EFFECTS OF JIGSAW5-COOPERATIVE AND SIMULATION-GAMES STRATEGIES ON MOTIVATION AND PERFORMANCE IN TRIGONOMETRY AMONG SENIOR SECONDARY STUDENTS IN NIGER STATE, NIGERIA

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Abstract
This study investigated the Effects of Jigsaw5-Cooperative and Simulation-Games Strategies on Motivation and Performance in Trigonometry among Senior Secondary Students in Niger State, Nigeria. A Quasi-experimental study which used pre-test post-test group design was adopted. The study used SSII students with a population of 8,154 and sample size of 216 comprising of seventy-two students (male = 36 and female = 36) each randomly drawn from three schools assigned to experimental1 group, experimental2 group and control group. One objective, research question and hypothesis were formulated and tested. Two research instruments: Trigonometry Performance Test (TPT) and Students Trigonometry Motivation Questionnaire (STMQ) with reliability coefficient of 0.750 and 0.704 respectively were used for data collection. Research question was analysed using mean and standard deviation. ANCOVA was used for hypothesis testing at $\alpha = 0.05$ level of significance. The results indicated that: there was significant difference between the motivation level of students taught trigonometry using Jigsaw5-Cooperative strategy; Simulation-Games strategy and the convention method. Based on the findings, it was recommended that the use of Jigsaw5-Cooperative and Simulation-Games strategies for teaching Mathematics and Trigonometry in particular should be encouraged in Nigerian Secondary Schools to improve students' motivation in Trigonometry.

Introduction

Mathematics is a branch of sciences which deals with quantities, sizes and shapes as determined by numbers and signs. The richness of Mathematics according to Ugboduma and Alio (2014) is evident in its branches such as: *Mathematics education* (the practice of teaching and learning Mathematics along with problem solving techniques and issues relating to curriculum); *practical Mathematics* (Arithmetic, elementary Algebra, plane and solid Geometry) and *Trigonometry* (covers measuring degrees, equations, bearings, trigonometry curves, and formulae) among others. Everyone needs Mathematics to survive be it literate or illiterate and this subject was made compulsory in the Nigeria school curriculum; Federal Republic of Nigeria (FRN, 2004).

Despite the inevitable importance and usefulness of Mathematics, it remains one subject in the school curriculum which majority of students has negative attitude and interest. This worrisome situation has grown to the level that needs critical evaluation and revitalization of the methodologies adopted by the teachers of this subject in order to improve and redirect their students' interest, perceptions and motivation towards Mathematics. Effective motivation

strategies to improve learning of Mathematics can make a big difference. Middleton and Spanias cited in Adeniji (2014) opined that intense motivation helps students overcome disappointing mistakes, expend effort to figure out complex Mathematics problems, sacrifice to improve Mathematics skills and remember Mathematics teaching for longer period of time. They maintained that motivations are reasons individuals have for behaving in a given manner in a given situation.

Farayola (2014) stated that the way Mathematics is taught is been criticized as lacking quality and at times dull, boring and stereotyped; and suggested that learners should be motivated and guided to understand concepts through appropriate activities and encouraged to discover patterns in Mathematics especially Trigonometry leading to rules, concepts and formulae. The experiences gained by actively involving students in designing and completing class procedures positively create strong motivation among them.

Emaikwu (2012) reported that teaching strategy affects the response of students and determines whether they are motivated and engaged in learning. The need for innovative strategies in teaching Mathematics is borne out by the facts that different situations which include teaching topics, learners' cognitive readiness, concept to be taught, skills intended to be developed in learners, demands for different teaching strategies among others (Gbadamosi, Abimbola & Ahmed; 2014). Achor cited by Gbadamosi, Abimbola and Ahmed (2014) considered some teaching strategies as learner centered, interest arousing and activity-oriented. These include conceptual change strategy, concept mapping, field trip, guided discovery, Jigsaw5-Cooperative and Simulation-Games strategies.

Bahrain (2012) describe simulation game as a competitive social activity with goals, rules and educational objectives which allows students to discuss and take practical decisions; facilitate the development of the imagination and developing the spirit of tolerance, planning and give and take. Game-based teaching is also a cooperative and community-based method (Ku, Chen, Wu, Lao, & Chan, 2014). Kajuru, Bolaji and Salihu (2012) stated that Mathematical games improve students' motivation in the learning of Trigonometry. In addition, Lee and Cheng (2009) maintained that Mathematical games are the perfect tools, with great motivational appeal for improving mathematical learning.

Cooperative learning is an instructional strategy where students work in groups to complete tasks collectively towards academic goals. There are various types of Cooperative learning strategies among which is Jigsaw Cooperative learning strategy. The Jigsaw a Cooperative learning strategy is of six different categories which are Jigsaw I; Jigsaw II, Jigsaw III; Jigsaw IV, Jigsaw V and Jigsaw VI.

