THE EFFECT OF MATHEMATICAL GAMES AND SIMULATIONS ON SENIOR SECONDARY SCHOOL STUDENTS’ INTEREST IN GEOMETRY

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Abstract
This study investigated the effect of mathematical games and simulations on Senior Secondary School Students’ interest in Geometry. The research design is pre-test-post-test control quasi-experimental design. Simple random sampling technique was used in selecting 287 senior secondary school students in five Area Councils in Federal Capital (F.C.T.) Territory, Abuja, Nigeria. Two research instruments were developed and validated by experts who were used for data collection. The result of the findings showed that the differences in the mean interest scores on geometry favour the experimental group. Also, the study revealed that method of teaching was a significant factor on students’ interest in geometry. Hence, students who were taught using games and simulations technique gain more interest in the learning of geometry than their counterparts taught using Conventional Teachers Method CTM. Based on this finings, it is recommended among others that teachers should be empowered to use games and simulations in teaching mathematics in our secondary schools. Keywords: Games, simulations, mathematics interest, conventional teachers’ method.

Keywords: Games, simulations, mathematics, geometry, interest

Introduction
Mathematics without doubt remains very important to all disciplines and fields of human work and study (Odili, 2006). It has continued to play significant role in the development of both the individuals and nations. Mathematics is also a fundamental science that is needed for the understanding of most fields in the sciences and technological education. Therefore, Mathematics is a necessary tool needed to be able to function effectively in the present technological age (Aremu, 1998). According to Abakpa and Iji(2011) teaching and learning of mathematics consistently generate interest among scholars over the years. Mathematics is an intellectually stimulating subject that affects every talent of human activities such as politics, economics science and technology. It is the model by which scientific concepts are understood and bedrock for understanding and applying technologies.

Despite the benefits of Mathematics to our-day-today activities and as an agent of nation’s development and wealth creation, students interest in the learning of mathematics has not been favourable due to certain factors such as students’ background, learning environment, non-utilization of viable instructional strategies among others (Ali, 1998 and Nkwo, 2003). There has been a repletion of poor performance and failure of students in mathematics at secondary school level (Olaleye, 2004 as in Olosunde & Olaleye, 2010).
Table 1: West African Examination Council (WAEC) performance in the Senior School Certificate Examination May/June 2004-2007 Mathematics

<table>
<thead>
<tr>
<th>Year</th>
<th>Total no of Candidates</th>
<th>A1-C6 %</th>
<th>P7-P8%</th>
<th>F9%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>1019524</td>
<td>33.97</td>
<td>28.16</td>
<td>34.47</td>
</tr>
<tr>
<td>2005</td>
<td>1054853</td>
<td>38.20</td>
<td>25.36</td>
<td>34.41</td>
</tr>
<tr>
<td>2006</td>
<td>1139277</td>
<td>41.12</td>
<td>31.09</td>
<td>24.95</td>
</tr>
<tr>
<td>2007</td>
<td>1249028</td>
<td>46.75</td>
<td>26.72</td>
<td>24.2</td>
</tr>
</tbody>
</table>


Table 1 explains what had been said about the poor performance of students in Mathematics in public examinations (WAEC, 2004-2007). The failure rate was high in 2004 and 2005 at 34.47 and 34.41 respectively and slightly reduced to 24.95 and 24.24 in 2006 and 2007 respectively. The reasons for this trend could have been as a result of efforts made by researchers and mathematics educators who introduced some instructional strategies which were used in the teaching and learning of mathematics.

With this trend, more efforts are needed to reduce the rate of failure and low interest in mathematics in public examinations. Also approaches of teaching mathematics that will improve students’ interest in mathematics learning to the expectations of all the stakeholders such as students, teachers’ parents, general public and government needs re-examination. As such an examination of games and simulations may be complementary to the conventional methods of teaching mathematical sciences in schools, so as to arise students’ interest in the learning of mathematics.

