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# Collaborative Practicum, Experimental Demonstration, and Lecture Methods' Effects on Basic Technology Students' Academic Achievement in Edo State

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***Abstract***
*This research investigated the effects of cooperative practicum, experimental demonstration, and lecture approaches on the academic performance of basic technology students at Edo State. This study employed a 3x2 pretest, posttest, control group quasi-experimental design. The survey included a total of 29,000 students who were studying basic technology. The research sample consisted of 312 JSII basic technology students from six public mixed junior secondary schools in Edo State. Data collection was conducted using the Basic Technology Achievement Test (BTAT). The validity of the BAT was confirmed by three experts. A Kuder-Richardson 21 test was employed to assess the reliability of the BTAT. The obtained reliability coefficient value was 0.80. Prior to and following treatment, the BTAT was administered as both a pretest and a posttest. Analysis of the gathered data was conducted using mean, standard deviation, and ANCOVA. Significantly different mean achievement levels were seen among students who received instruction in fundamental technology through collaborative practicum, experimental demonstration and lecture method. According to Scheffe's post-hoc test, the direction of significance shifts from the collaborative practicum to the experimental demonstration and lecture method, respectively. According to the study's findings, collaborative practicum, experimental demonstration, and lecture method can all help students retain basic technologies and accomplish better academically. However, collaborative practicum was shown to be the most successful, followed by experimental demonstration. The study comes to another conclusion once more: when interaction is taken into account, students' academic achievement in basic technology was not impacted by their sex in conjunction with the utilisation of collaborative practicum, experimental demonstration, and lecture. In order to increase students' active participation and interaction during instruction, basic technology teachers at the junior secondary school level are advised to implement collaborative*

*practicum and experimental demonstration in their instruction. This recommendation is based on the study's findings.*

***Keywords:*** *Collaborative Practicum, Experimental Demonstrations, Lecture Method, Academic Achievement*

## Introduction

The general education curriculum includes basic technology instruction in an effort to help students grasp the industrial and technological aspects of life. Specific areas of instruction include metalworking, woodworking, electrical, plastics, ceramics, textiles, and technical drawing. Using suitable teaching strategies during instruction is necessary to support junior secondary schools in achieving the goals of the basic technology curriculum. The way that educators choose to teach can either help or hinder how well their students learn basic technology (Obomanu, 2021). Therefore, the purpose of this study is to investigate how a teacher's chosen technique of instruction affects students' achievement in basic technology.

Teaching is the deliberate and systematic delivery of educational ideas, information, skills, and techniques to students in order to optimise their learning potential. Proposed methodologies for teaching science include problem solving, inquiry-based learning, project-based learning, practical exercises, laboratory instruction, cooperative learning, collaborative learning, and demonstrative tactics. Regrettably, educators persist in delivering classes in the same manner as they were originally taught, sometimes by employing the conventional lecture method (Emerhiona, Ajaja, Pius, Nwanze & Izuegbuna, 2018). The lecture method of instruction involves the teacher verbally presenting all the necessary material to the pupils without permitting interactive participation in the teaching and learning process. According to Ajaja (2016), the instructor speaks, reads, and frequently uses visual aids to illustrate throughout a lecture session. He went on to say that during the teaching-learning process, students merely listen. Students who participate passively in the teaching-learning process are more likely to memorise and repeat the basics of technology. As a result, the students lack the practical abilities that would have enabled them to fully comprehend and grasp the basic technology concepts they have acquired. As a result, students become dependent on memorisation and lack a thorough comprehension of scientific ideas, concepts, and phenomena.

One possible explanation for students' inconsistent achievement on the Basic Education Certificate Examination (BECE) is the ongoing use of the lecture method. Researchers have been greatly concerned about the high rates of failure reported by students in Edo State's junior schools (Edo State Ministry of Basic and Secondary Education, 2019–2023). Thus, it is possible to link the low accomplishment in basic technology to the traditional lecture approach, which disregards the participation of the students in the learning process. Being a core science subject, basic technology should provide students with the foundational scientific and technological knowledge they need to adapt to a society that is both scientifically and technologically advanced. Basic technology proficiency is anticipated of a sizable portion of students enrolled in science and science-related courses in senior high schools and postsecondary institutions. Despite this

anticipation, low student proficiency in basic technology seems to have continued, which is sometimes attributed to subpar teaching strategies used by educators.

