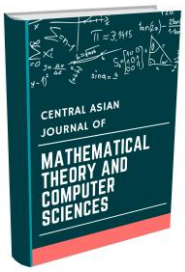

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Article

Effectiveness of the Use of Concept Attainment Model on Senior Secondary One Students' Achievement in Mathematics in Lokoja Metropolis, Kogi State, Nigeria

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Abstract: The purpose of this study was to find out the effectiveness of Concept Attainment Model on students' achievement in algebra at senior secondary school one. The research was carried out in Lokoja Metropolis of Kogi State with a population of 1210 senior secondary one students. 356 SS1 students were sampled out of 1210 students. Quasi-experimental design of nonrandomized pre-test post-test control group design was adopted. The Instrument of the study was Algebraic Achievement Test (AAT) which was used for collection of data. The AAT was validated by experts and this gave a reliability index of 0.82. Two research questions were asked and answered using means and standard deviations. The two hypotheses formulated were tested at 0.05 level of significance using Analysis of Covariance. The study found among others that the students taught using Concept Attainment Model (CAM) improved in their achievement than those taught without CAM. It was therefore, recommended that Curriculum planners and mathematics textbook writers should be encouraged to include CAM in their books as complementary to other teaching methods.

Keywords: Algebraic, Students' Achievement, Concept Attainment Model

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1. Introduction

Mathematics knowledge and skills are a precursor of scientific discoveries and inventions. The learning of mathematics has become imperative in every society if the citizens are to cope with the fast changing development in science and technology. The importance of mathematics to man may account for its inclusion in school curriculum as a compulsory subject for every child of school age to acquire the appropriate mathematical knowledge that enable him cope with life challenges in everyday life. The Information Technology (IT) of today has transformed the world into a global village. These advances in science and technology are made possible by the numerous developments in pure mathematics (Salman, 2005). One of the main objectives of teaching and learning of mathematics is to prepare students for successful living. Students can develop their

knowledge, skills; logical and analytical thinking while learning Mathematics (Federal Republic of Nigeria, 2005) This acquired knowledge can lead them to enhance their curiosity and ability to solve problems in almost all fields of life. This is why Nurudeen (2007) posits that mathematics is the mother of all learning and the queen of all sciences. Explicitly, Abakpa and Agbo-Egwu (2007) assert that mathematics is an important tool for the overall development of the individual in the conduct of his daily activities in the society; it builds the individuals' intellectual instincts, scientific and technological potentials for the advancement of science and technology in the society.

Algebra, the language of symbols and relations (Odili, 2006), is characterized as generalized arithmetic and the backbone of school mathematics. According to National Council of Teachers of Mathematics (NCTM, 2000), algebra is the language through which most of mathematics is communicated. It also provides a means of operating with concepts at an abstract level and then applying them, a process that often fosters generalizations and insights beyond the original context. In recognition, recently in 2007, algebraic processes have been enshrined in the Upper Basic Education (JSS) mathematics curriculum as a theme. While in the senior secondary school (SSS) mathematics curriculum introductory calculus, modular arithmetic, and logic among others were enshrined. The reasons, apart from pursuit of academic excellence, may also be for preparing citizenry for today's technological society that has become so demanding for people with problem-solving capacities to solve the non-routine problems that occur on daily basis. According to Erbas (2004), without algebra, not only advancement into most areas of mathematics, but also study of other disciplines requiring mathematical abstraction and modeling are limited if not impossible.

Literature has revealed that students' low achievement in mathematics and especially algebra is due to non-utilization of manipulative materials in the classroom (Obioma, 2005; Aburime, 2007; Galadima & Okogbenin, 2012). According to Ukpebor and Omole (2012), factors that lead to students' poor performance in algebral include students' negative attitudes towards mathematics as a subject, students' negative attitudes to mathematics teacher, nature of mathematics, cultural bearing of the content, the teacher factor, poor student background in mathematics, lack of mathematics laboratory, negative attitudes of parents and guardians, and inappropriate methods of teaching mathematics. Oteze (2011) suggests that mathematics teaching should be structured such that knowledge is built on a foundation already possessed; encourage students to learn by doing, ensuring that learning grows out of useful experiences and experimentations, by effective use of concept attainment model that stimulate cognitive, affective and psychomotor domains' development. Based on the observed strong relation between taking algebra in the middle school and achievement gains in high school and lack of manipulative materials in the classroom among others, the current study explores the effects of concept attainment model on the achievement of secondary school student in algebra.