In order to complement other instructional strategies which are being used in the teaching and learning of mathematics, interest and the researcher is of the view that if games and simulations are incorporated to complement the conventional methods of teaching mathematics, the right cognitive skills may be developed for effective teaching and learning of Mathematics (Olosunde & Olaleye, 2010). Simulations and games are miniature realities of situations prepared for man to react, get him ready for real life situations. It involves learning experiences which do not require immediate exposure of the learners to the real object. The practice with the use of teacher made objects before trying the real object is what is meant by simulation. Simulation technique makes learning more practical, vivid and meaningful and helps learners determine the pros and cons implication of a given task (Manguwat, 2004).

Dotun(2005) defined mathematical games as form of puzzles, magic tricks, fallacies paradoxes or any type of mathematical activities which provides amusement a curiosity. Mathematical games bring joy to the learner and teacher, break resistance or negative attitude to learning by reducing tension, flushing boredom and providing environment for learners to develop interest and acquire skills and competence. Games enhance learners to think Mathematical, embibe the culture of cooperation, competition, organization and spirit of individualism (Okigbo and Okeke, 2011).

Simulation comes from the latin world “similis” which means to act like to resemble
etc. As such a situation is always created in which activities are presented as if they are real life. There are 3 major kinds of simulation methods such as historical simulation, simulation activities and simulation Sabo (2006). According to Orlich, Harder, Callahan and Gibson (1998) simulation is a representation or recreation of a real object, problem, event or situation. It makes the learner an active participant in behavior modification and skills acquisition. Greenblat (1988) argued that classroom interactions are very much encouraged by simulation activities which stimulate interest, provide adequate information enhance skill development, change attitude and improve performance of learners and teachers. The emerging paradigm of mathematics teaching is based on threshold of constructivists ideas which makes teaching more learner-centred and activity based as against didactic and teacher-centered methods of teaching (Godwin, 2012).

Games and simulation as an approach to teaching is based on constructivists ideas of teaching which is rooted in Ausbelian Psychology of teaching (Ausbel 1962). With games and simulations children are found to be very much involved in the lesson as they are seemed to interact actively (Orlich et al 1998). Participation and interaction by students actively results in active and meaningful learning which means improvement in students’ learning outcomes.

A mathematical game is one of the most potent means of stimulating students’ interest in Mathematics. In every culture children play games either as part of learning to show up in the culture or as pass-time or leisure. Games have been used to teach science and mathematics in many countries (Azuka, 2006). This is because of the usefulness of games in the educational process. Learning is exciting, interesting and at the same time academically rewarding. Games and simulations can facilitate the mathematical environment as they release boredom, tension and establish a friendly atmosphere, which allows for growth of interest, skills and knowledge (Obioma, 1992). Games and mathematics are related because, each has rule which involves experience, drill and practical application. This study therefore, exploits how games and simulations can enhance students’ interest in geometry.

Research findings have shown that students display poor performances due to lack of interest. Amoo, (2002) in a study with a sample of 240 students on problems encountered in the teachers and learning of mathematics in secondary schools revealed that lack of interest reflects in students’ attentiveness when mathematics lesson is going on. Uhumuaubi and Umoru, (2005) used 100 students’ as sample to study the relationship between interest in mathematics and achievement in mathematics and science among Polytechnic students’ intrinsic and extrinsic interest positively affect their achievement in mathematics.

A recent study on interest and achievement by Imoko and Agwagah, (2006) experimented with 297 SSII students’ from eight classes randomly selected from four (4) co-educational secondary schools. Data was collected using trigonometry interest inventory, mean and standard deviation, as well as ANCOVA was for analyses. Results revealed that students’ in the experimental group which was exposed to concept mapping techniques gained more interest in trigonometry content than the control group that was exposed to the conventional method.

Statement of the problem
Research findings has shown that despite significant results using innovative strategies in the teaching and learning of mathematics, students’ interest in mathematics is still low. Therefore, there is need for more simulation as an approach to the teaching of Geometry so as to improve students’ interest in mathematics. This study is therefore focused on investigating the effects of games and simulations on SSS students’ interest in geometry. The objective of this study therefore, is to determine the effect of games and simulations on interest of students in geometry. Thus Hypothesis (Ho1) below was
raised and tested at P<0.05 level of significance.

Ho1: There is no significant difference in the interest scores of students taught using games and simulations and their counterparts taught using conventional Teachers method

This study served as part of the efforts by educators in Nigeria to encourage teachers to abandon the old methods of rote-learning and teacher centered approach of teaching mathematics. The findings of this study may provide an empirical basis for improvement in the interest of students in secondary school mathematics as well as providing empirical evidence on the efficacy of games and simulation in the teaching of mathematics in our secondary schools.