Jigsaw5-Cooperative learning strategy is an activity based strategy known as Reverse Jigsaw cooperative learning strategy. According to Hedeen (2003), students move from their respective home group to expert group from which they will not return to their home group after the assigned task has been completed but rather remain in that group and teach the whole class what they have learnt. The experiences gained by actively involving students in designing and completing class procedures positively create strong motivation among them. Mbacho and Mbuthia (2016) maintained that students who were taught mathematics using Jigsaw learning strategy performed better than those taught with conventional teaching methods

Iwuanyawu (2014) stated that students work longer, harder and with more vigor and intensity when they are motivated than when they are not; and where students are not motivated to learn, they will memorize the material. In addition, Tella (2007) worked on motivation and concluded that active teaching strategies improve interest and raises the degree of motivation of the

students. Hence Mathematics and Trigonometry in particular should be taught in a way that will make it learner-friendly by practically applying its instruction using activity oriented strategies. Therefore this study investigated the Effects of Jigsaw5-Cooperative and Simulation-Games Strategies on Motivation and Performance in Trigonometry among Senior Secondary Students in Niger State, Nigeria.

Objective of the Study: The objective of this study was to determine the motivation level and performance of students exposed to Jigsaw5-Cooperative and Simulation-Games strategies in Trigonometry among Senior Secondary Students in Niger State.

Research Question

A research question was posed as guide: What is the difference between the motivation level and performance of students in Trigonometry exposed to Jigsaw5-Cooperative and Simulation-Games strategies?

Null Hypothesis

A null hypothesis was formulated and tested at 0.05 level of significance as follow:

Ho: There is no significant difference between the motivation level and performance of students taught trigonometry using Jigsaw5-Cooperative and Simulation-Games strategies.

Research Methodology

The research design adopted for this study was the quasi-experimental research design. three groups were involved in the study which were experimental 1 (EG1) and experimental 2 (EG2) and control group (CG). The population of the study comprised of all senior secondary school year two (SS II) students in Niger State, Nigeria. A multi-stage stratified random sampling procedure was used to select a sample of two hundred and sixteen students comprising of seventy-two (male=36 and female=36) in each group. Three co-education schools (3) were selected for the study through balloting simple random sampling having same characteristics.

The instruments for data collection were Trigonometry Performance Test (TPT) and Students Trigonometry Motivation Questionnaire (STMQ). The instruments were subjected to both face and content validity with reliability coefficients of 0.750 using Pearson Product Moment Correlation Coefficient (PPMCC) for the TPT analysis while 0.704 was obtained for STMQ using Cronbach alpha-20 (α_{20}).

Treatment for the two experimental groups lasted for six weeks while there was no treatment for the control group. The students were taught same Trigonometry concepts during the six weeks. The experimental 1 group was treated with Jigsaw5-Cooperative Learning Strategy while experimental 2 group was treated with Simulation-Games Strategy. No treatment was given to the control group during the six weeks. A pretest was conducted before treatment and posttest was conducted after treatment using same instruments for data collection.

Result Analysis

The data collected from this study were analysed using Descriptive Statistics (Mean and standard deviation) to answer the research question and Inferential Statistics (ANCOVA) was used for the hypothesis testing at $\alpha = 0.05$ level of significance with the aids of the Statistical Packages for Social Sciences (SPSS version 20). The details of the analyses were as follow:

Research Question: What is the difference between the motivation level and performance of students in Trigonometry exposed to Jigsaw5-Cooperative and Simulation-Games strategies? To answer this research question, a Descriptive Statistics of means and standard deviations were carried out. The result was presented in Table 1.

Table 1: Mean, Standard Deviation, Standard Error and Mean Differences of the Jigsaw5-Cooperation and Simulation-Games Strategies and Conventional Method in Trigonometry Performance Test and Motivation level

Strategy	N	Mean	SD	Std Error	Mean Diff.
Jigsaw5-ooperative	72	52.03	16.64	1.96	
					8.93
Conventional	72	43.10	14.45	1.70	
	72	54.86	10.67	1.26	
Simulation-Games					
					11.76
Conventional	72	43.10	14.45	1.70	

Results in Table 1 showed that the mean performance score of the Jigsaw5-Cooperative strategy was 52.03 with standard deviation of 16.64; the mean performance score of Simulation-Games strategy was 54.86 with standard deviation of 10.67 and the mean performance scores of the conventional Method was 43.10 with standard deviation of 14.45. The mean difference between Jigsaw5-Cooperative strategy and Conventional Method was 8.93; and the mean difference between Simulation-Games strategy and Conventional Method was 11.76. This shows that there was impact of treatment on academic performance of the students exposed to Jigsaw5-Cooperative and Simulation- Games teaching strategies employed during the study.

