Effectiveness of Peer-Collaboration Learning Strategy and 21st Century Skill Knowledge on Pre-Service Teachers’ Academic Achievement in Integrated Science in Nigerian Colleges of Education

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ABSTRACT

This study examined the effectiveness of peer-collaboration learning strategy and 21st century skill knowledge on pre-service teachers’ academic achievement in integrated science in Nigerian colleges of education. This research employed non-equivalent group pre-test-post-test quasi experimental design. The sample for this study was 80 integrated science pre-service teachers from two colleges of education selected for the study. The instrument used for data collection was Integrated Science Achievement Test (ISAT). One research question and two null hypothesis were formulated were designed to guide the study. Descriptive statistics of means and standard deviation were used to answer all the research questions. The results of the study showed that, peer collaboration learning strategy enhanced 21st century skills pre-service teachers’ and performance in Integrated Science better than conventional method. Integrated science lecturer should not only use peer collaborative strategy to teach the students the subject matter but should also allow them to interact with one another, so that they (students) can take charge of how they can learn. This can foster confidence in the students and enhance their achievement in integrated science.

Keywords: Peer-Collaboration, Pre-service, 21st Century Skill, Performance, Colleges of Education.

1. Introduction

Nigeria is one country that is devoted to advancing its technology and scientific capabilities (Adejoh et al., 2013). Only effective science instruction and learning at all academic levels will make this possible. According to Ali (2004), the development and majority of civilization of nations can be attributed to their citizens' intentional and strategic scientific education. In regard to the nation’s efforts to achieve indigenous technical and industrial development through enhanced technique, scientific educators have received relative national priority. In its Vision Statement for STEM Education, the National Science Foundation (2020) asserts that all citizens may contribute to our nation’s prosperity and vibrancy. All students must have an equal chance to study the fundamentals of STEM in order to be ready for future STEM employment. The STEM Education of the Future combines our cutting-edge knowledge of how people learn with contemporary technology to make learning more individualized, to motivate learning, and to nurture creativity from a young age. As a result, a culture of creativity and inquiry will be fostered, and it will ensure that the Nigerians maintain its position as the world leader in scientific and technology discovery and competitiveness.

The Federal Government of Nigeria realized the need for National Commission for Colleges of Education (NCCE, 1990). This body is saddled with the responsibility of producing teachers with
Nigeria Certificate in Education (NCE) to teach in Primary and Junior Secondary Schools levels. Students’ who enrolled in this teacher training programme and working toward teacher certification are called pre-service teachers. They equipped with field-based teaching experiences with the support and mentorship of their institution and cooperating teachers. The cooperating teacher works with and encourages the pre-service teacher to assume greater responsibility for instruction and classroom management as the experience progresses. The pre-service teacher begins as an observer and finishes the pre-service teaching experience as a competent professional. The countries need to train individuals, who can think critically, creatively, and analytically in the 21st century, have high communication skills, can develop solutions to the problems they encounter in daily life, make decisions, conduct studies, interrogate and make conscious decisions in the future career choices (Holmes et al., 2018; Kızılay, Yamak & Kavak, 2020; Kier et al., 2014; Tuijl & Molen, 2016).

Examining answers of prospective science teachers related to themes of “Learning and innovations skills”, Kızılay et al. (2020) declared that STEM education contributed to the development of learning and innovation skills. When the explanations of the pre-service science teacher are considered; they have explained the development of their creativity by the fact that they have offered many solutions for solving a problem encountered in daily life. They have also mentioned that their ability to work in a team and collaboration has been increased and since they conducted some mini research and they needed the scientific information for solving the problems, this education program contributed to the development of their problem solving, critical thinking, and scientific process skills.

Pre-service teachers are expected to acquire adequate knowledge and perform excellently through innovative teaching strategies so as to fulfill the main objectives of establishing the Colleges of Education, which is to produce quality and competent teachers for primary and junior secondary schools. There are various teaching strategies that can be employed in the teaching and learning of Biology, these include inquiry method, scaffolding, concept mapping, discussion method, project method, programmed instruction and computer assisted instruction, mind mapping among others. In spite of these various teaching methods, pre-service teachers, according to (Marasigan, 2018) pre-service teachers still record low performance in the subject. Hence, there is the need to introduce other innovative teaching approaches that would help pre-service teachers to perform very well as classroom teachers. The researcher is of the view that if the improved teaching strategy such as peer-collaboration learning is emphasized in training pre-service teachers, they will master the innovative teaching strategy in the course of their training and find it more convenient to apply when they are in the field practicing as teachers.

