



Effects of Peer Tutoring Strategy on Academic Achievement of Senior Secondary School Students in Technical Drawing in Nigeria

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

This study was designed to determine the Effects of Peer Tutoring Strategy on Academic Achievement of Senior Secondary School Students in Technical Drawing in Ekiti State, Nigeria. The study adopted the quasi-experimental research design, precisely, pre-test, post-test non equivalent control group design which involved groups of students in their intact classes. The population for the study was all 81 SSS II students offering Technical Drawing in all Senior Secondary Schools in Ekiti State. Two research questions and three null hypotheses tested at 0.05 level of significance guided the study. The instrument used for data collection was the Technical Drawing Achievement Test (TDAT), The TDAT instrument was subjected to face and content validation by three experts. The trial test for determining the coefficient of internal consistency and stability of the instrument was carried out using Pearson Product Moment correlation statistics, Kuder –Richardson-20. (K-R.20). The value was found to be 0.70. Mean was used to answer the research questions, while ANCOVA was employed to test the hypotheses. The result of the study indicated that peer tutoring strategy was more effective in improving students' cognitive achievement than the conventional teaching method. The study also indicated effects of gender on

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students' achievements in Technical Drawing favouring girls. There were no interaction effects of treatments and gender on achievement of Senior Secondary School Students in Technical Drawing. It was recommended that technical drawing teachers should endeavor to incorporate peer tutoring strategy into the teaching of technical drawing so as to increase achievement and encourage students' enrolment among other recommendations.

Keywords: Peer tutoring; technical drawing; senior secondary school; Ekiti state.

1. INTRODUCTION

Technical drawing is essentially a language by which technicians, engineers, craftsmen, and industrialist communicate. It is a pictorial language that depends mainly on lines for conveying the intended meaning. Technical drawing (TD) is thus a universal language that is understood by technicians and engineers all over the world. At present, TD is not being made compulsory at the SSS level. It is essentially chosen by students who intend to study science, engineering and technology related courses at the tertiary level. According to Okoro [1] the importance of Technical drawing cannot be over emphasised. He asserts that technical drawing allows efficient communication among engineers and prospective engineers alike such communication can thus be kept as a record of the planning process. He further opined that TD enables trainee to develop the ability to produce simple engineering drawing and sketches based on current practice. It also makes individual to develop the skills to read manufacturing and construction drawings used in industry, to develop a working knowledge of the layout of plant and equipment, to develop skills in abstracting information from calculation sheets and schematic diagrams to produce working drawings for manufacturers, installers and fabricators. Thus for a nation to develop technologically the study of TD must be emphasized as it is the foundation of all engineering related courses.

In order to achieve the objective of effective training of prospective competent engineers and technologist, government at both the federal and state levels expended huge amount of money on the procurement of equipment for use as technical education equipment in the secondary schools. In the same vein, such effort like curriculum review, policy shift, re-training, and production of technical education teachers by the government to ensure qualitative education at the Senior Secondary School (SSS) level and bring about high quality products both in academics and for employment have not yielded

much dividend [2]. There have been persistent reports of high rate of failure in technical drawing in the West African Senior School Certificate Examination (WASSCE). The analysis of West African Examination Council (WAEC) result compiled by the planning, Research and Statistics Department, Ekiti State Ministry of Education, Science and Technology in 2015 revealed that of the entire forty six candidates that sat for TD in 2013, no single candidate passed at credit level. Thus a perfect 100% failure was recorded, only 06.0% of the fifty five candidates that sat for TD in 2014 passed at credit level, while in 2015 only a disturbing 15.5% of the 42 candidates that sat for the examination passed at credit level. One probable cause of the steady fall in the performance level in technical/ vocational subjects like Technical Drawing according to WAEC Chief Examiner's report [3] is indicative of a serious variance between the expectations of National Policy on Education (NPE) and reality, and calls for an assessment of the available infrastructure as well as the strategies for the teaching and learning of the subject.