Null Hypothesis Ho: There is no significant difference between mean motivation level and performance scores of students taught Trigonometry using Jigsaw5-Cooperative, Simulation-Games strategies and those taught using conventional teaching method. To test the hypothesis, Analysis of Covariance (ANCOVA) statistic was used as presented in Table 2.

Table 2: Analysis of Covariance (ANCOVA) statistic of difference in the mean motivation level and performance scores of students taught Trigonometry using Jigsaw5-Cooperative, Simulation-Games strategies and those taught using conventional teaching method

Source	Sum of Squares	DF	Mean Square	F	P-value	Remark
Pre-test	487.113	1	487.113	2.453	.119	**
Group	5761.444	2	2880.722	14.509	.000	*
Error	42091.792	212	198.546			
Corrected Total	48006.459	215				

*Significant at $P \leq 0.05$ **Not Significant at $P > 0.05$

The result of data in Table 2 showed significant difference. The calculated p-values of the experiment 0.000 was less than alpha value of 0.05. Based on this result, the null hypothesis of no significant difference was rejected and the alternative hypothesis was upheld. It revealed that there was significant difference in the mean motivation level and performance scores of students

taught Trigonometry with Jigsaw5-Cooperative, Simulation-Games strategies and those exposed to conventional teaching method.

Summary of Major Finding (s)

The finding was made after treatment and analyses of the pre-test and posttest results of the motivation level and performance of students taught trigonometry using Jigsaw5-Cooperative strategy and Simulation-Games strategy showed that there was significant different. This may be due to the involvement of students during the teaching and learning process.

Discussions

The study was set to investigate the Effects of Jigsaw5-Cooperative and Simulation Strategies on Motivation and performance towards Trigonometry among Senior Secondary Students in Niger State, Nigeria. The findings obtained from the hypothesis tested were discussed as follows:

The results of hypothesis in Table 2 showed that the motivation level and performance of students taught trigonometry with Jigsaw5-Cooperative and those exposed to Simulation-Games strategies differ significantly. These strategies help students to develop positive attitude to Mathematics and particular Trigonometry. The students participated fully thus were highly motivated as such felt comfortable. The two groups' motivation was influenced by the strategies used as such the hypothesis was rejected. The findings of study were in line with Kajuru, Bolaji and Salihu (2012) who stated that Mathematical games improve students' motivation in the learning of Trigonometry. In addition, Lee and Cheng (2009) maintained that Mathematical games are the perfect tools, with great motivational appeal for improving mathematical learning. It is also in agreement with the findings of Tella (2007) on motivation and concluded that active teaching strategies improve interest and raises the degree of motivation of the students. In this study, there was no degree of motivation attached to the study.

The strategies created high level of students' participation and increased their motivation level; respect for others view and learn the spirit of give and take. This is in line with Bahrain (2012) and Haruna (2015) on their reports on motivation which revealed significant positive changes after the use of various active teaching strategies. Akinshola and Animashahun (2007) concluded that teachers' use of stimulating teaching strategy would go a long way in sustaining and motivating students in the learning of Mathematics. This study was also supported by Mbacho and Mbuthia (2016) who maintained that students who were taught mathematics using Jigsaw learning strategy performed better than those taught with conventional teaching methods. The students' intrinsic motivation was also enhanced when they learned with the simulation game.

These findings have some important implications that will be useful for the teaching and learning of geometry and mathematics generally. The lack of motivation noticed in the learning of Mathematics and its various branches before now perhaps could be due to inappropriate strategy used in the teaching of mathematics. The motivation level among students in mathematics and Trigonometry in particular using Jigsaw5-Cooperative and Simulation-Games Strategies has improved tremendously.

Summary

This study considered two groups which are experimental 1 group and experimental 2 group. The treatment administered to experimental 1group was the use of Jigsaw5-Cooperative Learning Strategy while Simulation-Games Strategy was administered to experimental 2 group.

The results and findings revealed that the Jigsaw5-Cooperative and Simulation-Games strategies used improved students motivation and performance in the learning of Trigonometry.

Conclusions

Based on findings from the study, the following conclusions were drawn:

Jigsaw5-Cooperative and Simulation-Games strategies have helped greatly in raising the motivation level and performance of students in the learning of Trigonometry. The use of Jigsaw5-Cooperative and Simulation-Games strategies in the teaching of Trigonometry increased motivation level and performance towards Trigonometry among senior secondary (SSII) students. This shows that the methods which were minds-on, hands-on activity oriented create room for full participation, attentiveness and raised their motivation in the learning of Trigonometry concepts by collaborating with their group members. Therefore, the quest for clear pedagogical principles likes the Jigsaw5-Cooperative and Simulation-Games teaching strategies that is student-centred can be employed to increase motivation level towards trigonometry teaching and learning.