In agreement with these assertions, science educators, (Adejoh, 2012; Samba & Eriba, 2012) have researched into method combination and modifications that can bring about effective teaching and learning of Integrated Science which is the foundation of all sciences at the higher levels. Perhaps, an addition of method combinations, such as peer collaboration and that form literature are scarce in the study area, could make for the intended change. Peer-collaboration learning is a method in which 4 or more students work together face-to-face in a classroom setting towards achieving a mutual goal of learning from a particular task (O’Donnell, 2006). Generally, some scholars (Zimmerman, 2008; Samuelson, 2010) have suggested that peer collaboration is a more effective method of teaching science at the Junior Secondary School level.

Chiappetta & Koballa (2010) considered that the learning and application of “science process skills” are always associated with scientific inquiry. Many factors have an impact on students’
achievement such as classroom environment, attitude and motivation, and above all teaching methods and strategies. Educators around the world have been investigating various teaching strategies in science classes to improve students’ outcomes. One of the most favored investigated teaching strategies among science educators is cooperative learning; it is considered as one of the most efficient instructional methods that enable students to work together in solving scientific problems, as it improves students’ thinking skills and abilities, and has the potential to promote academic achievement, enhance social skills, and improve self-esteem by engaging students in an active learning environment (Vijayratnam, 2009).

There seems to be an existing gap that needs to be filled by the researcher, which this study aims to achieve, that is, effect of peer-collaboration learning strategy on pre-service teachers’ performance in integrated science in Nigerian colleges of education. This study aimed to develop and assessed a peer-collaboration Learning Strategy in teaching integrated science pre-service science students. Specifically, it answered the following questions:

1. Determine the skills that peer-service integrated science will acquired when using peer collaboration learning strategy in terms of critical thinking, problem solving, creativity, communication, collaboration, scientific process skills.
2. The mean achievement scores of Pre-service taught integrated science using peer collaboration and those taught using conventional method.

The following null hypotheses were formulated and tested at 0.05 level of significance in the study:

HO1: There is no significant difference in the mean gain scores of integrated science pre-service teacher taught with peer-collaborative learning strategy and those taught with conventional method in Nigeria Colleges of Education.

HO2: There is no significant difference in the pre-test and post-test mean gain scores of integrated science pre-service teacher academic performance when taught with peer-collaborative learning.

2. **Materials and Methods**

2.1 **Research Design**

The research design adopted in this study was pre-test and post-test control group quasi-experimental design.

2.2 **Research Location**

The population for this study comprised all the 200 level pre-service integrated science teachers in all the public colleges of education in Oyo State.

2.3 **Respondents of the Study**

The researcher made use of 200 level pre-service teacher from which 40 students were selected from each institution using gender and academic performance as basis for selection. The integrated science pre-service teachers in Federal College of Education (Special) Oyo, were used as treatment group and they were exposed to peer-collaboration while the integrated science pre-service teacher in Emmanuel Alayande College, Oyo, were used as the control group and they were exposed to a conventional strategy.
2.4 Research Instruments

Three research instruments were used which are: Teacher Instructional Guide for Peer-Collaboration Learning Strategy (TIGPCLS), Teacher Instructional Guide for Conventional Teaching (TIGCT) and Pre-service Teachers’ Achievement Test in Integrated Science (PTATIS). Teacher Instructional Guide for Peer-Collaboration instrument contained sub-heading of description such as topic selection, duration, performance objectives, schedule of activity, selection of tutor, students’ activities (peer tutoring), description of activities/briefing, summary, evaluation and assignment (schedule of next classroom activities). Teacher Instructional Guide for Conventional Teaching (TIGCT) was constructed by the researcher as treatment for the conventional group. The instrument contained sub-headings of description such, topic, duration and expected performance objectives, the procedure, and content for each lesson, summary of the lesson, evaluation and assignment. The Pre-service Teachers’ Achievement Test in Integrated Science (PTATIS) consisted thirty multiple-choice objective test items drawn from the topics taught (Component of the Environment II, Dynamics & Carbon Compound). It consisted of two sections with Section A consists of the demographic information such as school (college), name, age, gender, name and mode of entry while section B containing duration, instruction and the test items. The alternatives for the questions range from A to D.