It is important that instructors of basic technology use effective teaching strategies that will help students grasp ideas and concepts in this regard. It has been recommended that the utilisation of collaborative practicum and experimental demonstration can improve students' simple comprehension of acquired basic technology ideas. Thus, the purpose of this study is to determine whether using experimental demonstration and collaborative practicum will enhance students' academic achievement and retention in basic technology more than traditional lecture-based instruction.

Collaborative learning, also known as collaborative practicum, refers to an instructional approach in which students with different competence levels work together in small groups to accomplish a shared objective. Accountability is applied to both the pupils' own development and the learning of their peers. Within a collaborative learning setting, students effectively cooperate in small groups to complete activities that yield advantages for both the entire group and each individual member. Successful cooperative group learning necessitates two essential elements. These components consist of individual accountability and shared goals. Collective goals serve as a potent means of bringing together students to complete assignments, obtain rewards, or attain acknowledgment, and the success of the group relies on the individual learning of each member (Okobi & Ajaja, 2022). Individually accountable students engage in collaborative learning yet carry out tasks autonomously. This ensures the capability to assess the work of others. In order for students to evaluate whether the group as a whole or each member individually is achieving the objective, the lesson's aim for individual responsibility must be sufficiently explicit. This study aimed to determine the extent to which a collaborative learning method can enhance students' competence in basic technology.

A planned and regulated approach to using small groups to improve students' learning and interdependence is called collaborative learning. Students collaborate to complete a task, also called an assignment, that is assigned to them. The successful completion of the project relies on the collective efforts of all group members, as each individual has specific responsibilities and is expected to contribute towards its completing. Collaborative learning is a form of classroom instruction that promotes teamwork among individual pupils. Within the context of collaborative learning, teachers assume the position of guides or facilitators as students or individuals collaborate in small, heterogeneous groups to address challenges, finish projects, or accomplish other educational goals. Moon (2023) defines collaborative learning as an educational method that promotes social interactions and experiences that can impact students' cognitive processes in a learning setting. Furthermore, they argue that collaborative learning facilitates the generation of information and the transformation of many perspectives into individual analysis. Empirical evidence has indicated that collaborative learning is a successful teaching strategy for many subject areas (Moon, 2023). Will collaborative learning, as opposed to experimental demonstration, improve students' proficiency in basic technology, though?

The teacher uses the experimental demonstration approach to demonstrate to the students how to use basic technology concepts and ideas to carry out specific tasks or achieve specific things. Experimental demonstration, as defined by Omiko (2015), is a bilateral procedure

conducted by one or more individuals employing exercise and experimental techniques, both of which are advantageous for the instruction of science. Through the use of experimental methods, students are afforded the opportunity to acquire knowledge. Careful observations and data interpretation are required for this approach. It possesses the abilities to probe, question, and face uncertainty. Students have the chance to answer real-world problems arising from the experimental approach through the exercise approach.

Omiko (2015) had previously advised against using experimental demonstration in science classes because it hinders students' ability to create knowledge from experiences with discrete objects. In this instance, the students comprehend and perform better because the hazy notions and made-up objects become tangible. Since verbal recitation and drill are tedious learning methods that don't inspire students to learn more, it's critical to enhance achievement while taking into account their impact on basic technological education. A novel approach to learning science is provided by experimental demonstration, which offers a realistic, non-threatening, and hands-on method of learning science instead than the formal, abstract treatment found in most textbooks. The finest learning occurs when students are allowed to observe and make sense of the material being presented to them. In order to accomplish the teacher-stated objectives at the end of instruction, which represent the students' degree of academic success in the ideas they have studied, students are given the opportunity to employ their senses through experimental demonstration.

Students' sex is by far the most significant aspect that could impact how effective a teaching approach is in achieving student achievement. According to Emerhiona et al. (2018), sex is the categorisation of individuals as male or female, usually determined at birth based on the appearance of external genetelia organs. In this study, "sex" simply meant "male and female students." Certain instructional strategies use students' sex to affect their academic achievement. Will the employment of cooperative practicum, experimental demonstration and lecture approaches interact with students' sexual orientation to affect their achievement in basic technology courses? It is necessary to ascertain whether the use of collaborative practicum, experimental demonstration, and lecture approaches is sex dependent, even though sex is an intervening variable in this study. In light of this, the study set out to examine the effects of cooperative practicum, experimental demonstration and lecture method on students' academic achievement in basic technology in Edo State. Its goals were to identify the most efficient method of teaching basic technology and to ascertain whether or not these methods are sex-dependent.

