

Effects of Collaborative Learning on Academic Performance of Students in Technical Drawing in Rivers State University, Port Harcourt, Nigeria

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Abstract

The study investigated the effects of collaborative learning on academic achievement of students in Technical Drawing in Rivers State University, Port Harcourt, Nigeria. The study adopted quasi-experimental pre-test post-test control design. A sample size of 28 technical education first year students out of a population of 55 students of technical education department in the University was purposively sampled for the study. Two research questions and two hypotheses guided the study. The instrument used for data collection was Technical Drawing Achievement Test (TDAT), which was validated and its reliability coefficient of 0.86 was obtained using Kuder-Richardson formula. Mean was used to analyze data for the two research questions while t-test was used to test the two null hypotheses at 0.05 level of significance. The major finding revealed an improvement in students' academic performance in Technical Drawing after being taught with collaborative learning. Based on the finding, it was recommended amongst others that teachers should orient and appropriate students' tasks, encourage students' social interaction in class and facilitate students' collaboration in any Technical Drawing class.

Keywords: Technical Drawing, performance, collaborative, learning, teaching, conventional.

Introduction

Technical Drawing is one of the foundational courses in Engineering, Architecture, Technical Education, and other related technological courses offered in tertiary institutions across the globe. Amaechi (2006) described Technical Drawing as a graphic representation of figures by engineers, technicians, artisans, technologists, architects and students for effective communication in the industrial sector. In the same vein, Yarwood (cited in Umar, 2005) viewed Technical Drawing as a means by which those working in industries such as mechanical engineering, building, architecture or electrical engineering communicate their ideas of the shapes, forms and dimensions of the articles being made. It is also seen as the universal language, which is used by engineers, architects, building technologists, and other professionals to communicate their thoughts, ideas and feelings about objects, which are of interest to them as compared to verbal or written description, this method is brief and more clear (Reddy, 2008).

Thus, Technical Drawing refers to the skills required to produce accurate plans and designs that act as a form of visual communication to others based on certain globally

accepted standards. In essence, Technical drawing involves creativity, which is expressed in graphics and arts. Although the importance of technical drawing are numerous and varied, nevertheless some undergraduate students admit some level of difficulty in learning it and this invariably leads to their poor academic performance in the course (Amaechi, 2006). Prominent among possible factors that might be responsible for poor academic performance of students in technical drawing is method of instruction (Fajimi, 2005). The teaching of technical drawing at first level in tertiary institutions is of great importance to the students and it is most desirable that current principles are observed from the preliminary stage of instruction in any drawing course. Based on the foregoing, the researchers believe that there is need to consider alternative teaching strategies to complement the dominant traditional teaching method for effective instruction delivery in Technical Drawing as an undergraduate course. One of these is collaborative or cooperative learning (CL) method, which according to Gull and Shehzad (2015), is a method which presumes that team effort of students towards single goal of learning a particular aspect result in more understanding than solo efforts.

Statement of the problem

Technical drawing being one of the foundational courses in technology and engineering disciplines is not only useful in the academic environment but also in everyday life experiences. However, it has been observed that students' prospect for advanced career pursuits in TVET and Engineering are being hampered as a result of their poor performance in Technical and Engineering Drawings (Amaechi, 2006; Diraso, Manabete, Amalo, Mbudai, Arabi & Jaoji, 2013). It is possible that the method of instruction could be one factor responsible to this poor student achievement in Technical Drawing (Fajimi, 2005), hence the need to consider a more pragmatic approach to teaching Technical drawing in schools.

Based on literature, cooperative learning (CL) has been documented in educational research as successful pedagogy in preference to conventional teaching (CT), to improve students' academic achievement (Aziz & Hossain, 2010; Hossain & Tarmizi, 2012; Gull & Shehzad, 2015). However, a vast majority of research on cooperative learning in local and international contexts had been carried out either in science subject learners or at primary and secondary school levels, with little on technology based subjects and at higher education research. In particular, available literature to the authors of this research, revealed paucity of research evidence on the effect of CL on technical subjects such as Technical Drawing at tertiary institutions in Nigeria. Taking into cognizance the numerous benefits of cooperative learning structures, the researchers believe that its application in technology-related subjects needed to be highlighted. Therefore, it was in an attempt to bridge the knowledge gap on the effects of cooperative learning on technology based subject such as Technical Drawing at higher education level that gave credence to this study.