The goal of technical drawing can however be achieved only when the subject is appropriately and effectively taught to learners. This can be possible by making the teaching/learning process to be student-centered as against being teacher-centered and by also viewing students as problem solvers rather than direction followers. Salami [4] observed that many teaching methods do not use students to their full capacity, and for this reason Salami suggested the use of appropriate teaching methods that is student centred as against teacher centred.

A major goal of the 6-3-3-4 in Nigeria is to produce a new generation of students that is productive, innovative, and has critical and creative thinking skills. To this therefore the learning environment should be transformed from one that is predominantly memory-based and teacher-based learning environment, to one that emphasises critical and creative thinking and

promotes learner-centered learning [5]. Such as peer tutoring.

Peer tutoring is an instructional strategy that consists of pairing students together to learn or practice an academic task. It can also be regarded as the process between two or more students in a group where one of the students acts as a tutor for the other group-mate(s). Paul [6] defined peer tutoring as an instructional strategy that partners students to help one another learn material, reinforce skills or practice a learned task. Conrad [7] viewed Peer tutoring as an organized learning experience in which one student serves as the teacher or tutor, and one is the learner or tutee. that peer tutoring gives students an opportunity to use their knowledge in a meaningful, social experience On this same vein Howard, Heron, Ellis & Cooke [8] assert that Tutors reinforce their own learning by reviewing and reformulating their knowledge. Tutees gain one-on-one attention. Both tutors and tutees gain self-confidence further more Brittany, Jennifer and Jasneen [9] also sees Peer tutoring as a flexible, peer-mediated strategy that involves students serving as academic tutors and tutees.

There are mainly two types of peer tutoring namely incidental peer tutoring (IPT) and structured peer tutoring (SPT). Incidental peer tutoring often takes place, either at school or while students are playing after school or when they are socializing. Whenever children are cooperating, playing or studying and one guides the others, such is regarded as incidental peer tutoring.

Structured peer tutoring on the other hand refers to peer tutoring implemented in specific cases and for specific subjects, following a well-structured plan prepared by the teacher. Structured peer tutoring is spontaneously used by experienced teachers who are able to plan well in advance and are familiar on how to combine tutors and tutees appropriately in order to have good results. Varieties of the SPT exists, this include, Cross-age Peer Tutoring (CAPT), Peer Assisted Learning Strategies (PALS), Reciprocal Peer Tutoring (RPT), Same-age Peer Tutoring (SAPT) and Class wide Peer Tutoring (CWPT). The Classwide peer tutoring (CWPT) which was adopted in this study involves dividing the entire class into groups of two to five students with differing ability levels. Students then act as tutors, tutees, or both tutors and

tutees. Typically, CWPT involves highly structured procedures, direct rehearsal and competitive teams [10].

Despite the Variations that exist among peer tutoring instructional approaches, the underlying theory is that peer interaction can have consistent powerful influence on academic achievement [11,12,13].

Studies have shown that socialization experiences that occur during peer tutoring can benefit both the tutor and tutee by motivating students to learn and increasing their social standing among peers [14,15,16]. It has also been attest to that When students understand the benefits of peer tutoring and have the tools to become effective tutors and tutees, they make greater progress than those who are not given any instruction on how to work together [17] Again, peer tutoring allows teachers to accommodate a classroom of diverse learners including students with learning disabilities. This instructional strategy increases response opportunities for students, provides additional time for positive feedback, and increases the amount of time a student is on-task [10].

Additionally, peer tutoring allows teachers to accommodate a classroom of diverse learners including students with learning disabilities. This instructional strategy increases response opportunities for students, provides additional time for positive feedback, and increases the amount of time a student is on-task [10] without recourse to gender.

Gender refers to a psychological term, which describes behaviours and attributes expected of individual on the basis of being a male or a female [18], (2005). Several studies, Oyenuga [19], Jimoh [20] Owodunni [21] have shown differential performance in vocational education trade subjects in secondary schools as a result of gender, while some other studies such as Ogundola and Fakorede [22] Owodunni and Ogundola [23] who found no gender influences in vocational education trade subjects achievement at the secondary school level.