The term geometry was derived from two Greek words - 'geo' meaning 'Earth' and 'metria' meaning to measure. The words were coined by the early mathematicians who systematized mathematics into a discipline to refer to the science of the properties and relations of lines, figures angles, surface and solids.

Geometry is a vibrant and exciting part of mathematics and a key to understanding our world through concrete experiences with geometric figures and relationship. It is a science of space, that is describing and measuring figures, theory of ideas and methods by which we can construct and study idealized models of the physical world as well as of other real world phenomenon (Timku, 2004) the choice of geometry is because it is considered to be an aspect of mathematics that presents difficulties to students (WAEC, 2003). Moreover, geometry has been identified as an important source of mathematical thinking (Hogan, 2000).

Methodology
The research design for this study was pre-test-post-test, control group quasi-experimental design. The independent variables are instructional strategies at 2-levels (Games and simulations and teachers’ conventional method) while the dependent variable was interest in geometry.

The target population for the study consisted of all senior secondary school two (SS2) students in Gwagwalada Area Council FCT, Abuja.

Six schools were randomly selected from the Area Council. Mathematics teachers in each of the schools sampled participated in the study. Intact classes were assigned to experimental and control groups. The study used the non-equivalent control design, in which intact class were assigned to experimental condition. The total number of students in the experimental group is 139 while that of the control group is 148 totaling 287.

Research instrument
The instrument used for the study was as follows:

1. Games and simulations Instructional Package (GSIP). The GSIP is an instructional package adapted by the researcher for the experimental group. It can be used for groups or individualized study. It could also be used for instruction and remediation purposes. The GSIP was developed by modifying the format of Agwagah (2001).

2. Mathematics Interest Inventory (MII) is the researcher made 20 items questionnaire that was used to help students’ express their feelings toward mathematics. It consisted of two sections. Section A sought information about respondents’ sex, while section B bothered on interest in mathematics. Each of the items is a 4-point type rating scale with response options. The options are: Strongly agreed (SA); Agreed (A); Disagreed (D) and Strongly disagreed (DS). The MII was validated by experts in Department of Science and Environmental Education. Cronbach Alpha (α) was used to ascertain the reliability of MII. This gave α value of 0.90 which is considered adequate for research. Cronbach Alpha was used for MII
because the items were not dichotomously scored Ozio, (2002).

**Research procedure**

In each secondary school, the experimental group was taught with games and simulations using games and simulation Instructional package while the control group was taught with conventional teachers’ method (CTM) using different class teachers. The experimental treatment lasted for four weeks which was withheld for control group. The students were taught by their regular teachers who were trained on the key structure of games and simulations strategy. These teachers also administered the MII before and after the experimental treatment and CTM classes. The data were tested at 0.05 level of significant using the Analysis of Covariance (ANCOVA).

**Results**

The data collected were analyzed using mean and standard deviation scores for the experimental and control groups pre-test while ANCOVA was used to test the hypothesis (Ho1) on the post-test interest scores of students in geometry (post MII).

Ho1: There is no significant difference in the interest of students taught using games and simulations and their counter parts taught using conventional Teachers methods.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Pre-MII X</th>
<th>Pre-MII δ</th>
<th>Post-MII X</th>
<th>Post-MII δ</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>139</td>
<td>48.95</td>
<td>13.89</td>
<td>68.17</td>
<td>8.08</td>
<td>19.22</td>
</tr>
<tr>
<td>Control</td>
<td>148</td>
<td>50.04</td>
<td>12.48</td>
<td>51.76</td>
<td>11.54</td>
<td>1.72</td>
</tr>
<tr>
<td>Mean Difference</td>
<td></td>
<td>1.09</td>
<td></td>
<td>16.41</td>
<td></td>
<td>17.50</td>
</tr>
</tbody>
</table>

Table 3: 2-way ANCOVA on the post-test interest scores of students’ in Geometry (Post-MII)