Purpose of the Study

The study seeks to investigate the effects of collaborative learning on academic performance of students in Technical Drawing in Rivers State, Port Harcourt; Nigeria. Specifically, the study was conducted to:

1. Determine if a mean gain difference exists in student's academic performance when taught Technical Drawing with collaborative learning strategy and when taught with conventional method in Rivers State University, Port Harcourt.
2. Determine if a mean gain difference exists in the pre-test and post-test mean scores of students' academic performance in Technical Drawing when taught with collaborative learning in Rivers State University of Science and Technology, Port Harcourt.

Research Questions

The following research questions were posed to guide the study;

1. What is the mean gain difference in academic performance of students taught Technical Drawing with collaborative learning strategy and those taught with conventional method in Rivers State University, Port Harcourt?
2. What is the mean gain difference in the pre-test and post-test mean scores of students' academic performance in Technical Drawing when taught with collaborative learning in Rivers State University, Port Harcourt?

Null Hypotheses

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

1. There is no significant difference in the mean gain scores of students taught Technical Drawing with collaborative learning strategy and those taught with conventional method in Rivers State University, Port Harcourt.
2. There is no significant difference in the pre-test and post-test mean gain scores of students' academic performance in Technical Drawing when taught with collaborative learning in Rivers State, Port Harcourt.

Literature Review

Cooperative learning can be an educational approach that promotes interaction among students and shared responsibility for academic achievement. Laal and Laal (2012) defined collaborative learning as an educational approach to teaching that involves groups of learners working together to solve a problem. In collaborative learning, students take responsibility for their learning which leads to better performance (Rester & Laferriere, 2007). It may be in this context that Shimazoe and Aldrich (2010) stated that cooperative learning promotes students with deep learning of materials, ensures students achieve better grades, help students develop positive attitudes towards autonomous learning, promotes personal growth and higher-order critical thinking skills among students. In a nutshell, cooperative learning promotes positive learning attitude among students (Johnson & Johnson, 2008; Ifamuyiwa & Akinsola, 2008). A cooperative learning strategy is considered crucial in improving performance.

As a concept, cooperative learning is believed to be rooted within social interdependence theory; with its basic premise that the way in which social interdependence is structured determines how individuals interact within the situation which, in turn, affects outcomes (Johnson & Johnson, cited in Herrmann, 2013). According to this theory, cooperation is most effective when students perceive that they share similar goals and when the individual members' goals are positively dependent on the actions of the group. Such positive interdependence is assumed to enhance promotive interaction, where students encourage and help each other to reach their goals, students giving each other feedback, students challenging each other's conclusions and reasoning, and students taking the perspectives of others to better explore different points of view. On the contrary, negative interdependence exists when the efforts of others are detrimental to the students learning outcome (Johnson & Johnson, 2009). In this context continued, Johnson and Johnson, healthy interaction among students expectedly, will lead to higher academic achievement. Thus, with well-coordinated collaborative learning, students are not only in groups but they work together in groups, playing a significant role in each other's learning. According to Johnson and Johnson (cited in Aziz & Hossain, 2010), collaborative learning fosters positive interdependence in that students believe they sink or swim together. Students participating in collaborative learning do not only learn the materials themselves, but they also ensure that their team members learn the materials too. In essence, collaborative learning therefore, is student-centered – instructional method of promoting active student engagement (Herrmann, 2013). Thus, with the application of collaborative learning in the teaching of Technical Drawing in Rivers State University (RSU), Port Harcourt, Nigeria, students will have ample opportunity to work together as a team thereby enhancing their learning skills which will automatically improve on their academic performance in the course.

Unlike the collaborative learning approach, the conventional teaching method commonly used in Technical Drawing instruction as obtainable in other courses is teacher-centered. This implies that the teacher becomes the center of attraction rather than the students. Conventional teaching method constitutes a loss both for the teachers who apply it in teaching technical courses and the students (Felder & Brent, 1994). Cooperative learning has edge over other teaching methods in terms of its effectiveness for improved cognition, social skills and motivation.

Cooperative learning has been a subject of interest to researchers for the past decades (Aziz & Hossain, 2010). There is a substantial body of literature supporting the idea that students can attain higher achievement, through working together in groups. For example Effandi (2003) found that there was an overall significant difference between the Collaborative (experimental) and traditional (control) groups in terms of achievement in a mathematics matriculation class; concluding that the utilization of collaborative methods is a preferable alternative to traditional instructional method. Similarly, study carried out by Arbab (2003) on general science students also proved that students taught with cooperative learning method has improved results than control group. Effandi, Lu Chung and Daud

(2010) in their study showed that cooperative learning methods improve students' achievement in mathematics. Ajaja and Eravwoke (2010) in their research on the effects of cooperative learning in students' achievement in Integrated Science subject revealed a significant higher achievement test scores of students in cooperative learning group than those in traditional classroom. Furthermore, Hossain and Tarmizi (2012) reported that cooperative learning had significant effects on mathematics achievement.

