EFFECT OF PROJECT WORK ON SECONDARY SCHOOL STUDENTS SCIENCE PROCESS SKILL ACQUISITION IN BIOLOGY

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Abstract
The study investigated the effect of students’ project work on secondary school science process skills acquisition in Biology. The study was carried out in Owerri North Local Government Area of Imo State. Three research questions guided the study and three null hypotheses were postulated and tested at 0.05 level of significance. The design of the study was quasi experimental design; specifically pre-test-post-test non-equivalent control group design. The sample consisted of one hundred and thirty four (134) SSII biology students. A Science Process Skill Acquisition Test (SPSAT) was used for Data Collection. The instrument was validated by experts and the reliability coefficient obtained was 0.87 using the test-retest method in conjunction with the Pearson Product Moment Correlation analysis. The data collected were analyzed using mean and standard deviation for the research questions and analysis of covariance (ANCOVA) at 0.05 level of significance for the hypotheses. The results revealed that students’ project work had a significant effect on science process skill acquisition in biology. It also revealed that Gender was not a significant factor in students’ science process skill acquisition in biology. Based on the findings of this study, it was recommended among others that workshops and conferences should be organized to update the teachers’ knowledge on the use of students’ project work as an instructional strategy for enhancement of students’ acquisition of science process skills in biology.

Keywords: Project work, science process skill acquisition, gender

Introduction
Science process skills are the activities which scientists employ in carrying out scientific investigation in order to arrive at new knowledge (Obialor, 2016). Science process skills can also be described as mental and physical abilities and competences which serve as tools needed for the effective study of science and technology as well as problem solving, individual and societal development (Nwosu and Okeke as cited in Akinyemi, 2010). Realizing the importance of science process skills as solution to scientific problem and nations development, The federal Government among other things states as one of the national goal of education in Nigeria that education should aim at helping the child in the acquisition of appropriate skills, abilities and competences both mental and physical as equipment for the individual to live and contribute to the development of the society (Federal Republic of Nigeria (FRN), 2004). In order to realize this goal, series of workshop were organized in different country; one of the outcome was the revision of subject curricula at different levels of education to lay more emphasis on the acquisition of science process skills. Following this, various bodies and association have contributed to ensure the development of such curriculum that would emphasis the acquisition of science process skills such curricula include Nigeria primary science project (NPSP), The Nigeria secondary school science project (NSSP) and the Nigeria integrated science project (NISP). The NSSP is a curriculum in the chemistry, physics and biology was developed by the Comparative Education Study and Adaptation Centre (CESAC). Several science bodies such as Science Teachers Association of Nigeria (STAN), National Education Center also contributed immensely to the development of the various curricula used at various levels of Nigeria education system. The various curricula developed have their objectives which have to be achieved for successful acquisition of science process skills, learning of science and attainment of national goals.

Despite the various effort by government various agencies, professional bodies to emphasis on students mastering of science process skills because of its central role in nations development and solution to scientific problem; there is still non acquisition of science process skill (Nwagbo, 2001; Nwosu, 2006); and students may pass through their secondary
school without acquiring enough scientific process such as observing, classifying, measuring, experimenting, manipulating, and hypothesizing (Obialor, 2016). Several factors have been identified as being responsible for this ugly and wholesome situation. One of the factors identified was teachers’ method of teaching (Nwagbo, 2001). Okoli (2006), asserted that most science teachers still prefer lecture method of teaching, that is, a teaching method in which the teacher presents a spoken discourse on a particular subject and avoid the use of activity-oriented teaching method which are student-centered such as inquiring method, discovering method, investigative laboratory approach. Obialor (2016), maintained that such teaching centre approach in which there is steady flow of information going from the teacher to students and students being passive listener do not enhance achievement or process skill acquisition needed for proper understanding of biological concepts. Hence, In this study the effects of teaching some biology concepts using biology project work as part of instructional strategy on students acquisition of science process skills in biology will be investigated.

Project work in biology provides opportunities for students to actually do science as opposed to learning about science. Project work in ordinary sense simply means doing something practical either individually or in a group (Obialor, 2016). Project work is defined as an additional exercise given to the students by the teacher in order to encourage their involvement in teaching-learning process (Obialor, 2016). Project work is also described as a task done individually or cooperatively that combines investigating the topic and presenting it in a written form illustrated with photos, pictures or diagrams (Blumenfeld, Soloway, Marx, Krajcik, Guzdiel and palinorsar, 1991). In project work, students have to participate in the lesson; they are responsible for the result of their work. Moreover, they learn to cooperate in groups, listen to other, think progressively and also develop confidence, independence, experimental skills and attitude helpful to scientific problem solving process. In addition, project work is essentially students-centered and may help break down barriers between subjects. Project work also serves as a bridge to independent learning for students’ (Taylor in Obialor, 2016). Apart from teaching method/strategy used by the teachers in teaching the students, gender may be implicated in students’ acquisition of science process skills.