On the issue of gender differences on students' low achievement in mathematics, literature revealed conflicting findings. While some found no significant gender difference when concept attainment model was used in teaching and learning mathematics (Etukudo & Utin, 2006; Galadima & Okogbenin 2012), Sarah (2013) reported significant

gender difference favoring male in the pre- test, and in favour of female in the post-test while studying the gender difference in mathematics achievement in geometry using manipulative based instruction. According to Sarah, the female students scored less than the male students scores in the post- test which indicate that they have internalized the manipulative to a more abstract concept. In the same vein, Stoet and Geary (2013) analyzed data collected for one decade by the Programme for International Student Assessment (PISA) from 75 countries. They reported that, across nations, boys scored higher than the girls in mathematics. However, Spencer (2004), Osemmwinyen (2009) and Iwendi (2012) found no gender difference in the performance of male and female student in school mathematics. Contrary to these reports, Kurumeh (2004) and Gimba (2006) found that female students performed better than male students while exposed to geometry, menstruation and 3 – dimensional mathematics instructional materials respectively. There was considerable variation in the extent of the gender differences between nations.

Concept Attainment Model was developed by Bruner, Goodnow and Austine (1956).The model emerged out of the study of thinking process in human beings. It is based on the assertion that a human being is endowed with the capacity to discriminate and to categorize things in groups. This model is used for teaching concepts to the students. It enables them to understand fully the similarities and relationship among various things in the environment. Concept is a mental representation or a mental picture of some object or experience. It represents a category of objects which share common properties. Concept Attainment model is an indirect instructional strategy that uses a structured inquiry process. In concept attainment model, students figure out the attributes of a group or category that has already been formed by the teacher. To do so, students compare and contrast examples that contain the attributes of the concept with examples that do not contain those attributes. Concept Attainment Model provides guidance to the teacher as well as to the students to reach the goals of instruction (Joyce, Weil, & Calhoun, 2006).

Achievement on the other hand is the measurement of accomplishment in a specific field of study (Elliot, Kratochwill, Cook & Travers, 2002). In algebra achievement is therefore the demonstration of the learner's ability to attain certain level of instructional objectives out of classroom experience. Low achievement in mathematics which could be due to poor achievement in algebra aspect of mathematics in public examinations has been a source of worry to the public and mathematics educators in view of the premium attached to algebra as a vital tool for the development of individuals and the society at large (Agwagah, 2005). Review of studies show inconsistency on results of male and female students' achievement in mathematics achievement tests. Studies by Zhang and Manon (2000), Johnson (2000), all show no significant differences in mathematics achievement between boys and girls. Jahun and Momoh (2001), Mullis (2002) and Koller, Baumert and Schnabel (2006) on the other hand indicated sex differences in favour of boys. Specifically most of these studies did not examine the achievement of male and female students in algebra but rather on mathematics in general. Thus, this study investigates if males and females will benefit equally in algebra achievement test when taught using CAM. The results of gender differences in knowledge retention and achievement seem to be conflicting with each other. This study will therefore endeavour to ascertain if male and

female students' differences exist in achievement in algebra when concept attainment model is applied.

2. Purpose of the Study

The purpose of this study was to determine the effectiveness of concept attainment model (CAM) on students' achievement in algebra. Specifically it;

1) Determine whether the Senior Secondary School One students will improve on their achievement in algebra when taught using concept attainment model.
2) find out if male and female students' achievement in algebra would improve when taught using concept attainment model.

3. Research Questions

The following research questions were considered for this study:

1) What are the mean achievement scores of SS 1 students taught algebra using concept attainment model and those taught algebra using lecture method?
2) What is the mean achievement scores of male and female students taught algebra using concept attainment model?

4. Research Hypotheses

The following null hypotheses were tested at 0.05 level of significance.

1) There is no significant difference between the mean achievement scores of SS 1 students taught algebra using concept attainment model and those taught with lecture method.
2) There is no significant difference between the mean achievement scores of male and female SS 1 students taught algebra using concept attainment model.