A number of studies cited, as seen above, report cooperative learning to improve students' achievement in many school subjects. Nevertheless, some studies report that not all forms of cooperative learning is instructionally effective (Slavin, 2011). For example, Machemer and Crawford (2007) found that cooperative learning activities, unless they are perceived to relate to examinations, were valued less than lectures or other forms of active learning. Similarly, Hammond *et al* (cited in Herrmann, 2013) reported that students valued the social aspects of working with peers, but that they were less likely to agree that cooperation helped them achieve better in assessed tasks. All the same, Johnson and Johnson (2004) in their study stated that since 1897, over 550 experimental studies have been conducted on CL in different disciplines, and the results show the effect of CL promote more positive attitudes toward the task as well as cooperation tends to promote higher achievement.

Methodology

The study adopted quasi-experimental pre-test post-test control group design which compared a control group using conventional teaching method with an experimental group using collaborative learning to identify the effects of collaborative learning in students' academic performance in Technical Drawing course. The population of the study comprised 55 first year students of technical education in Rivers State University (RSU) as at 2016/2017 academic session. A total of 28 students were purposively sampled and used for the study. The participants were distributed equally into the control and experimental groups of 14 students each respectively. The instrument used for data collection was a 10-item Technical Drawing Achievement Test (TDAT) prepared by the researchers based on the 100 level Technical Drawing course content. Two experts in technical education and one in Measurement and evaluation at the Rivers State University, Port Harcourt validated the instrument and its reliability was ascertained at correlation coefficient of 0.86 using Kuder-Richardson formula.

In carrying out the experiment, one of the researchers with skills in technical drawing and cooperative learning strategy was assigned to teach both the control and experimental groups. In order to determine the pre-existing differences in overall ability of both groups, the groups were pretested and their mean scores obtained. Then, the experimental group received treatment in the form of collaborative learning leading to the administration of a post test on the group after which the mean score was recorded. However, the students in cooperative learning group completed learning activities in small groups while the students in

the control group did not receive any treatment rather they were taught via the conventional method and thereafter, post-tested and the mean score noted. The entire exercise lasted for a period of four weeks. The data obtained were statistically analyzed using mean for the two research questions while the t-test statistics was used to test the two null hypotheses at 0.05 level of significance.

Results

The results were presented in relation to the research questions and hypotheses as follows.

Research Question 1: What is the mean gain difference in academic performance of students taught Technical Drawing with collaborative learning strategy and those taught with conventional method in Rivers State University, Port Harcourt?

Table 1: Mean Gain scores of students' academic performance in Technical Drawing.

Groups	Pre-test (N)	Post-test (N)	Pre-test mean (M ₁)	Post-test mean (M ₂)	Mean gain
Experimental	14	14	4.78	8.85	4.07
Control	14	14	4.71	7.78	3.07

Table 1 revealed that the pre-test mean score of the experimental group which used collaborative learning strategy was 4.78 while that of the control group which used conventional method was 4.71. Again, the post-test mean scores for both the experimental and the control groups were recorded as 8.85 and 7.78 respectively. Again, the mean gain on the basis of the differences between the pre-test scores and post-test scores of each group indicated 4.07 for the experimental group and 3.07 for the control group. This shows that the performance of students in Technical Drawing was better when taught with collaborative learning.

Research Question 2: What is the mean gain difference in the pre-test and post-test mean scores of students' academic performance in Technical Drawing when taught with collaborative learning in Rivers State University, Port Harcourt?

Table 2: Pre-test and post-test mean scores of students taught with collaborative learning.

Group	Teaching method	N	Pre-test mean	Post-test Mean	Mean Difference
Experimental group	Collaborative learning	14	4.78	8.85	4.07

Table 2 above showed that the pre-test and post-test mean scores of students taught Technical Drawing with collaborative learning were obtained as 4.78 and 8.85 respectively, giving a mean difference of 4.07. This is an indication that there was an improvement in performance of students in Technical Drawing when taught with collaborative learning approach.

Null Hypothesis 1: There is no significant difference in the mean gain scores of students taught Technical Drawing with collaborative learning strategy and those taught with conventional method in Rivers State University, Port Harcourt.