The need to inculcate in students' the workplace basic and thinking skills that will enable them to fit properly in the world of work and improve their performance, encourage both male and female students' participation called for effective instructional techniques.

1.1 Statement of the Problem

The problem of this study is that senior secondary school students offering TD are not performing well in the subject. There have been persistent reports of high rate of failure in technical drawing in WSSCE. This is because not even a single candidate of all the 44 candidates that sat for technical drawing out of a total 11,011 that wrote WAEC in 2013 passed at credit level in Ekiti state, in 2014 only three passed at credit level out of all the 50 students that did TD of the 13,617 WAEC candidates while in 2015 out of 13,690 WAEC candidates, only 45 students sat for TD exam in Ekiti state and only seven passed at credit level. Furthermore there are a total of 329 schools, made up of 183 public and 146 private secondary schools respectively in Ekiti State, out of which only eleven of the schools presented candidates for TD in the last three years i.e 2013, 2014 and 2015 respectively. Low enrolment of students in TD is another problem affecting TD subject in Nigeria secondary schools Thus, any subject repeatedly experiencing low performance will surely be patronized by few students unless if such subject is made compulsory.

1.2 Purposes of the Study

Thus, the purpose of this study was to determine the effect of peer tutoring on technical drawing achievement among senior secondary school students in Ekiti State, Nigeria. The study also investigate differences in technical drawing achievement between male and female students.

1.3 Research Questions

The following research questions were posed to guide this study:

1. What is the effect of peer tutoring technique on students' achievement in technical drawing?
2. What is the influence of Gender on the achievement of students (male and female) when taught technical drawing with peer tutoring technique?

1.4 Hypotheses

The following Null hypotheses were tested at 0.05 level of significance.

- 1 HO₁: There is no significant difference in academic achievement of students taught TD with peer tutoring technique and those taught using conventional method.

- 2 HO₂: There is no significant difference in academic achievement of male and female students taught TD with peer tutoring technique
- 3 HO₃: There is no significant interaction effect of treatments given to students taught with peer tutoring techniques and their gender with respect to their mean scores in TD achievement test.

2. METHODS

2.1 Design of the Study

A quasi-experimental design was used in this study. Specifically, the pre-test, post-test, non-equivalent control group design was adopted for the study. According to Gall, Gall and Borg [24] quasi-experimental design can be used when it is not possible for the researcher to randomly sample the subject and assign them to treatment groups without disrupting the academic programmes of the schools involved in the study. Gall et al stated further that in a non-equivalent control group design, it is possible to have all groups receive treatments. This design was considered suitable for the study because intact classes (non-randomized groups) were assigned to the two different groups in this studies i.e peer tutoring and control groups.

$$E_G, O_1 \times O_1$$

$$C_G, O_1 - O_1$$

Where

- E_G stands for experimental group
- C_G stands for control group
- O₁ stands for pre-test/post-test observation
- X stands for the peer tutoring instructional Technique treatments
- stand for the use of the Conventional method

The independent variables consisted of conventional method and peer tutoring technique, while the dependent variables were the posttest achievements.

2.2 Population & Sampling Technique

The population for the study comprises of all the 81 senior secondary school two students in all the eleven senior secondary schools offering technical drawing in Ekiti State. The reason for choosing SSS two is that the students have undergone the curriculum of the subject in their year one and they could respond to the test

items. The sample size for the study consisted of 59 students offering TD in eight of the secondary schools. These comprises 48 male and 11 female students out of which 29 of the students were treated with peer tutoring technique while the remaining 25 students were used as control group.