5. Methodology

The research design for this study was quasi-experimental. Precisely, the study used a non-randomized pre-test post-test control group design. The subjects of the study were not randomized into experimental and control groups but were left as intact classes. This was to avoid the disruption of the school programmes. However, the study was conducted in Lokoja Metropolis, Kogi State, Nigeria. The population of this study was 1210 Senior Secondary School One Students in the study area. The sample of this study consists of 356 SS1 students chosen out of the target population of 1210 students. The sample comprised 178 male and 178 female students. Two schools were selected through the purposive sampling techniques, one for the experimental (treatment) group and the other for the control group. In addition, The SS1 Students were used because this is the class where vigorous academic work begins and the students undergo the study of Algebra. The Instrument of the study was Algebraic Achievement Test (AAT). It consisted of 25 items made up of 10 lower order questions and 15 higher order questions. These items were developed in line with the instructional objectives as contained in the senior secondary one text book by the Mathematics Association of Nigeria (2012). AAT covered all the units taught during the period of this study. It was validated by one mathematics teacher and two mathematics educators. It has a reliability index of 0.82, established using Kuder-Richardson (KR-20) formula. The researcher and the assistant administered the pre-test for all the Senior Secondary One (SS1) students in the schools before the teaching, after four weeks of teaching a post test was administered. Data collected and collated were analyzed using mean, standard deviations and Analysis of Covariance (ANCOVA). The choice of ANCOVA for the test of hypotheses was based on it statistically removes the

initial differences across the non-randomized group by variation due to extraneous variable, thereby increasing the precision of the experiment.

6. Results

The results from analysis of data for this study are presented according to the research questions asked and hypotheses formulated.

Research Question 1

What are the mean achievement scores of SS 1 students taught algebra using concept attainment model and those taught algebra using lecture method? Answer to this research question is presented in Table 1.

Table 1. Means and standard deviations achievement scores of ss1 students taught algebra using cam and lecture method

Group	N	Pre-test		Post-test	
		Mean	SD	Mean	SD
CAM	172	8.18	3.02	18.72	1.85
Lecture Met.	184	8.44	3.11	14.15	3.76
Mean Diff.		**0.26**		**4.57**	
Total	**356**				

Table 1 showed that for post-test, the CAM had a mean score of 8.18 while the control had a mean score of 8.44. Their mean difference is 0.26. For post-test scores, the CAM has a mean score of 18.72 while the control group had a mean score of 14.15. Their mean difference is 4.57.

Research Question 2

What are the mean achievement scores of male and female students taught algebra using concept attainment model? Answer to this research question is presented in Table 2.

Table 2. Differences in the mean achievement scores of male and female students taught algebra using cam

Group	N	Pre-test		Post-test	
		Mean	SD	Mean	SD
Male	87	8.92	2.94	19.02	1.83
Female	85	7.42	2.93	18.40	1.82
Mean Diff.		**1.50**		**0.62**	
Total	**172**				

Table 2 shows that for pre-test, the male had a mean score of 8.92 while the female had a mean score of 7.42. Their mean difference is 1.50. For post-test scores, the male has a mean score of 19.02 while the female group had a mean score of 18.40. Their mean difference is 0.62.

Hypothesis 1

There is no significant difference between the mean achievement scores of SS 1 students taught algebra using concept attainment model and those taught algebra with lecture method. The result of this hypothesis is presented in table 3.

Table 3. Ancova test on students' mean achievement scores of cam and lecture method in

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1900.351[a]	4	475.087	57.987	.000
Intercept	4610.166	1	4610.166	562.687	.000
Pre-Test	1900.351	1	1900.351	231.944	.000
CAM	**695.72**	**1**	**5695.72**	**695.193**	**.000**
Error	2900.368	353	8.193		
Total	101392.000	356			
Corrected Total	4800.719	355			

a. R Squared = .396 (Adjusted R Squared = .394)

aat

Table 3 shows that P- value of 0.00 was less than the significance level of 0.05. Since the p-value of 0.00 is less than the significance level of 0.05, the null hypothesis of no significant difference was rejected. This means that there is a significant difference between the mean achievement scores of SS1 students taught algebra using CAM and those taught without CAM.

Hypothesis 2

There is no significant difference between the mean achievement scores of male and Female SS 1 students taught algebra using concept attainment model. The result of this hypothesis is presented in table 4.

Table 4. Ancova test on students' mean achievement scores of male and female taught algebra using cam

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	338.281[a]	2	169.140	159.906	.000
Intercept	3984.574	1	3984.574	3.767E3	.000
Pre-test	316.948	1	316.948	299.643	.000
Gender	**.430**	**1**	**.430**	**.407**	**.525**
Error	178.760	169	1.058		
Total	61211.000	172			
Corrected Total	517.041	171			

a. R Squared = .610 (Adjusted R Squared = .605)

Table 4 reveals that the P-value of 0.525 was greater than the significance level of 0.05. Since the p-value of 0.525 is greater than the significance level of 0.05, the null hypothesis of no significant difference was not rejected. This means that there is no

significant difference between the mean achievement scores of male and female SS1 students taught algebra using CAM.