Gender according to Yang (2010), refers to the social attributes and opportunities associated with being male and female and the relationship between women and men; girls and boys, as well as the relationship between women and those between men. Okeke (2008), describe gender as a socially culturally constructed characteristics and role which are ascribed to males and females in any society. There have been contrasting opinions on gender related issues in science process skills acquisition. Ibe (2006), found out that gender has no influence on students’ science process skill acquisition. Nnachi as cited in Olike (2006), reported that female students achieved significantly higher than their male counterpart in science process skills. These differences shows that a consensus has not been arrived at on the use of gender as a factor in science process skill acquisition in science and more work needed to be done in order to ascertain if gender is a factor on students science process skill acquisition. It is against this background that the researcher thought it is necessary to empirically find out what impact the use students project work as part of instructional strategy in biology can make in solving the problem of non-acquisition of science process skill of male and female biology students in Owerri North local government area in Imo state; Nigeria.

The significance of this study will help ginger science teachers into effective use of project work as an effective instructional strategy for acquisition of science process skills and science instruction so as to help the students acquire the necessary science process skill better.

The main purpose of this study was to investigate the effect of projects work on secondary school science process skill acquisition.

Methodology

Research design
The study adopted quasi experimental design, specifically pretest-posttest non equivalent control design.

Area of the Study
The study was carried out in Owerri North local government area in Imo state, Nigeria.

Population of the Study
The population of the study comprised of one thousand eight hundred and three (1803) SS2 biology students in the 16 senior secondary students in Owerri north local government area in Imo state, Nigeria; out
of which seven hundred and forty three (743) are male while one thousand and sixty (1060) are female.

Sample and sampling technique
The sample constituted one hundred and thirty four (134) SS2 biology students selected from four co-educational schools in Owerri north local government area in Imo state, Nigeria. Purposive sampling technique was used in selecting the four (4) co-educational schools used for the study. This is to ensure that both girls and boys were operating under the same classroom teaching-learning conditions. From each of the school selected, one intact class was selected using simple random sampling techniques by balloting without replacement. In each chosen class, all the students were used for the study. Two classes were randomly assigned to treatment group while the other two were randomly assigned to control group.

Instructional technique
The researcher used two instruments for the study; Science Process Skill Acquisition Test SPSAT and the lesson plan.

SPSAT: A twenty item science process skill acquisition test constructed based on the lesson topics from transport system, cell reaction to its environment and relevance of biology to agriculture in SS2 Syllabus was used for data collection in this study. The test was in theory form designed to measure the level of acquisition of science process skills (observing, classifying, measuring, interpreting data, hypothesizing and experimenting) in biology before and after teaching the selected biology concepts using lecture method and exposure to students’ project work process. The same test was used for pretest and posttest.

Lesson Plan: The lesson plan was written in two forms;
1. Plan that integrated the use of lecture method and exposure to biology project work in each lesson for the treatment group and
2. Ordinary lesson plan using lecture method that does not involved students’ exposure to biology project work for the control group.

Both plan covered these sub-topics; diffusion, osmosis, materials for transportation, media of transportation, types of responses and relevance of biology to agriculture. Also the both plans were the same in terms of content, basic instructional objectives, length of time for teaching, and mode of evaluation expects for the project work that was incorporated in treatment group. The teachings in both groups were done by the regular biology teachers of the participating schools and classes which lasted for six weeks.

Results
Research Question One
What are the mean science process skill acquisition scores in science process skill acquisition test (SPSAT) of Biology students’ exposed to Biology project work and those not exposed to Biology project work?

Table 1 Mean and standard deviation scores of students on SPSAT in the experimental and control group.

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Pretest Mean</th>
<th>Standard deviation</th>
<th>Posttest Mean</th>
<th>Standard deviation</th>
<th>Gain scores Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental (Project Work)</td>
<td>67</td>
<td>26.36</td>
<td>7.66</td>
<td>55.48</td>
<td>9.29</td>
<td>29.12</td>
</tr>
<tr>
<td>Control (not exposed to project work)</td>
<td>67</td>
<td>26.06</td>
<td>6.01</td>
<td>46.72</td>
<td>5.29</td>
<td>20.66</td>
</tr>
</tbody>
</table>

Table 1 shows that the experimental pretest and posttest mean science process skill acquisition scores were 26.36 and 55.48 with standard deviation scores of 7.66 and 9.29 respectively. The control group had pretest and posttest mean process skill acquisition scores of 26.06 and 46.72 with standard deviation scores of 6.01 and 5.29 respectively. The mean science process skills gain scores for experiment group was 29.12 while the mean science process skills acquisition gain score of control group was 20.66. Using the mean and standard deviation scores to answer the research question, the mean and standard deviation scores of both groups were low at pre-test scores but at post-test scores the mean scores of the students exposed to Biology project work (EG) was high (55.48) and low in standard deviation scores (9.29) while in the control group that is students not exposed to Biology project work the
mean score were low (46.72) and also low in standard deviation score (5.29). This indicates that students exposed to Biology project work (EG) performed better than those not exposed to Biology project work (CG) in SPSAT by decision rule. Therefore biology project work strategy is effective in fostering students’ science process skills acquisition in biology.