2.3 Research Instrument

The instrument for data collection for this study was the technical drawing achievement test (TDAT) developed by the researcher. The TDAT instrument contained 30 multiple choice items with five options developed into two versions (A) and (B). While the TDAT A contained 30 test items as explained above, the TDAT B contained all item in A but has all its items and options to each of the 30 items reshuffled. This reshuffling is to curtail over familiarization of students with an arrangement pattern. The version tagged TDAT (A) was used for pre-test while that tagged TDAT (B) was used for post-test. The test items covered all the contents of the lesson plans developed to cover the major topics used for the study. The peer tutoring lesson plans was used by the technical drawing teacher who is also the research assistance in the experimental school to teach the experimental group while the control group was taught with conventional lesson plans. The instrument was validated by test and measurement and language education experts. The pilot tryout of TDAT was conducted in a secondary school that will not take part in the study. The psychometric test analysis was carried out to determine the Difficulty and Discrimination Index of each item in the test. An item is adjudged to be good if it has Difficulty Index ranging from 20 to 80; Discrimination of 0.20 and above and its entire distractor index a negative decimal [25]. Therefore, a total of the 30 items of the TDAT had good difficulty, discrimination and distractor indices.

The trial test for determining the coefficient of stability of the TDAT was carried out using test re-test reliability technique using two weeks interval. The reliability coefficient of the instrument was found to be .79 using Kuder Richardson formula 20 ($K - R 20$), since the test items are of multiple choice types.

2.4 Experimental Procedure

One week intensive training programme was organized for the teachers who were

involved in the study. The training exercise was based on the purpose of the study, the topic to be taught, the use of the lesson plans, the use of instrument and general conduct of the study.

The conduct of the study took place during the normal school lesson periods. On the first day, before the lesson commenced, TDAT was administered as pre-test to both the experimental and control groups after which proper teaching commenced by using the prepared lesson plans. The experimental group was taught with peer tutoring lesson plans by doing the following:

1. Teacher selects the lessons or topics of which peer tutoring technique was used to teach as indicated in the lesson plans
2. Next was the setting up or breaking the students into groups of three to five depending on the population of the class. Groups were made up of mixed age, ability level, spatial ability, and gender of students for the intended lesson. Selection of the grouping before the lesson were done in order to save time and focus on the implementation of peer tutoring during the lesson period
3. Selection of the peer tutors for each group and design activities was next. Since one of the most sensitive parameters for successful peer tutoring is the selection of the best tutors among the members of the group. Age and academic performance were two of the criteria used for selecting students. Other important variables or parameters considered in the selection of the tutors includes sociability and personality of the potential tutors
4. Record keeping of the activities in each student's group and the overall progress of the teams enables the teacher to monitor progress of the technique. In addition recording any distinctive characteristics of effective or ineffective tutoring behaviour enabled the teachers to understand better the ways that children cooperate together and also provide input on how to support better peer tutoring in the class.
5. Discussion with young tutors by the teachers before the activities encourages them on their tasks and remind them of the importance of the work they were about to do. They were advised on proper conduct when tutoring their team mates or tutees. Teachers gave verbal examples on how to

instruct others. Discussion with young tutors after the lesson enables teacher to record any positive or negative aspects of the procedure. Encouraging the tutors again by thanking them for a job well done (even if they make mistake) inspired them for continuing tutoring activities in the future. Discussion with tutees before and after peer tutoring activities also assures the students that they are not looked down upon as inferior and also to assess their opinion of the procedure.

6. Activities that allowed peer tutors to actually support their tutees were designed. Teacher chooses different tutors on different topics depending on the performance of the students in the topics and other stipulated criteria. Tutors were given in-depth instructions on how to perform the tutoring activities and how to handle their tutees. Preparations of materials that help children to manage tutoring activities were also made. This is done by summarizing some advice for the tutors in a piece of paper and giving it to them. The teachers also supervise the tutors discreetly, while tutoring.

The lesson plans designed for the peer tutoring activities were comprehensive, clear and gave adequate information as above on each lesson.

The control group was taught with the conventional lesson plans by the respective teachers. Each lesson lasted for 45 or 90 minutes depending on school on timetable. The treatment lasted for 5 weeks. At the end of the treatment, a posttest was administered on both groups with the TDAT; the scores obtained from both groups were compared to determine if there is any significant difference in the performance of the two groups. The data collected was used for further analysis

2.5 Data Analysis

The data collected from the administration of pre-test, post-test was analyzed using Mean to answer the research questions. The hypotheses formulated for the study was tested at .05 level of significance using Analysis of Covariance (ANCOVA). This is because ANCOVA as a statistical technique removed the initial differences between groups, so that the selected or pre-tested groups can be correctly considered as equated or equivalent by removing score difference in the pre-test performance across

groups and reducing the between-group source variation [26].