7. Summary Findings

Based on the analysis of data presented in this chapter, the following findings were made:

1) The mean achievement scores of the CAM group were statistically significant based on the SS1 Algebra topics taught. This implies that the CAM enhanced students' achievement in algebra than the lecture teaching method.
2) The female students improved more than the male students over their pre-AAT scores as indicated by their Post-AAT scores during this study. However, there was no much significant difference between the mean achievement scores of both sexes in the experimental group.

8. Discussion of Findings

The results show that the mean post-test achievement scores of the experimental and control groups were 18.72 and 14.15. These mean achievement scores are considered high meaning that the prior knowledge of algebraic content that was taught during the study among experimental and control groups was the same. The low mean scores exhibited showed that the subjects in this study were not actually exposed to the Algebra contents before the treatment. This indicates that CAM enhanced achievement of students in algebra better than the lecture method. This finding is in agreement with Wasike (2006) who found that the application of the concept attainment model in the course of teaching enhanced high school students' achievement in Physics in Mohindergran city. Also, Mayer (2012) support the use of concept attainment model in teaching high school Biology students in Bozeman, Montana. The reason for higher achievement in the CAM group compared with the lecture method may be due to proper explanation, application, student center and understanding of algebraic symbols, notations, vocabularies, formulae and terminologies which gave room to students' deeper understanding of the algebra concepts.

Besides that, the Post-AAT scores are 19.02 and 18.40 for the Male and Female students respectively in the experimental group. This implied that the CAM had brought about improvement in their mean achievement scores. This means that the male and female students in the experimental group performed well in the study of algebra concepts in the course of this study. This finding is in agreement with the research result of Abiam and Odok (2006) who found no significant relationship between male and female students' achievement in Number and Numeration. Algebraic process and Statistics. However, the finding is at variance with the research results of Olagunju (2001); Jahun and Momoh (2001); Koller, Baumert and Schnabel (2006) who all reported that boys had out performed girls in their study of mathematics.

9. Conclusion

It could be concluded in this study that the use of CAM in the teaching and learning of mathematics enhanced students' achievement in Algebraic irrespective of gender. This implies that if mathematics teachers use innovative teaching strategies such as CAM which is found to have enhanced students' achievement, the issue of low achievement in mathematics at the senior secondary school level could improve. Similarly, the gender gap

created by continued use of unfavourable teaching strategy in algebraic could also be bridged with CAM.

References

Abakpa, B.O. & Agbo-Egwu, A.O (2007). Improving the Teaching and Learning of Mathematics in Secondary Schools using the Collaborative Approach. In Adejoh, M.J. and Iji, C.O. (Eds) Innovations in Teaching and Learning. Makurdi. Adaka printing and publishing company limited. 334-343.

Abiam, P.O. & Odok, J.K. (2006). Factors in students' achievement in different branches of secondary school mathematics. *Journal of Education and Technology 1(2), 161-168.*

Aburime, E.F. (2007). Refocusing research in science, technology and mathematics education. A case mathematics laboratory. *STAN annual proceeding* pg. 183-187.

Agwagah, U. N. V. (2005). Influence of gender difference of students in their achievement in secondary school mathematics. Abacus, 25(1), 102 - 112.

Bruner, J., Goodnow, J., & Austin, G. (1956). A study of thinking. New York: Wiley & Sons, Inc.

Elliot, S.N., Kratochwill, TR; Cook, J. I. and Travers J. P. (2002). Educational psychology: Effective Teaching Eddective Learning (3rd edition). Boston: MicGraw-Hill

Erbas, A. K. (2004). Teachers' knowledge of student thinking and their instructional practices in algebra. Retrieved on january,5th 2014: Fromhttp://jwilson.coe.uga.edu/pers/erbas_ayhan_k_200408_phd.pdf

Etukudo U.E. (2006). The effect of computer assisted instruction on gender and performance of Junior Secondary School Students in mathematics. Abacus: *Journal of mathematical Association of Nigeria* 27(1), 1-8

Federal Republic of Nigeria (2005). National Policy on education. Abuja: NERDC

Galadima, I. & Okogbenin, A.A. (2012). The Effect of Mathematical Games on Academic Performance and Attitude of Senior Secondary Students toward mathematics in Selected Schools in Sokoto State Abacus: The Journal of Mathematical Science Educators in Nigeria, 4th-5th Oct.

Gimba, R. W. (2006). Effects of 3 - dimensional instructional materials on the teaching and learning Of mathematics among senior secondary schools in Minna metropolis. 2nd SSSE Annual National Conference, Federal University of Technology, Minna. Held between 19th – 2nd November, 2006.