2.5 Methods of Data Analysis

The quantitative data collected were analysed using Mean and Standard Deviation and inferential statistics of analysis of covariance (ANCOVA) to determine the significant main effects.

3. Results and Discussion

3.1 Quantitative Data Analysis of 21st Century Skills Data

In analyzing the 21st Century skills data, it began by determining descriptive statistics, which include the mean and standard deviation of initial data, final data based on learning, mathematical prior knowledge (MPK), and overall. The data of descriptive statistics is presented in Table 1.

<table>
<thead>
<tr>
<th>s/n</th>
<th>Variable</th>
<th>N</th>
<th>Skills</th>
<th>Mean</th>
<th>Grand mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Peer collaboration</td>
<td>40</td>
<td>Critical Thinking</td>
<td>2.68</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Problem solving</td>
<td>3.08</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Creativity</td>
<td>2.92</td>
<td>2.62</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Communication</td>
<td>2.34</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Collaboration</td>
<td>2.46</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Science process skills</td>
<td>2.23</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Conventional Teaching</td>
<td>40</td>
<td>Critical Thinking</td>
<td>1.08</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Problem solving</td>
<td>1.68</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Creativity</td>
<td>0.82</td>
<td>1.09</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Communication</td>
<td>1.34</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Collaboration</td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Science process skills</td>
<td>1.43</td>
<td></td>
</tr>
</tbody>
</table>

Based on Table 1 in the organizing skill acquire through peer collaboration, the highest mean is the Problem solving with the value of 3.09 (Very High) while the average mean in skills acquire is in the science process skills which is 2.23 (Average). While other skill like creativity, critical thinking,
communication and collaboration (2.92, 2.68, 2.34 and 2.46) average. In other hand, skill acquire through conventional learning, the highest mean is the Problem solving with the value of 1.68 (Low) while the very low mean in skills acquire is in the collaboration which is 0.16 (very low). While other skills like communication, critical thinking, science process skill and creativity (1.34, 1.08, 1.43 and 0.84) which all low. Table 1 shows that peer collaboration learning strategy has a positive significant on the skills acquire in pre-service integrated science teacher than convention learning.

Figure 1. Mean 1 percentage of peer collaboration learning strategy based on 21st century skills acquired.

Figure 2. Mean 2 percentage of conventional learning strategy based on 21st century skills acquired.
Figures 1–3 shows that the mean of overall for the 21st century skills of students taught by using peer collaboration learning is higher than students taught by using conventional learning. The mean percentage of the PS skill in both classes of peer collaboration learning and conventional learning has higher mean, but PS skills is in Peer collaboration learning is higher than PS skill in conventional learning. That shows, when a integrated science pre-service teacher is being engaged with peer collaboration learning strategy, there will be great significant in acquired 21st century skills.

In order to answer the question, mean scores relating to academic performance of pre-service teachers in integrated science before and after being exposed to peer collaboration learning and conventional teaching instructional strategies were computed and compared.

Table 2. Mean and standard deviation of academic performance of pre-service teachers in integrated science using peer collaboration and conventional learning.

<table>
<thead>
<tr>
<th>Instructional Strategies</th>
<th>N</th>
<th>Pretest Mean</th>
<th>Pretest SD</th>
<th>Posttest Mean</th>
<th>Posttest SD</th>
<th>Means Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peer-collaboration Learning Strategy</td>
<td>40</td>
<td>11.46</td>
<td>1.74</td>
<td>26.21</td>
<td>1.91</td>
<td>14.75</td>
</tr>
<tr>
<td>Conventional Teaching</td>
<td>40</td>
<td>11.90</td>
<td>1.63</td>
<td>16.80</td>
<td>2.82</td>
<td>4.90</td>
</tr>
</tbody>
</table>

Table 2 shows the mean and standard deviation of academic performance of integrated science pre-service teachers using peer-collaboration learning and conventional method. The result revealed that before the treatment, the integrated science pre-service teachers in peer-collaboration group had performance mean score of (11.46) while those in conventional teaching groups had performance mean scores of (11.90) with mean difference of (0.44) which is marginal. Their measure of variability had a difference of (0.11). After the treatment, the pre-service teachers exposed to peer collaboration had performance mean score of (26.21) while those exposed to Conventional Teaching method had performance mean score of (16.80) with mean difference of (9.41). Their measure of variability had a difference of (0.91). This implies that the use of peer collaboration influences academic performance of pre-service teachers in integrated science as peer collaboration strategy has the higher mean difference of (14.75) as against the (4.90) for the conventional teaching strategy.