Table 3: t-test analysis on the post-test mean gain scores of the experimental and control groups.

Groups	N	Mean	Mean Difference	df	t-cal	t-crit	Decision
Experimental	14	8.85					
			1.07	26	2.75	2.00	Rejected
Control	14	7.78					

From Table 3, the following values were obtained: t-cal (2.75); t-crit (2.05) at degree of freedom of 80 and 0.05 level of significance. Post-test mean of the experimental group yielded 8.85 and that of the control group 7.78. Therefore, the null hypothesis is rejected implying that with collaborative learning, there is a significant positive difference in the performance of students in Technical Drawing in Rivers State University.

Null Hypothesis 2: There is no significant difference in the pre-test and post-test mean gain scores of students' academic performance in Technical Drawing when taught with collaborative learning in Rivers State University, Port Harcourt.

Table 4: t-test analysis on the pre-test and post-test mean gain scores of experimental group.

Subjects	Teaching method	N	Mean	SD	Level of significance	df	tcal	tcrit	Decision
Pre-test	Collaborative learning	14	4.78	0.87	0.05	80	4.93	2.00	Rejected
Post-test	Collaborative learning	14	8.85	1.12					

Table 4 showed the pre-test and post-test mean scores of students in Technical Drawing when taught with collaborative learning as 4.78 and 8.85 respectively. The results from the Table 5 further revealed t-cal as 4.93 and t-crit (2.00) at a degree of freedom of 80 and 0.05 level of significance. The null hypothesis is therefore rejected, revealing that there was significant improvement in performance of students in Technical Drawing when taught with collaborative learning approach.

Discussion

The analysis in Table 1 shows that students exposed to collaborative learning strategy performed better academically than those exposed to conventional method in technical drawing. This finding is in line with Johnson and Johnson (2009) who stated that healthy interaction among students leads to higher academic achievement.

Table 2 indicated that the pre-test and post-test mean scores of students taught Technical Drawing with collaborative learning recorded 4.78 and 8.85 respectively, giving a mean gain difference of 4.07. This implies that students' academic performance in Technical Drawing was better after being taught with collaborative learning. This finding is in line with Hossain and Tarmizi (2012) who reported that cooperative learning had significant effects on student's achievement. Table 3 shows the t-test analysis of the null hypothesis to find out if significant difference exists between the performances of students in Technical Drawing in both groups after they have been taught using collaborative learning and conventional methods of instruction. From the Table 3 result showed that the t-cal (2.75) was greater than the t-crit (2.00). Therefore, the null hypothesis is rejected indicating that with collaborative learning, there is a significant positive difference in the performance of students in Technical Drawing in Rivers State University, Port Harcourt. This finding is consistent with previous research studies by Ajaja and Eravwoke (2010); Aziz and Hossain (2010); Arbab (2003); Effiandi (2003); Gull and Shehzad (2015); Hossain and Tarmizi (2012) who found that cooperative learning is more effective in comparison to traditional methods for improving academic achievement in different subjects and at various levels of learning .

From Table 4, the t-cal (4.93) was greater than the tcrit (2.00), implying that the null hypothesis which stated that there is no significant difference in the pre-test and post-test mean scores of students in technical drawing when taught with collaborative learning was rejected. 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. This finding is also in consonance with Borich (2004) who submitted that cooperative learning guarantees intense and prolonged interaction among students thereby making them to gradually take responsibility for each other's learning.

Conclusion

Based on the study findings, it can be concluded that collaborative learning as a method of instruction creates an opportunity for students to learn in groups by sharing their views, ideas and perceptions among themselves thereby promoting better academic performance in any skill-oriented courses such as technical drawing. Secondly, collaborative learning is seen as very instrumental in promoting positive learning attitude in students. Thus, for improved instruction in technical drawing, collaborative learning strategy is considered indispensable. When implemented well, cooperative learning encourages achievement, student discussion, active learning, student confidence, and motivation. Taking into cognizance the numerous benefits of cooperative learning structures, the researchers believe that its application at all levels of education and in technology-related subjects needed not be overstressed.

Recommendations

From the findings of the study, the following recommendations are made:

1. Technical drawing teachers in universities should be encouraged to deliver instructions in Technical Drawing via collaborative learning strategy.

2. Technical drawing teachers in universities should encourage social interactions among students in order to boost their academic achievement in schools.
3. Technical drawing teachers in universities should orient and develop appropriate students' tasks and guide towards achieving maximum results.
4. Technical drawing teachers in universities should facilitate students' collaboration in any technical courses such as technical drawing.

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