3. RESULTS AND DISCUSSION

3.1 Research Question 1

What is the effect of peer tutoring technique on students' achievement in technical drawing?

Table 1 indicates that the treatment group taught technical drawing with peer tutoring technique had a mean score of 3.76 in the pretest and a mean score of 25.36 in the posttest. The posttest mean gain in the group taught with peer tutoring method is 21.60. The group taught technical drawing with conventional method had a mean score of 3.60 in the pretest and a posttest mean of 17.38 with a posttest mean gain of 13.78. The implication is that students taught with peer tutoring have higher mean gain.

3.2 Research Question 2

What is the influence of Gender on the achievement of students (male and female) when taught technical drawing with peer tutoring technique?

Table 1. Mean of Achievement test scores of TD students taught with peer tutoring techniques

Test	Peer tutoring		Conventional method	
	N	Mean	N	Mean
Pre-test	31	3.76	28	3.60
Post-test	31	25.36	28	17.38
Mean gain score		21.60		13.78

Table 3 shows that male students taught TD with peer tutoring technique had a mean score of 3.78 in the pretest and a mean score of 30.30 in the posttest making a posttest mean gain in the male students taught with peer tutoring technique to be 26.52. Meanwhile, female students taught TD with peer tutoring technique had a mean score of 3.10 in the pretest and a posttest mean of 30.08 with a posttest mean gain of 26.98. Also, male students taught with the conventional method had a mean score of 3.67 in the pretest and a mean score of 23.20 in the posttest, making a posttest mean gain in the male students taught with conventional method to be 19.53. Meanwhile, female students taught TD with the conventional method had a mean score of 3.20 in the pretest and a posttest mean of 17.66 with

Table 2. Mean of cognitive achievement test scores of TD students taught with peer tutoring techniques based on gender

Gender	Peer tutoring technique				Conventional method			
	N	Pretest	Posttest	Mean gain \bar{X}	n	Pretest	Posttest	Mean gain \bar{X}
Male	25	3.78	30.30	26.52	23	3.67	23.20	19.53
Female	06	3.10	30.08	26.98	05	3.20	17.66	14.46

a posttest mean gain of 14.46. With these results female students taught TD with peer tutoring technique had higher mean scores than male students in TD Achievement Test. Thus, there is an effect attributable to gender on the achievement of students taught TD with peer tutoring techniques favouring girls.

3.3 Hypotheses

- 1 HO₁: There is no significance difference in academic achievement of students taught TD with peer tutoring technique and those taught using conventional method.
- 2 HO₂: There is no significance difference in academic achievement of male and female students taught TD with peer tutoring technique
- 3 HO₃: There is no significant interaction effect of treatments given to students taught with peer tutoring techniques and their gender with respect to their mean scores in TD achievement test

The data presented in Table 3 shows F-calculated values for three effects: Treatment, gender and interaction effect of treatments and gender on students' achievement in technical drawing. The F-calculated value for treatment is 317.94 with a significance of F at .00 which is less than .05. The null-hypothesis is therefore rejected at .05 level of significance. With this result, there is a significant difference between the effects of treatment on students' achievement in TD. The F-calculated value for gender is 91.03 with a significance of F at .00 which is less than .05. This means that there is significant effect of Gender on students' achievement in TD. Therefore, the null hypothesis of no significant difference between the effect of gender (male and female) on students' achievement in TD is rejected at .05 level of significance. The interaction of treatments and gender has F-calculated value of 2.75 with significance of F of .10. Since .10 is higher than .05, the null hypothesis for interaction effect of treatment and

gender is accepted. Hence, there is no significant interaction effect of treatments given to students taught TD with Peer Tutoring techniques and their gender with respect to their mean scores on Achievement Test.