Recommendations

Based on the findings of the study the following recommendations were made:

- Students should take the advantage of Jigsaw5-Cooperative and Simulation-Games Teaching Strategies opportunities to engage actively in learning trigonometry practically, develop skills of manipulative, reasoning, communicating and connecting concepts Trigonometry. This will raise the Motivation level in teaching trigonometry among Senior Secondary School students.
- Teachers should engage students in an active process of learning such as minds-on, hands-on, authentic learning and discoveries using Jigsaw5-Cooperative and Simulation-Games teaching strategies which will make them create and discover trigonometry concepts for themselves. This will improve students' motivation and performance when learning trigonometry lessons.

References

Adeniji, K. A. (2014). Motivational Teaching Strategies towards Improving Learning of Mathematics at Primary and Secondary School Levels. *ABACUS-Journal of Mathematical Association of Nigeria*, 39(1), 344-354.

Akinsola, M. K. & Animasahun, A. I. (2007). Effect of Simulation-Games Environment on Students Achievement and Attitudes to Mathematics in Secondary Schools. *The Turkish Online Journal of Educational Technology–TOJET*, 6 (3), 113-120.

Bahrami, F; Rahimi, C. Z; Kianzadeh, A. F. & Abdi, E. H. (2012). A Comparison of the Effectiveness of Game-Based and Traditional Teaching on Learning and Retention of First Grade Mathematics

Concepts. *European Journal of Experimental Biology*, 2 (6), 2099-2102. Retrieved on Thursday, February 18, 2016 at 11:26am from www.pelagiaresearchlibrary

Emaikwu, S. O. (2012). Assessing the Relative Effectiveness of the Three Teaching Methods in the Measurement of Students' Achievement in Mathematics. *Journal of Emerging Trends in Educational Research and Policy Studies (JETERAPS), 3(4*), 479-486.

Farayola, P. I. (2014). Teaching of Mathematics at Tertiary level through effective use of Information and Communication Technology and Mathematics Laboratory. *ABACUS-Journal of Mathematical Association of Nigeria*, 39(1), 247-254.

Federal Republic of Nigeria (FRN, 2004). *National Policy on Education*. Nigerian Educational Research and Development Council (NERDC) Press: Abuja, Nigeria.

Gbadamosi, A. F; Abimbola, I. O. & Ahmed, M. A. (2014). Biology Teachers' level of Awareness and Utilization of Innovative Teaching Strategies in Oyo South Senatorial District, Nigeria. *ABACUS-Journal of Mathematical Association of Nigeria*, 39(1), 307-324.

Haruna, D. Z. (2015). Impact of Peer-Instruction and Just-In-Time-Teaching on Motivation and Performance in Physics among secondary School Students with varied Abilities, Kano, Nigeria. Unpublished Ph. D Thesis; Department of Science Education, ABU-Zaria.

Hedeen, T. (2003). The reverse Jigsaw: A process of cooperative learning and discussion. *Teaching Sociology, 31(3), 325-332*.

Iwuayanwu, G. O. (2014). Effects of Concept Mapping and Simulation–Games Strategies on Academic Achievement and Attitude among Biology Students of Zaria Educational Zone. An Med Thesis of Ahmadu Bello University, Zaria.

Kajuru, Y. K; Bolaji, C. & Salihu, T. U. (2012). Effects of Simulation Games Strategy on the Performance and Motivation in Trigonometry among Senior Secondary Schools Students in Zamfara State. An M.Ed Thesis, Department of Science Education, Ahmadu Bello University-Zaria.

Ku, O; Chen, S. Y; Wu, D. H; Lao, A. C. C. & Chan, T. W. (2014). The Effects of Game-Based Learning on Mathematical Confidence and Performance: High Ability vs. Low Ability. *Educational Technology & Society, 17* (3), 65-78.

Lee, C., & Cheng, M. (2009). A computer game as a context for non-routine mathematical problem solving: The effects of type of question prompt and level of prior knowledge. *Computers & Education, 52*, 530-542. http://dx.doi.org/10.1016/j

Mbacho, N. W. & Mbuthia, N. (2016). Effect of Jigsaw Cooperative Learning Strategy on Students' Mathematics Achievement in Secondary Schools in Laikipia County, Kenya. *International Journal of Social Science and Economic Research* 1(8),1174-1189 www.ijsser.org

Tella, A. (2007). The Impact of Motivation on Student's Academic Achievement and Learning Outcomes in Mathematics among Secondary School Students in Nigeria. *Eurasia Journal of Mathematics, Science & Technology Education*, 3(2), 149-156. Retrieved on Thursday 18th February, 2016.

Ugboduma, S. O. & Alio, B. C. (2014). Mathematics: An Effective tool for Poverty Alleviation, and Solving Crime and Security Problems. *ABACUS-Journal of Mathematical Association of Nigeria*, 39(1), 325-335.