Research Question Two
What are the mean science process skill acquisition scores in science process skill acquisition test (SPSAT) of Biology students’ exposed to Biology project work and those not exposed to Biology project work based on gender?

Table 2: Mean and standard deviation scores of students’ Pretest and Posttest Science Process Skill Acquisition Test (SPSAT) Classified by Gender.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Gender</th>
<th>N</th>
<th>Pretest Mean</th>
<th>Post test Mean</th>
<th>Gain scores Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Standard deviation</td>
<td>Standard deviation</td>
<td></td>
</tr>
<tr>
<td>Experimental (Project Work)</td>
<td>Male</td>
<td>39</td>
<td>25.00</td>
<td>7.47</td>
<td>29.22</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>28</td>
<td>28.25</td>
<td>7.64</td>
<td>28.29</td>
</tr>
<tr>
<td>Control (not exposed to project work)</td>
<td>Male</td>
<td>27</td>
<td>24.37</td>
<td>4.11</td>
<td>21.30</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>40</td>
<td>27.20</td>
<td>6.83</td>
<td>20.23</td>
</tr>
</tbody>
</table>

Table 2 shows that the experimental pretest and posttest mean science process skill acquisition scores of male and female students were 25.00 and 54.72; 28.25 and 56.54 with standard deviation scores of 7.47 and 10.33; 7.64 and 7.65 respectively. The mean science process skill acquisition gain scores for male and female in experimental group were 29.22 and 28.29 respectively. The mean science process skill acquisition gain scores for male and female in experimental group were 29.22 and 28.29 respectively.

Research Question Three
What are the interaction effects of instructional strategy (Biology project work) and gender on students’ science process skill acquisition in biology.

Table 3: Test of interaction between instructional strategy and gender on students’ science process skill acquisition in biology.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Gender</th>
<th>N</th>
<th>Mean Gain Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental (Project Work)</td>
<td>Male</td>
<td>39</td>
<td>29.22</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>28</td>
<td>28.29</td>
</tr>
<tr>
<td>Control (not exposed to project work)</td>
<td>Male</td>
<td>27</td>
<td>21.30</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>40</td>
<td>20.23</td>
</tr>
</tbody>
</table>

Table 3 shows that the mean achievement gain scores are higher at the two level of gender male and female in the experimental group than the control group. This indicates that there is no interaction between gender and instructional strategy on students’ science process skill acquisition in biology.

Null Hypothesis
There is no significant difference between the mean science process skills acquisition scores in science process skills acquisition test (SPSAT) of biology students exposed to Biology project work and those not exposed to Biology project work.
Table 4: Summary of ANCOVA on biology students science process skill acquisition test by instructional
treatment, gender, and interaction effect.

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III sum of squares</th>
<th>Df</th>
<th>Mean square</th>
<th>F</th>
<th>Sign</th>
<th>Decision at p&lt;.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected model</td>
<td>3602.949*</td>
<td>4</td>
<td>900.737</td>
<td>17.863</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>13500.391</td>
<td>1</td>
<td>13500.391</td>
<td>267.734</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>927.847</td>
<td>1</td>
<td>927.847</td>
<td>18.401</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Strategy</td>
<td>2472.197</td>
<td>1</td>
<td>2472.197</td>
<td>49.027</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>10.688</td>
<td>1</td>
<td>10.688</td>
<td>.212</td>
<td>.646</td>
<td></td>
</tr>
<tr>
<td>Strategy *Gender</td>
<td>.092</td>
<td>1</td>
<td>.092</td>
<td>.002</td>
<td>.966</td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>6504.790</td>
<td>129</td>
<td>50.425</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>359969.000</td>
<td>134</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>10107.739</td>
<td>133</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4 shows that $F (49.027)$ is significant at $P<.000$ for the strategy used, at 1 and 133 degrees of freedom (DF). This is because .000 is less than .05 significant level earlier set for the hypothesis. Hence, (decision) the hypothesis is rejected and the alternative hypothesis is upheld. This implies that there is significant difference between the mean science process skills acquisition scores in science process skill acquisition test (SPSAT) of biology students exposed to Biology project work and those not exposed to Biology project work.

