Location, Sex and Resource Availability Factors Affecting Technology Integration in Mathematics Learning in Abia State, Nigeria

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Abstract
This paper investigated the effect of location, sex and resource availability on technology integration in mathematics learning in Abia state, Nigeria. It tried to examine if; resource persons and facilities are available for technology integration in mathematics learning, the separate effects of location and sex on the performance of students taught mathematics using technological tools, and determine the joint effect of location and sex on the performance of students taught mathematics using technological tools. The area of the study was Ikwuano LGA of Abia state, Nigeria; its geographical coordinates on the globe being 5°26´N 7°34´E. A survey and a quasi-experimental research designs were adopted. A check-list was used to check for availability of technological facilities while the geometry achievement test (GAT) was administered to generate pretest and posttest scores for data analysis. Data for quasi-experimental study was analyzed running ANCOVA using SPSS. After data analysis it was found that; uneven distribution and unavailability of technological resources and facilities are responsible for the differences in students’ performance within the semi-urban and rural divide when taught mathematics using technological tools, location had a significant effect while sex had no significant on students’ performance when taught mathematics using technological tools, and that sex and location had no significant joint effect on students’ performance when taught mathematics using technological tools.

Keywords: Location, sex, resource availability and ICT/technology integration.

Introduction
Improving classroom teaching and learning of mathematics hence improving learners’ interest and performance in the subject, has been the concern of educators and contemporary research works. In suggesting ways to improve students’ interest and performance in mathematics, Drew and Hansen (2013) summated that the use of instructional materials or resources has an important role to play in mathematics instructions as it allows teachers to model or demonstrate representations of mathematical ideas and in supporting learners to develop mathematical understanding and thinking; hence improving their interest and performance. An innovative and resourceful mathematics teacher will focus on using all
available resources to reduce abstraction in the mathematics classroom, hence increasing learner’s interest, confidence and performance in the subject.

Information and communication technology (ICT) today offer a handful of useful resources which can be harnessed in a mathematics classroom to improve student interest and learning. African Virtual University, AVU (2012) established that ICT has become one of the fundamental building blocks of modern society. Today’s learners on another hand, being born into this technological age, are showing great affinity to technological devices and applications (Prensky, 2001; Digital Minds, 2013). Based on this obvious affinity, many countries now regard the mastering of the basic skills and concepts of ICT as an inevitable part of the core of education. To this end, various new models of education are evolving in response to the new opportunities that are becoming available by integrating ICT and particularly, web-based technologies into the teaching and learning environment (AVU, 2012).

The implication of this development on mathematics education as an option is; the development, mastering and integration of appropriate ICT tools in the mathematics classroom with the overall aim of increasing the effectiveness of teaching and improving students’ learning, hence performance. Ogwel (2012) while arguing on ICT integration in mathematics education in Kenya, observed that though full integration of ICT in mathematics education is desirable, there are inherent curricula challenges in the education system that have to be tackled for optimal technology-enabled education. These obstacles may be viewed from those emanating from inadequate curriculum coherence in the education system (availability of resources cum policies), uneven distribution of educational resources and facilities across locations and the biological factor of sex. Bingimlas (2009) and Ogwel observed that most teachers in schools have limited knowledge of ICT skills hence they shy away from ICT use and its integration in classroom teaching and learning. Sufficient long-term opportunities and training should be given to teachers to make sense of new technologies themselves.

With respect to the educational curriculum of the concerned country, the following questions may arise: Is time allotted sufficient to both master and integrate ICT in a mathematics classroom? Is there sufficient in-service training program for mathematics teachers to facilitate smooth ICT integration? Is there any or sufficient technical support available to manage and maintain ICT equipment in the classroom? What is the availability of technological equipment in schools to enhance appropriate ICT integration? The true position with regard to the answers to these key questions affecting ICT integration in mathematics education in Nigeria is still uncertain.

Another factor which may be considered in technology integration in mathematics education is the geographical location of the school; this considers the effect of the spread of technological facilities and other support facilities (power supply etc) within the urban, semi-urban and rural divide on students’ performance when taught mathematics using technological tools (Chianson, 2012; Ijenkeli, Paul and Vershima, 2012). Also the effect of the biological divide (male and female), on students’ performance when taught mathematics using technological tools may be considered (Manger and Gjested, 2014; Santos, Ursini, Ramirez and Sanchex, 2006).
This research work on location, sex and resource availability factors affecting technology integration in mathematics learning in Abia state, Nigeria; adopted the use of PowerPoint presentation integrated with Multimedia projection (a practical mathematics experiment) for the teaching of Geometry. This tool was used to help stimulate students’ interest in geometry since separate figures and their properties were highlighted on separate slides; emphasizing and comparing their individual properties. It was also used to help prepare them for more in-depth ICT operations in geometry as teacher/student ICT proficiency improved.