Null Hypothesis 1: There is no significant difference in the mean gain scores of integrated science pre-service teacher taught with peer-collaborative learning strategy and those taught with conventional method in Nigeria Colleges of Education.
From Table 3, the following values were obtained: \( t\text{-cal} \) (2.75); \( t\text{-crit} \) (2.00) at degree of freedom of 78 and 0.05 level of significance. Post-test mean of the experimental group yielded 9.85 and that of the control group 8.78. Therefore, the null hypothesis is rejected implying that with peer collaborative learning, there is a significant positive difference in the performance of integrated science pre-service teachers in used as treatment group than control group.

**Null Hypothesis 2**: There is no significant difference in the pre-test and post-test mean gain scores of integrated science pre-service teacher academic performance when taught with peer-collaborative learning.

Table 4 shows the pre-test and post-test mean scores of integrated science pre-service teachers when taught with peer-collaborative learning as 4.77 and 8.89 respectively. The results further revealed \( t\text{-cal} \) as 4.94 and \( t\text{-crit} \) (2.00) at a degree of freedom of 78 and 0.05 level of significance. The null hypothesis is therefore rejected, revealing that there was significant improvement in performance of integrated science pre-service teachers when taught with peer-collaborative learning strategy.

The result showed that there is a main significant effect of treatment on pre-service teachers’ academic performances in integrated science. The main effect of peer-collaborative learning strategy was the best while the conventional strategy has the least main effect of treatment. This indicates that peer-collaboration learning strategy will improve 21st century skill knowledge among integrated science pre-service teacher and capable of improving pre service teacher achievement in integrated science than the conventional method that is the control. This is probably because it is a strategy that motivates and encourages both the students and teachers during classroom interaction. In this method, the teacher provides the students with opportunity to discover new truths, rules and methods to tackle problems as well as new values for themselves which will leads to developments of 21st century skills among integrated science pre-service teachers. In the study, the teacher provides the student materials to manipulate explore and experiment in order to find out facts and gain knowledge by themselves. All these are seen as capable of improving the teachers’ effectiveness and as well enhancing students’ academic performance in integrated science pre service teachers.
The finding agrees with Ibidiran (2017) that pre-service teachers learn better when engage with the information and processes deeply enough to wave the content of the subject matter into their personal views and understanding. The report of Marasigan (2018) is also in line with the performance of pre-service teachers after the post-test which reported a consistent significant relationship between instructional strategy and pre-service teachers’ performance. This developed their 21st century skills, critical thinking, problem solving, creativity, collaboration, science process skills, and communication skills, increased cooperation and tolerance of one another as pre-service teachers are from diverse background working together to achieve group goal and aspiration. Also, this is supported with Srinivas (2011) who submitted that in collaborative learning environment, learners have the opportunity to interact among themselves thereby actively engaged in teaching learning activities.

4. Conclusion and Recommendation

The findings of this study also revealed that the achievement (post-test) mean scores of pre-service teachers in the two groups (peer-collaboration learning and conventional strategies) were significantly different after the treatment. The peer-collaboration group was more effective strategy than the conventional strategy.

Pre-service teachers’ better performance in peer-collaboration may also be due to fact that they worked cooperatively with their peers thereby providing the social context for the pre-service teachers to actively learn and make deeper connections among facts, concepts and ideas. This developed their creativity, critical thinking, problem solving, communication and science process skills, increased cooperation and tolerance of one another as pre-service teachers are from diverse background working together to achieve group goal and aspiration. This made learning to be more permanent.

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

1. Integrate science lecturer in Nigerian Colleges of Education should be encouraged to deliver instructions in integrated science via peer collaborative learning strategy.
2. Integrated science lecturer should encourage social interactions among students in order to boost their academic achievement in schools.
3. Science lecturers should embrace the innovative instructional strategies by using peer collaboration instructional strategy in order to facilitate performance of pre-service teachers in integrated Science. Also, the strategy should be encouraged among pre-service teachers so that they will find the strategy convenient and easy to use when practicing as a teacher and developed 21st century skills.

References