**Statement of the Problem**

A lot of broad scientific knowledge is imparted to students in basic technology, a topic that also highlights the need of observation in gaining a deeper grasp of the surrounding world. It is unfortunate that students' low achievement in basic technology has sparked a public outcry in recent years.

For the past four years, the outcomes of basic technology students in the Basic Education Certificate Examinations (BECE) have fallen short of the required minimum (Ministry of Basic and Senior Secondary Education, 2019; 2020; 2021; 2022; 2023). Numerous reasons, including ineffective teaching strategies, have been suggested as the cause of the students' subpar achievements. It is no longer news that the majority of junior secondary school technology

instructors in Nigeria employ the lecture method of teaching. The primary flaw in the lecture method is the students' inactivity during the teaching and learning process. This suggests that teaching through lectures could keep students from picking up essential practical skills. It appears that the lecture method hinders student involvement during instruction and does not enable students to achieve satisfactory outcomes in practical abilities in basic technology. Due to these shortcomings in the lecture method, other approaches including collaborative practicum and practical demonstration should be explored, keeping in mind that sex may have an impact on students' achievement and the development of their practical skills. Therefore, the study's main problem, is: will the utilisation collaborative practicum and experimental demonstration improve students' achievement in basic technology more than utilisation of the lecture method?

**Purpose of the Study**

The study's main purpose was to find out how Edo State basic technology students' achievement was affected by collaborative practicum (CB), experimental demonstration (ED), and lecture method LM). In particular, the research aimed to ascertain:

1. the variation in mean achievement scores between students in Edo State who were taught basic technology by CP, ED and LM;
2. the interaction between sex and teaching method on Edo State students achievement in basic technology.

**Research Questions**

1. How do the mean achievement scores of Edo State students who are taught basic technology utilising CP, ED, and LM differ from one another?
2. How does sex and teaching methods interact to affect Edo State students' achievement in basic technology?

**Hypotheses**

The following theories served as the study's compass:

1. The mean achievement scores of Edo State students who were taught basic technology utilising CP, ED, and LM did not differ significantly.
2. In Edo State, there is no discernible interaction effect between the method of instruction and student's gender on their achievement in basic technology.

**Research Method**

This study employed a 3x2 pretest, posttest, control group quasi-experimental factorial design. The survey included a total of 29,000 students who were studying fundamental information technology. The research sample consisted of 312 JSII basic technology students from six public mixed junior secondary schools in Edo State. The BTAT, the instrument used for data collection, was validated by three experts: a technical educator from Delta State University in Abraka, an expert in measurement and evaluation from Delta State University in Abraka, and an experienced basic technology teacher from a school in the Ethiope East Local Government Area of Delta State. Additionally, the construct and content validity of the BTAT were established. Kuder-Richardson 21 was used to establish the BTAT's reliability. 30 JSII students at a Delta State junior secondary school—which is beyond the study's geographic boundaries—were given the BTAT. Students' answers were graded, and Kuder-Richardson 21 was used to analyse the scores, producing a

reliability coefficient value of 0.80. The primary treatment for the study involved instructing JSII basic technology students in their assigned groups utilising the three instructional methods (collaborative practicum, experimental demonstration and lecture method). Following a six-week course of treatment, the students in each of the three groups took the rearranged BTAT again, which was scored. Analysis of Covariance was then used to compare the data from the pretest and posttest of three groups.

**Results**

- How do the mean achievement scores of Edo State students who are taught basic technology utilising CP, ED, and LM differ from one another?

**Table 1: Average Scores on Pretest and Posttest for Students who Were Taught Basic Technology Using CP, ED, and LM**

| Group | N | Pre-test | | Posttest | | Mean Gain |
|---|---|---|---|---|---|---|
| | | Mean ($\bar{x}$) | SD | Mean ($\bar{x}$) | SD | |
| CP | 112 | 27.12 | 6.18 | 65.98 | 10.43 | 38.86 |
| ED | 103 | 29.42 | 5.70 | 63.08 | 9.59 | 33.66 |
| LM | 97 | 28.33 | 6.00 | 56.87 | 8.23 | 28.54 |

The students in the three groups (CP, ED, and LM) had mean differences of 38.86, 33.66, and 28.54, respectively, as indicated by Table 1. This suggests that the three groups' mean achievement scores differ from one another.

