoy the beauty and elegance found in mathematics, they will surely change their attitude and show more interest which will result in improved achievement in the long run. The abstractness reduced in algebraic processes made the students not only to enjoy the lesson, but see reason to make effort to master each day's lesson by finding time at leisure to do their assignment at home. So the learning did not end in school but continued at home (Kurumeh, 2007).

Furthermore, it was observed in Table 1 that the male students obtained higher mean interest scores (68.62) than their female counterparts (60.23) in the experimental treatment. This mean difference in their interest was found to be statistically significant at $p<0.05$. This means that the male students benefited more than their female counterparts using Aesthetic Value Approach (AVA). This finding is in line with the saying of Nelson (2000) who posited that the essence of mathematics is aesthetic and beauty, and if such values are exposed, students will really be committed and involved. This really happened in this study. This supports the findings of Imoko (2006) which posits that new approach evokes interest in students. The beauty and aestheticisms exposed in algebra helped to reduce the abstractness usually associated with algebra. When the abstraction in algebra is reduced, the students began to understand the mathematics around them, interest developed and fear reduced resulting in more participation, involvement and taste in the course resulting in higher achievement. That the males scored higher is not by chance because they love and admire beauty while females build up the beauty (Kurumeh, 2007). A remarkable notice of this study is that this approach has shown to be effective in improving students' mathematics ability irrespective of gender as observed in Table 1. Both sexes had their achievement and interest improved though the males were favored more than the females. This is contrary to the findings of Kurumeh (2007) who found female students showing more interest than their male counterparts, but in agreement with that of Imoko (2006). Though these approaches were new and innovative, their mechanisms are different.

CONCLUSION

Based on the results of data analyzed for this study, the following major findings are made:-

- Using AVA in teaching in teaching algebraic word problem solving .proved more effective in arousing and facilitating students' interest.
- The use of AVA in algebraic processes favored male students more than their female counterparts.
- AVA is a viable method of teaching school mathematics.

From the findings of this study, we have come to the conclusion that students will like and show interest in mathematics if the values, beauty, utility, aestheticism, elegance and order in mathematics, are exposed by the teachers using AVA. This interest will lead to more commitment to the study of mathematics resulting to better achievement and interest in mathematics. The onus now lies on teachers to expose those values especially aesthetic, beauty and elegance of mathematics as it is seen around us and our environment. This beauty is not far fetched since mathematics is virtually found in every activity in the world. In short, using AVA improves students' interest particularly with the males in mathematics.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations become very essential and immediate:

- Teachers should bring the beauty, joy and aesthetic values of mathematics into every topic they are to teach in all mathematics classrooms. This, they should do by exposing students to what they are to teach, by using things in the environment (concrete) to bring out the joy of mathematics. They should equally use such practices that expose aesthetic values and usefulness of mathematics in the classroom lessons not only when teaching algebra, but when teaching topics in other branches of mathematics.
- The planners of mathematics curriculum should include aesthetic values approach components in different topics students are expected to learn in the curriculum.
- Mathematics Association of Nigeria and Science Teachers Association of Nigeria should organize conferences and workshops where these new innovative approaches especially AVA in mathematics teaching, will be exposed to teachers for better application and subsequent improvement in students' mathematics achievement and interest.
- The government while making mathematics compulsory in primary and secondary schools should use its aesthetic value, importance and usefulness in life to explain and convince the learners to make effort to learn it. This should be done the same way they convince people to vote for their leaders even when those leaders have failed the general public.

REFERENCES

Abakporo, J.E., 2005. Effective problem solving in mathematics: Challenges and Prospects. J. Issues Math., The Annual Publication of Mathematics Panel of Science Teachers Association of Nigeria, 8(1): 19-33.

Ali, A.A., 2006. Conducting Research in Education and the Social Sciences. Enugu:Tashiwa Networks Ltd.

Armshead, M.E., 1996. Constructivism on arts based programs. A Paper Presented at National Association of Early Childhood Educators Conference, June 5, Minneapolis, MN.

Eisner, E., 1985. Aesthetic Mode of Knowing. In: Learning and Teaching the Ways of Knowledge. Eisner, E. (Ed.). Eighty-fourth Yearbook of the Society for the Study of Education, Path 11, Chicago IL: The University of Chicago, pp: 23-36.

Eisner, E., 1988. The role discipline-based art education in America's schools. The Getty Centre for Education in Arts. Los Angeles CA., pp: 47.

FME, 2004. Federal Ministry of Education: National Policy on Education, Yaba.

Harbor-Peters, V.F.A., 2002. Attitudes and Interest of Students to the Mathematical Sciences in Nigeria. A Commissioned Paper Presented to Mathematical Science Educators' Summit 2002 Organized by NMC, Abuja on Improving the Attitude of Mathematical Science Educators in Nigeria, 4th-5th Oct.

Iji, C.O., 2005. Effects of Logo and basic programs on students' achievement in Junior secondary school geometry. ABACUS., 30(1): 67- 77.

Imoko, B.I. and U.N.V. Agwagah, 2006. Improving Students' Interest in Mathematics Through the Concept Mapping Technique: A focus on gender. J. Res. Curr. Teach., 1(1): 30-38.

Kurumeh, M.S., 2006. Effects of Ethnomathematics approach on students' achievement in geometry and mensuration. ABACUS., 31(1): 67-79.

Kurumeh, M.S., 2007. Effect of Ethnomathematics approach on students' interest in geometry and mensuration. ABACUS., 32(1): 103-115.

Nelson, R., 2000. Proofs without Words II: More exercises in visual thinking. USA: MAN.

Obodo, G.C., 2004. Principles and Practice of Mathematics Education in Nigeria: Floxtone Press.

Ohuche, R.O. and A.A. Ali, 1989. Teaching Senior Secondary Mathematics Creatively: A Book of Methods Onit, Sha: Summer Education Publishers Ltd.

Okolo, P.A., 2007. Aesthetic Value of Mathematics: Implication to Mathematics Educators. A Paper Presented at the 44th Annual Conference of MAN held at FCE (Tech) Asaba, Delta State, Nigeria.