Statement of the problem
The issue of using instructional materials or resources (especially Information and Communication Technology (ICT)/Modern Technological teaching tools) in simplifying and improving students’ learning in mathematics instructions provides a wide area of research interest (particularly in the teaching of geometry, being that area of mathematics having numerous properties and identities that often leave learners bewildered). This research work is set to investigate the effect of inadequate curriculum coherence in the education system (availability of resources cum policies), uneven distribution of educational resources and facilities across locations and the biological factor of sex(male and female divide) on technology integration in mathematics learning in Abia state, Nigeria.

Objectives of the study
The main aim of the study was to investigate the effect of location, sex and resource availability on technology integration in mathematics learning in Abia state.

The specific objectives included to;

1. Examine if resource persons and facilities are available for technology integration in mathematics learning.
2. Determine the separate effects of location and sex on the performance of students taught mathematics using technological tools.
3. Determine the joint effect of location and sex on the performance of students taught mathematics using technological tools.

Research question
1. What is the availability of resource persons and facilities for technology integration in mathematics learning?

Hypotheses

HO₁: There is no significant effect of location on the performance of students taught mathematics using technological tools.

HO₂: There is no significant effect of sex on the performance of students taught mathematics using technological tools.

HO₃: There is no significant joint effect of location and sex on the performance of students taught mathematics using technological tools.
Scope of the study

This work centered on Junior Secondary One students in Abia state, Nigeria; Ikwuano LGA was randomly selected from the 17 LGA in the state. A survey and quasi-experimental designs were adopted. Though the survey covered all the junior secondary schools in Ikwuano LGA, not all the schools were used for the quasi-experimental study; this was because the researcher investigated male and female traits coupled with environmental differences between semi-urban and rural schools as related to Technology integration in the teaching of mathematics, hence co-educational schools were purposively selected. Not all branches of mathematics within the junior secondary one (JS1) syllabus were used for the study, geometry was purposively selected. For the quasi-experimental design, only two schools were randomly selected; one semi-urban and one rural school (both schools having experimental and control groups). Not all Modern Technological/ICT tools available for the teaching of geometry were used for the study owing to cost and ICT proficiency of involved parties; a PowerPoint presentation integrated with Multimedia projection of a practical mathematics experiment was used.

Research design

The research adopted both a survey and a quasi-experimental design. The survey adopted the use of check-list to ascertain the availability of resource persons and facilities for technology integration in mathematics learning in Ikwuano LGA of Abia state, Nigeria. While the quasi-experiment adopted a pre-test post-test control group design; there were two experiments; one in a semi-urban school and the other in a rural school. Each consisted of an experimental group and a control group. This design adopted the use of intact classes.

<table>
<thead>
<tr>
<th>Groups</th>
<th>PRE-TEST</th>
<th>TREATMENTS</th>
<th>POST-TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXPERIMENTAL</td>
<td>Y₁</td>
<td>X</td>
<td>Y₃</td>
</tr>
<tr>
<td>CONTROL</td>
<td>Y₂</td>
<td>-</td>
<td>Y₄</td>
</tr>
</tbody>
</table>

The independent variable were the Technological tools (PowerPoint presentation integrated with Multimedia production) while the dependent variable was students’ performance. Sex and location were treated as intervening variables.

Area, population, sample and sampling technique

The study area was Ikwuano local government area of Abia state, Nigeria; being one of the seventeen (17) local government areas in the state with headquarters at Isiala Oboro. It has an area of 281 square kilometers (km²) and a population of 137,993 at the 2006 census. Its geographical coordinates on the globe are 5°26’N 7°34’E (Wikipedia, 2014). It is made up of a few semi-urban towns and a handful of rural communities. The population of the study consisted of all Junior Secondary One (JS1) students in the thirteen government-owned Secondary Schools in Ikwuano LGA (all of which were co-educational). The survey covered all the junior secondary schools in Ikwuano LGA. Approximately eight hundred (800) JS1 students were on enrolment as at October 2013 in the above schools; these constituted the population for the quasi-experimental study (source: Secondary Education Management Board (SEMB), Umuahia Zonal Office, Evangel High School, Old Umuahia (2013). Stratified random sampling technique was adopted for the quasi-experimental study. The two Secondary Schools randomly selected from the semi-urban/rural strata among the thirteen government-owned co-educational Secondary Schools in Ikwuano LGA include;
1. International Secondary School, Michael Opara University of Agriculture, Umudike (a semi-urban school).