4. DISCUSSION OF FINDINGS

The study indicated that students taught TD with peer tutoring technique has higher mean gain than students taught TD using the conventional teaching method. The findings corroborated the study of Bryan [27] who investigated on the effects of peer tutoring on the academic achievement of university students in Georgia. When he discovered that those exposed to peer tutoring performed better than those that are not exposed to peer tutoring. It is also in line with the study of Presbitero [28], in a study designed to investigate the effectiveness of peer tutoring in improving mathematics achievement of second year high school students, he observed that students who received peer tutoring performed better than students who did not received peer tutoring. The result is also in agreement with the study of Okoye [29] who discovered that peer tutoring technique yield higher mean achievement score when adopted in teaching home economics students than some other home economics students taught with lecture method. Studies of Tella [30] and Fuchs et al. [31] all indicated higher mean score gain for students exposed to peer tutoring technique over the conventional teaching methods. The higher mean gain observed on students in the experimental group may be due to the fact that students who participated in this study originally belong to a school that is framed around a philosophy of direct instruction. This philosophy supports teacher-centered instruction rather than student-centered learning. Thus, most students desire to communicate with other learners when encouraged and given the chance, resulting in a willingness to participate in the study. Students' eagerness to participate in the tutoring groups because of the need to communicate with one

Table 3. Summary of analysis of covariance (ANCOVA) for Test of significance of three effects: Treatments, gender and interaction effect of treatments and gender on students' achievement in TD

Source of variation	Sum of squares	DF	Mean square	F	Sig of F
Covariates	1.05	1	1.05	.16	.70
Pre-test	1.05	1	1.05	.16	.70
Main Effects	2511.18	2	1255.59	184.64	.00
Treatment	2162.08	1	2162.08	317.94*	.00
Gender	619.05	1	619.05	91.03*	.00
2-way Interactions	18.71	1	18.71	2.75	.10
Treatment*Gender	18.71	1	18.71	2.75	.10
Explained	3728.55	4	932.14	137.07	.00
Residual	1292.07	024	6.80		
Total	5020.62	028	25.88		

*Significant at sig of $F < .05$

another freely without fear of being reprimanded when mistakes are made by tutor (teacher) also makes learning easier among Students within the experimental group.

Another noteworthy finding of the study was that female students exposed to peer tutoring technique has higher mean gain than male students taught TD This finding corroborated the study of Ozofofor [32] when he found that females achieve better than males in Mathematics. However, the finding contradict that of Ezenwosu and Nworgu [33] when in their study titled, Efficacy of Peer Tutoring and Gender on Students' Achievement in Biology revealed that the influence of gender on student academic achievement in biology was not significant. It is also not in agreement with the findings of Obiunu [34] in the study titled the effects of reciprocal peer tutoring on the enhancement of career decision making process among secondary school adolescents that indicated that sex is not a significant factor, in the career decision-making of adolescent students in the study treatment groups.

In addition, Analysis of covariance was used to test the hypothesis Table 3, at the calculated F-value (2.75), significance of F (.10) and confidence interval of 0.05 there was no significant interaction effect of treatments given to students taught with peer tutoring technique and their gender with respect to their mean scores on TD Achievement Test. This result showed that the effectiveness of peer tutoring technique on students' achievement in TD does not depend on gender. Hence, there were no differential effects of treatments over gender (male and female), which implies that peer tutoring technique is more effective than

conventional teaching method in improving students' achievement in TD regardless of Gender.

5. CONCLUSION

The study revealed that there was significant difference in the achievement of senior secondary students in Technical Drawing when taught using peer tutoring technique over the conventional method. Higher mean gain was also observed in the achievement of female over males in the achievement test.

6. RECOMMENDATIONS

Based on the findings, the following recommendations are made

1. Seminars, workshops should be organized to educate Technical Drawing teachers on the use of peer tutoring
2. Teachers should be encouraged to adopt the use of peer tutoring technique in the teaching of Technical drawing and all other vocational subjects, most especially trade or vocational subjects that are unattractive to female students in secondary schools.
3. Government agencies saddled with the responsibility of designing and revising curriculum for secondary schools should incorporate the use of peer tutoring technique in teaching TD.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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