Hypothesis 1: There is no significant difference between the mean science process skills acquisition scores in science process skills acquisition test (SPSAT) of biology students exposed to Biology project work and those not exposed to Biology project work based on gender.

Table 4 shows that $F (.212)$ is not significant at .646 for gender at 1 and 133 degree of freedom (Df). This is because .646 is greater than .05 significant level earlier set for the hypothesis. Hence (decision) the hypothesis is not rejected, that is, there is no significant difference between the mean science process skills acquisition scores in science process skills acquisition test (SPSAT) of biology students exposed to Biology project work and those not exposed to Biology project work based on gender.

Hypothesis 2: There is no significant interaction effect between instructional strategy and gender on students’ acquisition of science process skills in biology.

Table 4 shows that $F (.002)$ is not significant at .966 for the interaction between strategy and gender at 1 and 133 degrees of freedom (df). This is because .966 is greater than .05 significant level earlier set for this hypothesis. Hence (decision) the hypothesis is not rejected, thus, there is no significant interaction effect between teaching strategy and gender on students acquisition of science skill in biology.

Findings

The students exposed to Biology project work had a high mean science process skill acquisition score in science process skill acquisition test (SPSAT) than those not exposed to Biology project work. Gender had influence on students’ acquisition of science process skills in biology. There was a significant difference between the mean science process skill acquisition scores of students in Science Process Skill Acquisition Test (SPSAT) of biology students exposed to biology project work and those not exposed to biology project work. There was no significant interaction between instructional strategy and gender on students’ acquisition of science process skill in biology.

Discussion of results

Evidence from the present study revealed that the mean science process skills acquisition scores in science process skill acquisition test (SPSAT) of students in both control and experimental groups in the pretest were close before the commencement of the treatment, showing homogeneity of group in intellectual ability. But after the treatment the students in the experimental group had higher mean in science process skills acquisition than students in control group. This shows that the teaching strategy (students’ project work) helped the students to acquire higher mean in science process skills than the control group. Therefore, the active involvement of students’ in project work may have given rise to effective learning which accounted for the reported significant effect in acquisition of science process skills. The findings of this study were in line with the view of previous researchers like Mandor (2002) and Ibe (2004) who opined that active participation of students gave rise to more meaningful and effective learning. Again, the result is in line with the findings of Chukwuemeka (2006) that science process skills were better acquired through active participation of pupils in the use of resources than conventional method. Therefore, active participation of the students in project work which involves minds-on, hands-on, during biology lesson might have enhanced learning and acquisition of science process skill. Also, the findings of this study on gender and acquisition of science process skills shows that male and female students in experimental group performed better than those in control group in SPSAT although the differences was not significant. This was further confirmed by the ANCOVA result in table 4 which revealed that gender was not a significant factor on students’ science process skill acquisition in biology.

This result is in agreement with the findings of Ibe (2006) who found out that gender did not affect the performance of students’ in science process skills acquisition. Ibe therefore suggested that activity based instruction should be used in teaching. The findings of this study also indicated that there was no interaction between teaching strategy and
gender of the subjects to influence students’ acquisition of science process skills in biology. This result is in agreement with the findings of Chukelu (2008) who found no interaction effect between teaching strategy and gender in acquisition of science process skills as measured by science process skill acquisition test (SPSAT). This was further confirmed by the ANCOVA analysis in Table 4 which shows that teaching strategy and gender has no significant interaction effect on acquisition of science process skill in biology. This therefore implies that gender did not combine with teaching strategy to affect the students’ acquisition of science process skills in biology. Any difference observed in students performance could therefore be attributed to the teaching strategy used which facilitated male and female students’ acquisition of science process skills in biology during treatment.

Conclusion

In conclusion, the study revealed that project work strategy has a facilitative effect on students’ science process skill acquisition in biology. Also, gender is not a significant factor on students’ science process skill acquisition in biology and there was no interaction effect between instructional strategy and gender on students’ science process skill acquisition in biology.

Recommendations

Based on the findings of this study, it was recommended that:

1. Teachers should adopt students’ project work strategy of teaching which is student-centered. This is because; students’ learn better when they are actively involved in activity. In project work strategy of teaching biology class, students are actively involved in hands-on-experience and get chance to relate abstract ideas and theories with concrete observations which help them to make deep understanding of biological concepts and increase the ability to acquire science process skills.

2. Curriculum planners should restructure and emphasize much on students’ project work as a means of instruction in the science curriculum particularly biology and in teacher Education Programme such that classroom activities are not only based on one-directional flow of information from teacher to the students. This will help to sustain students learning and interest throughout and beyond the lesson period and also enhances students’ acquisition of science process skill in biology.

References


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achievement in biology students of different levels of scientific literacy. *Journal of Science Teachers Association of Nigeria*, 36(1 & 2), 43 – 51.