The actual sample comprised of one intact class for the experimental group and another intact class for the control group in each school, selected through simple random sampling from the JS1 classes.

**Instrumentation**

A check-list was design to establish the availability of resource persons and facilities for technology integration in mathematics learning in Ikwudoo LGA; all the thirteen schools were involved. Also a Teacher-made Geometry Ability Test (GAT) was used to gather data for the quasi-experimental study. It consisted of twenty six (26) subjective questions specifically testing the ability to solve problems and answer questions on properties, perimeter and area of plane shapes (in line with the current JS1 syllabus). The experimental groups were taught using carefully constructed lesson plans coupled with the use of PowerPoint presentations integrated with Multimedia production, while the control groups were taught with the lesson plans but by the traditional method. GAT was administered as the pre-test for the students one week before teaching took place in both schools. After the teaching (about four weeks), GAT was administered again as the post-test for both groups.

**Validity / Reliability**

Instrument was validated by Senior lecturers at the Department of Curriculum Studies and Educational Technology, Faculty of Education, University of Port Harcourt. Since the Geometry Achievement Test (GAT) was teacher made, a Test-Blueprint was used. A trail test was conducted with 15 students from Oboro Secondary School Ndoro, a subset of the population but not part of the study for reliability. The split-half reliability test, using Spearman Brown correlation (Kpolovie, 2010), was used to compute for reliability and was found to be 0.90 (Uwaezuoke, 2014).

**Data analysis**

A check-list was used to answer the stated research question while the raw data generated in the study were analyzed using the analysis of co-variance (ANCOVA). This statistical tool usually controls certain weak elements associated with the use of intact classes. ANCOVA was done using the statistical package for social sciences (SPSS).

**Answering the research question**

**Research question one:** What is the availability of resource persons and facilities for technology integration in mathematics learning?

<table>
<thead>
<tr>
<th>S/N</th>
<th>SCHOOLS</th>
<th>Resource Persons</th>
<th>Technical Support</th>
<th>Technological resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ambassador’s College, Obuohia Ibere. (R)</td>
<td>NA</td>
<td>NA</td>
<td>ANF</td>
</tr>
<tr>
<td>2</td>
<td>Awom Na Ebo Secondary Technical School, Amawom. (R)</td>
<td>NA</td>
<td>NA</td>
<td>ANF</td>
</tr>
</tbody>
</table>
Table 1 showed that all the rural (R) schools lacked resource persons and technical support, though there were traces of technological facilities which were not functional.

**Testing hypotheses**

**Table 2 Descriptive Statistics on students’ performance**

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Pretest Mean</th>
<th>SD</th>
<th>Posttest Mean</th>
<th>SD</th>
<th>Gain Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>52</td>
<td>12.6154</td>
<td>7.31947</td>
<td>18.6923</td>
<td>5.17740</td>
<td>6.0769</td>
<td>6.05804</td>
</tr>
</tbody>
</table>

Key: A= Available; NA= Not available; ANF= available but not functional; AF= available and functional; SU= Semi-urban school; R= Rural school.
MDBG = Mean difference between group

### B: By Location

<table>
<thead>
<tr>
<th>Location</th>
<th>N</th>
<th>Pretest Mean</th>
<th>SD</th>
<th>Posttest Mean</th>
<th>SD</th>
<th>Gain Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>52</td>
<td>9.3846</td>
<td>7.52105</td>
<td>29.2308</td>
<td>7.31195</td>
<td>19.8462</td>
<td>8.09786</td>
</tr>
<tr>
<td>Semi-urban</td>
<td>52</td>
<td>13.2308</td>
<td>5.51585</td>
<td>32.1538</td>
<td>11.4531</td>
<td>18.9231</td>
<td>13.3654</td>
</tr>
</tbody>
</table>

MDBG = Mean difference between location

### C: By Sex

<table>
<thead>
<tr>
<th>Sex</th>
<th>N</th>
<th>Pretest Mean</th>
<th>SD</th>
<th>Posttest Mean</th>
<th>SD</th>
<th>Gain Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>44</td>
<td>11.9091</td>
<td>7.05022</td>
<td>31.4545</td>
<td>10.3497</td>
<td>19.5455</td>
<td>11.6116</td>
</tr>
<tr>
<td>Female</td>
<td>60</td>
<td>10.8667</td>
<td>6.71967</td>
<td>30.1333</td>
<td>9.20170</td>
<td>19.2667</td>
<td>10.6412</td>
</tr>
</tbody>
</table>

MDBS = Mean difference between sex

Table 3 Summary of ANCOVA on the separate and joint effects of location and sex on the performance of students taught mathematics using technological tools.