- The mean achievement scores of Edo State students who were taught basic technology utilising CP, ED, and LM did not differ significantly.

**Table 2: ANCOVA Comparison of Mean Achievement Levels of Students Taught Basic Technology with CP, ED, and LM**

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 4569.370[a] | 3 | 1523.123 | 16.865 | .000 |
| Intercept | 45704.957 | 1 | 45704.957 | 506.072 | .000 |
| Pretest | 285.014 | 1 | 142.507 | 4.003 | .019 |
| Methods | 4516.686 | 2 | 2258.343 | 25.006 | .000 |
| Error | 27816.473 | 308 | 90.313 | | |
| Total | 1239041.000 | 312 | | | |
| Corrected Total | 32385.843 | 311 | | | |

As shown in Table 2, the calculated F value is 25.006, with a P-value of 0.000, which is below the significance level of 0.05. The numerator has 2 degrees of freedom and the denominator has 308 degrees of freedom. These findings indicate a significant disparity in the results obtained in the posttest. Therefore, the null hypothesis is rejected. Significant differences exist in the mean accomplishment scores of children who received instruction in fundamental technology using CP, ED, and LM. Table 3 identified the specific direction of the disagreement.

**Table 3: Scheffe Post-hoc Analysis on the Significance of Mean Achievement Differences Across Groups**

| (I) Teaching methods | (J) Teaching methods | Mean Difference (I-J) | Std. Error | Sig.[b] | 95% Confidence Interval for Difference[b] | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| CP | ED | 3.153* | 1.314 | .017 | .567 | 5.738 |
| | LM | 9.247* | 1.323 | .000 | 6.644 | 11.850 |
| ED | CP | -3.153* | 1.314 | .017 | -5.738 | -.567 |
| | LM | 6.094* | 1.348 | .000 | 3.441 | 8.747 |
| LM | CP | -9.247* | 1.323 | .000 | -11.850 | -6.644 |
| | ED | -6.094* | 1.348 | .000 | -8.747 | -3.441 |

The data presented in Table 3 demonstrates a statistically significant disparity (in favour of CP) in the average achievement scores of students who received instruction in fundamental technologies using ED and CP. Furthermore, Table 3 demonstrates a statistically significant disparity (in favour of CP) in the average achievement scores of students who were instructed in fundamental technology utilising least method (LM) and CP. Furthermore, Table 3 demonstrates a statistically significant disparity, in favour of ED, in the average achievement scores of students who were instructed in fundamental technology using ED and LM. Thus, the direction of importance changes from CP to ED and LM, in that sequence.

- How does sex and teaching methods interact to affect Edo State students' achievement in basic technology?

**Table 4: Mean on Interaction Between Teaching Method and Sex on Students' Achievement**

| **Methods** | **Collaborative** | | | **Experimental** | | | **Lecture** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **N** | **Mean** | **SD** | **N** | **Mean** | **SD** | **N** | **Mean** | **SD** |
| **Pretest** | | | | | | | | | |
| Male | 49 | 27.67 | 6.26 | 46 | 28.17 | 6.15 | 40 | 29.80 | 6.56 |
| Female | 63 | 26.68 | 6.13 | 57 | 30.42 | 5.14 | 57 | 27.30 | 5.39 |
| Total | 112 | 27.12 | 6.18 | 103 | 29.42 | 5.70 | 97 | 28.33 | 6.00 |
| **Posttest** | | | | | | | | | |
| Male | 49 | 67.10 | 9.84 | 46 | 61.39 | 9.23 | 40 | 58.30 | 6.27 |
| Female | 63 | 65.11 | 10.86 | 57 | 64.44 | 9.73 | 57 | 55.86 | 9.29 |
| Total | 112 | 65.98 | 10.43 | 103 | 63.08 | 9.59 | 97 | 56.87 | 8.23 |

The findings in Table 4 do not suggest an interaction effect as the male students in the CP group who achieved higher scores on the pretest also achieved higher scores on the posttest in comparison to the female students. Once again, the results of Table 4 do not demonstrate an interaction effect, as the male students in the ED group who achieved higher scores on the pretest also achieved higher scores on the posttest. The observed correlation between higher pretest scores and higher posttest scores among male students in the LM group suggests that there is no evidence of an interaction effect in Table 4.