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<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of squares</th>
<th>df</th>
<th>Mean squares</th>
<th>F</th>
<th>Sig</th>
<th>Decision at P&lt;.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>34350.674</td>
<td>4</td>
<td>8587.668</td>
<td>179.038</td>
<td>.000</td>
<td>S</td>
</tr>
<tr>
<td>Intercept</td>
<td>19545.859</td>
<td>1</td>
<td>19545.859</td>
<td>467.497</td>
<td>.000</td>
<td>S</td>
</tr>
<tr>
<td>Pre-MII</td>
<td>14897.822</td>
<td>1</td>
<td>14897.822</td>
<td>310.593</td>
<td>.000</td>
<td>S</td>
</tr>
<tr>
<td>SEX</td>
<td>799.116</td>
<td>1</td>
<td>799.116</td>
<td>16.660</td>
<td>.000</td>
<td>S</td>
</tr>
<tr>
<td>Method</td>
<td>20535.307</td>
<td>1</td>
<td>20535.307</td>
<td>428.125</td>
<td>.000</td>
<td>S</td>
</tr>
<tr>
<td>Sex* method</td>
<td>143.467</td>
<td>1</td>
<td>143.467</td>
<td>2.991</td>
<td>.085</td>
<td>NS</td>
</tr>
<tr>
<td>Error</td>
<td>13526.323</td>
<td>282</td>
<td>47.966</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>187141.00</td>
<td>287</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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Table 2 revealed the pre-test mean interest score of students in the experimental group was 48.95 with a standard deviation of 13.89, while that of the control group had mean of 50.04 with standard deviation of 12.48 respectively. This showed a mean interest difference of 1.09 which suggest that the two groups were almost at the same level of interest prior to the treatment. The results further showed that the post MII mean of experimental group is 68.17 with standard deviation of 8.08, while the control group has a mean interest scores of 51.76 with standard deviation of 11.54. The results further showed that the experimental group gained interest more than the control group, after the treatment.

The mean difference interest gained by experimental group after treatment is 19.22, while the control group gained mean interest of 1.72. The post –MII mean difference between the two groups is 16.41 in favour of the experimental group. The implication of these results is that the method of teaching employed for the experimental group stimulated the students to gain more interest in the learning of geometry than does the control group.

Result from table 3 revealed that method is significant factor on students’ interest in geometry at P < 0.05. The calculated F-value 428.125 is greater than the critical sig-value of 0.000. Therefore, the hypothesis (HO1) was rejected. Hence, the use of games and simulations enhanced students’ interest in geometry.

Discussion
Result from table 2 shows that the differences in the mean achievement scores on geometry favour the experimental group. This is further confirmed by the result in Table 3 which revealed that method of teaching was a significant factor on students’ interest in geometry. Hence, students who were taught using games and simulations technique gained interest more than their counter parts taught using CTM. Thus the result of the study revealed that students’ achievement in mathematics would greatly improve if relevant methods are applied. This supported (Obioma, 1992; Amoo, 2002; Uhumuaubi & Umoru, 2005; Imoko & Agwagah, 2006; Olosunde & Olaley, 2010) viewed that appropriate teaching method is a major contributory factor to students’ interest in mathematics. This also confirmed manguwat’s (2004) assertion that simulation technique makes learning more practical, vivid and meaningful and enhance learners interest. Also it is in agreement with the findings of Federal Inspectorate of Education (2010) in Katcha and Jibril (2011) that activity based teaching is an act of best practices in teaching mathematics as it improves participation and interaction.

Conclusion
The findings of this study have shown that the use of games and simulations technique does increase the students’ interest in Mathematics. This implied that some relationships exist between the technique of instruction and students skill in solving geometrical problems. The experimental group gained interest more than the control group. This study has therefore shown that mathematics is an area where the use of games and simulations enhanced students interest in the learning of mathematics. As such it is hereby recommended that:

* Mathematics teachers should be empowered to use games and simulations strategy. The school authorities are therefore required to organize workshops and seminars in order to re-train teachers especially in the use of games and simulations.
* Materials and research papers on games and simulations should be made available to teachers and students of mathematics.
* Mathematics teachers who had training on games and simulations can equally train colleagues in the school.

References
School Students achievement in geometry. *JSTAN* (1) 165-176.


European Journal of Social Sciences

13(2) 2010)