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>521.537(a)</td>
<td>4</td>
<td>130.384</td>
<td>2.417</td>
<td>.054</td>
</tr>
<tr>
<td>Intercept</td>
<td>1225.856</td>
<td>1</td>
<td>1225.856</td>
<td>22.727</td>
<td>.000</td>
</tr>
<tr>
<td>Posttest</td>
<td>116.201</td>
<td>1</td>
<td>116.201</td>
<td>2.154</td>
<td>.145</td>
</tr>
<tr>
<td>Sex</td>
<td>.794</td>
<td>1</td>
<td>.794</td>
<td>.015</td>
<td>.904</td>
</tr>
<tr>
<td>Location</td>
<td>319.425</td>
<td>1</td>
<td>319.425</td>
<td>5.922</td>
<td>.017</td>
</tr>
<tr>
<td>Sex * Location</td>
<td>21.790</td>
<td>1</td>
<td>21.790</td>
<td>.404</td>
<td>.527</td>
</tr>
<tr>
<td>Error</td>
<td>5340.001</td>
<td>99</td>
<td>53.939</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>21224.000</td>
<td>104</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>5861.538</td>
<td>103</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
HO₁: There is no significant effect of location on the performance of students taught mathematics using technological tools.

Table 3 showed that there was significant effect of location on the performance of students taught mathematics using technological tools (F₁, 99=5.92, p<.05). The null hypothesis one (HO₁) was rejected.

HO₂: There is no significant effect of sex on the performance of students taught mathematics using technological tools.

Table 3 showed that there was no significant effect of sex on the performance of students taught mathematics using technological tools. (F₁, 99=0.02, p>.05). The null hypothesis one (HO₁) was accepted.

HO₃: There is no significant joint effect of location and sex on the performance of students taught mathematics using technological tools.

Table 3 showed that there was no significant joint effect of location and sex on the performance of students taught mathematics using technological tools. (F₁, 99=0.40, p>.05). The null hypothesis one (HO₁) was accepted.

Discussion of results
Table 1 showed that resource persons, technical support staff and technological facilities, if present, were grossly insufficient for technology powered mathematics teaching and learning in secondary schools in Ikwuano LGA of Abia state; especially the rural schools (though they enjoy the recent donation of computers and laptops by the state governor, Chief T. A. Orji, yet the lack of resource persons and technical support to integrate these facilities into actual teaching and learning is still a huge obstacle).

Table 2 showed that students from the semi-urban school taught mathematics using technological tools performed significantly better than their rural counterparts while table 3 showed that location had a significant effect on students’ performance when taught mathematics with technological tools. Reasons could be the disparity in availability of technological resources and facilities between the semi-urban and rural divide.

Table 3 also showed that sex had no significant extraneous effect on students performance when taught mathematics with technological tools. This was in line with Ogunkunle (2009), thus technology integration bridges gender divide in mathematics teaching and learning.

Finally, table 3 showed that there was no joint effect of sex and location on students performance when taught mathematics using technological tools.

Conclusion
Based on the findings of this research work, the following conclusions were drawn:

- Uneven distribution and unavailability of technological resources and facilities are responsible for the differences in students’ performance within the semi-urban and rural divide when taught mathematics using technological tools.
• Location had a significant effect while sex had no significant on students’ performance when taught mathematics using technological tools.
• Sex and location has no significant joint effect on students’ performance when taught mathematics using technological tools.

For optimum technology powered mathematics teaching and learning in Abia state, frantic effort must be made to facilitate the availability of technological teaching tools and of course ensure their even distribution to schools, hence resolving the extraneous effect of location on technology integration in mathematics in the state

Recommendations
Based on the research findings, the following recommendations are proffered;

• Technology integration in mathematics education should be embraced by all stake-holders since it has been shown to improve students’ performance irrespective of gender.
• The government and other stake-holders are called upon to provide schools with appropriate and sufficient technological facilities for a successful technology powered mathematics teaching and learning.
• Finally, technological support should be sent to schools while serving mathematics teachers are given in-service training to enable them cope with the innovation.

References