Iwendi, B. C. (2013). Effects of gender and age on the mathematics achievement of secondary school students in Minna metropolis, Nigeria. JOSTMED,9(1),215-223.Availableonline:http://www.jostmed.com

Jahun I. U., & Momoh, J. S. (2001). The effects of Sex and environment on the mathematics achievement of JSS III students in Kwara State. *ABACUS, Journal of Mathematical Association Nigeria,* 26(1), 53-58.

Johnson, A. W. (2000). Cooperative Learning Methods: A meta-analysis. Journal of Research in Education, 12 (1), 5-14.

Joyce, B., Weil, M., & Calhoun, E. (2006). Models of teaching Seventh edition. Boston: Pearson Education, Inc.

Koller, O., Baumert, J. & Schnable, K. (2006). The relationship between Academic Interest and Achievement in mathematics. Journal of Mathematics Education. 32(5), 448 – 470.

Kurumeh, M. S.C. (2004). Effect of ethno - mathematics teaching approach on students aojnhb chievement and interest in geometry and mensuration. Unpublished Ph.D thesis, University of Nigeria Nsukka.

Mathematics Association of Nigeria (2012). MAN *Mathematics for senior secondary schools book two* 5th edition Ibadan : University press Plc.

Mayer, R. (2012). Learning and instruction. New Jersey. USA Pearson education,inc.

Maxima, J.A. (2004). The impact of using technology on students' Achievement, attitude, and anxiety In mathematics. *Journal for Research in Mathematics Education*. 17(2),83-99.

Mullis Y.S. (2002). "Gender Related Differences". Proceedings of 30th Conference of the International Group for the Psychology of Mathematics Education (5). 41-48

National Council of Teachers of Mathematics (2000). Principles and standards for school mathematics. Reston, VA: NCTM publications. National Mathematical Centre, Abuja.

Nurudeen, J.S. (2007). Secondary School Students misconceptions in solving mathematics problems. Abacus, 82(1), 84-101s in mathematics education in Nigeria with emphasis on the strategies for effective teaching and learning of word problems and algebraic expressions. *Journal of Issues on Mathematics* 8(1) A publication of the mathematics panel of the Science Teachers of Nigerin, 1-8.

Obioma, G.O. (2005). Emerging issues in mathematics education in Nigeria with emphasis on the strategies for effective teaching and learning of word problems and algebraic expressions. *Journal of Issues on Mathematics* 8(1): A publication of the mathematics panel of the Science Teachers of Nigeria, 1 – 8.

Odili, G.A. (2006). Mathematics in Nigeria Secondary Schools. A Teaching Perspective. Port-Harcourt Rex – Charles and Patrick Ltd.

Olagunju, S.O.(2001). Sex, age and performance in mathematics. *ABACUS: The Journal of Mathematical Association of Nigeria. 26(1), 15-18.*

Osemwinyen, A. C. (2009). Effects of e - learning on retention and achievement in secondary school mathematics in Abuja, Nigeria. Unpublished Ph.D thesis, University of Nigeria, Nsukka.

Oteze, I. K. (2011). Mock Examinations as a Predictor of Students' Performance in Senior School Certificate Examination Mathematics for the Attainment of Millennium Development Goals. Abacus: *The Journal of Mathematical Association of Nigeria,* 36(1) 18-26

Salman, K.A. (2005). Introduction to Basic Statistics in Management. In Adeyanyu, A.. (Ed). Introduction to Educational Management, Oyo: Green Light Press and Publishers

Sarah, J.P. (2013). The gender differences in mathematics achievement in geometry using manipulative based instruction. Retrieved on 18th March, 2014 *From http://csus-dspace.calstate.edu/bitstream/handle/10211.9/2092/Thesis-FINAL%*

Spencer, D. J. (2004). Engagement with mathematics courseware in traditional and online learning

Sperling, G. (1960). The information available in brief visual presentations. Psychol monogr. 1960;74: 1-29.

Stoet G, Geary DC (2013) Sex Differences in Mathematics and Reading Achievement Are Inversely Related: Within- and Across-Nation Assessment of 10 Years of PISA Data. PLoS ONE 8(3): e57988. https://doi.org/10.1371/journal.pone.0057988

Ukpebor and Omole (2012). Poor Performance in Mathematics Effective teaching –learning and assessment. From https://issuu.com/tjprc/docs/8._edu_sci_-_ijesr__-environmental

Zhang, L. & Manon, J. (2002). Gender and Achievement- Understanding Gender Differences and similarities in Mathematics Assessment. A paper presented at the meeting of the American Educational Research Association, New Orleans, LA.