- In Edo State, there is no discernible interaction effect between the method of instruction and student's gender on their achievement in basic technology.

**Table 5: ANCOVA Analysis on Interaction Effect of Teaching Method and Sex on Students' Basic Technology Achievement**

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 4988.953[a] | 6 | 831.492 | 9.257 | .000 |
| Intercept | 45744.392 | 1 | 45744.392 | 509.256 | .000 |
| Pretest | 62.091 | 1 | 62.091 | .691 | .406 |
| Methods | 4252.581 | 2 | 2126.291 | 23.671 | .000 |
| Sex | 14.053 | 1 | 14.053 | .156 | .693 |
| Methods * Sex | 406.569 | 2 | 203.284 | 2.263 | .106 |
| Error | 27396.890 | 305 | 89.826 | | |
| Total | 1239041.000 | 312 | | | |
| Corrected Total | 32385.843 | 311 | | | |

The results in Table 5 indicate that the calculated F value is 2.263, with a P-value of 0.106, which exceeds the significance level of 0.05. The numerator has 2 degrees of freedom and the denominator has 305 degrees of freedom. These findings indicate that the interaction effect lacks statistical significance. Consequently, the null hypothesis is deemed valid. Hence, there is no observable interaction impact between gender and the instructional approach (lecture, collaborative practicum, and experimental demonstration) on students' competence in fundamental technology.

**Discussion**

The study found that students who were taught basic technology by collaborative practicum, experimental demonstration and lecture method had significantly different mean achievement levels. According to Scheffe's post-hoc test, the order of significance shifts from the collaborative practicum to the lecture technique, then the experimental demonstration. The fact that collaborative practicum allows students to actively participate in hands-on learning experiences may contribute to the observed finding favouring collaborative practicum over experimental demonstration. This could result in a better understanding of the material than passive observation in experimental demonstration. Furthermore, the collaborative practicum fosters teamwork and problem-solving skills among students, leading to a deeper comprehension of the technology ideas being taught. In a similar vein, a collaborative practicum may give students additional chances to put the basic technological skills they are learning into practice, which would raise their achievement levels.

The study's findings once more shown that students who were taught basic technology through a collaborative practicum outperformed those who were taught the subject through lectures in terms of mean achievement scores. This might be because the collaborative practicum gives students the chance to actively interact with the basics of technology and put what they've

learnt to use in a real-world situation, which could improve their comprehension of the subject matter. Students are also encouraged to collaborate and learn from one another during their collaborative practicum, which may improve their comprehension of the subject matter and offer other viewpoints on how to successfully use the basics of technology. This finding aligns with the study conducted by Iji, Ochu, Adikwu, and Atamonokhai (2017), which revealed that students who were exposed to a collaborative teaching approach achieved higher mean achievement scores compared to those exposed to a traditional lecture style. The present outcome corroborates the conclusions drawn by Okwelle and Owo (2018), who observed a notable enhancement in students' academic performance in Technical Drawing when instructed through collaborative learning rather than lecture-based methods.

The study findings indicated that there was no noticeable interaction effect between gender and the instructional methods employed (collaborative practicum, experimental demonstration, and lecture method) on students' acquisition of fundamental technology skills. These findings indicate that the effectiveness of the teaching methods (collaborative practicum, experimental demonstration, and lecture technique) in improving student achievement was similar across the sex categories. The present study validates the conclusions established by Adolphus and Omeodu (2016), which indicate that gender and instructional approaches (lecture and collaborative practicum) do not collectively impact students' conceptual understanding of electromagnetic induction at the secondary school level. This result adds credence to the findings of Achimugu (2018), who found no evidence of a significant interaction between gender and instructional styles.

**Conclusion**

The study came to the following conclusions: collaborative practicum, experimental demonstration and lecture method all have the potential to raise students' academic achievement in basic technology, but cooperative practicum and experimental demonstration were the most successful. Additionally, it was determined that taking into account interactions, the application of cooperative practicum, experimental demonstration, and lecture method, and the students' sex did not combine to affect their achievement in basic technology.

**Recommendations**

1. In order to enhance students' engagement and interaction during education, junior secondary school basic technology teachers should incorporate collaborative practicum and experimental demonstration.
2. When the utilisation of experimental demonstration and collaborative practicum is not practical, basic technology teachers should switch to the lecture method.

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