Effects Of Collaborative Practicum, Experimental Demonstration And Lecture Methods On Retention Of Basic Technology Students In Edo State

KELUBIA, Daniel Isioma
Department of Technical Education, Faculty of Education, Delta State University, Abraka
Email: danielkelubia@delsu.edu.ng.

Prof. Umunadi, Ejiwoke Kennedy
Department of Technical Education, Faculty of Education, Delta State University, Abraka
Email: keumunadi@delsu.edu.ng

Prof. Samuel Idowu Akinseinde
Department of Technical Education, Faculty of Education, Delta State University, Abraka
Email: seinde55@yahoo.com
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Abstract
The study investigated the effects of collaborative practicum, experimental demonstration, and lecture method on the retention of Edo State basic technology students. This study employed a 3x2 pretest, posttest, control group quasi-experimental design. The research sample consisted of 312 JSII basic technology students from six public mixed junior secondary schools in Edo State. The data collection instrument employed was 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. Furthermore, as a delayed posttest, the BTAT was administered four weeks subsequent to the initial posttest. Next, the data were analysed using ANCOVA, calculations of mean, and standard deviation statistics. The study revealed that students who received instruction in basic technology through collaborative practicum, experimental demonstration, and lecture method had markedly distinct average retention scores. According to Scheffe's post-hoc test, the direction of significance proceeds from the collaborative practicum, followed by the experimental demonstration and lecture, respectively. According to the study's findings, collaborative practicum, experimental demonstration, and lecture techniques can all help students retain the fundamentals of technology better. However, collaborative practicum proved to be the most successful, closely followed by experimental demonstration. The study goes on to say that, when interaction is taken into account, the utilisation of collaborative practicum, experimental demonstration and lecture method did not affect students' retention of basic technologies in conjunction with their sex. In order to increase students' active participation and engagement during instruction, basic technology teachers are advised to implement collaborative practicums based on the study's findings. When teaching basic technology in junior secondary schools, educators should also use experimental demonstration as

a backup strategy in case collaborative practicum isn't practical. This will help to make the concepts more understandable and less abstract.

Keywords: *Collaborative Practicum, Experimental Demonstration, Lecture Method, Students' Retention*

Introduction

Any society's progress is fundamentally based on education, and the effectiveness of learning is greatly influenced by the instructional strategies used in classrooms. Various subjects including basic technology, are taught at the basic and secondary school levels to ensure that Nigerian citizens have a sufficient education. The purpose of the subject is to acquaint students with the fundamentals of technology and how it is used in daily life (Miller, 2020). It covers a wide range of subjects, including as materials, instruments, procedures, and the social effects of technology. The primary objective of basic technology curriculum is to equip students with the necessary theoretical knowledge and practical skills essential for their daily living and future employability. In the context of Basic Technology education in Edo State, Nigeria, the choice of teaching methods can significantly influence the extent to which students effectively retain knowledge and skills. The primary objective of the study is to compare the impact of three distinct teaching methods—collaborative practicum, experimental demonstration, and lecture—on students' tendency to retain fundamental technical knowledge. Enhanced educational outcomes can be achieved by educators and policymakers through more informed decision-making on the impact of different techniques on retention.

The lecture technique is a traditional pedagogical method where a teacher systematically communicates instructional content to a group of pupils (Emerhiona, Ajaja, Nwanze & Izuegbuna, 2018). This approach is frequently employed in a variety of educational contexts, such as colleges, universities, and even certain high school classrooms. Under this approach, students are primarily seen as passive consumers of knowledge, with the teacher serving as the main information source. A precise agenda or outline helps organise the information and directs students through the course of the lecture. The passive aspect of traditional lecture method has frequently been criticised as a potential cause of poor information retention (Miller, 2020). Conversely, experimental demonstration techniques and cooperative practicums encourage active learning, where students interact with the content and one another, which may improve retention (Johnson & Johnson, 2019).

Collaborative practicum, also known as collaborative learning, refers to an instructional approach in which students with different levels of performance work together in small groups to make progress towards a shared objective (Schon, 2017). Neither the students' individual learning nor the learning of their peers is subject to accountability. Within a collaborative learning setting, students work together in small groups to complete activities that are advantageous for both the cohort as a whole and each individual participant. In order to achieve successful collaborative group learning, two components are necessary. Both personal responsibility and collective objectives are key components. Group objectives serve as a potent means of bringing together students to achieve goals, obtain rewards, or get acknowledgement. The effectiveness of the group depends on the individual learning progress of each member. Students who are held individually responsible engage in collaborative learning but carry out tasks autonomously. This ensures the capacity to access and appraise the work of others. The educational purpose of a lesson on individual responsibility should be clearly defined so that students may evaluate whether the group as a whole or each member individually is achieving the target (Okobi & Ajaja, 2022).

Collaborative learning is an instructional approach in which students engage in group collaboration to address problems, complete tasks, or acquire new concepts. This approach places a strong emphasis on sharing responsibility for learning, teamwork, and communication. In order to promote conversation and engagement, students work in small groups. This can improve knowledge retention and comprehension. Common goals provide groups a sense of belonging and accountability among their members. Collaborative learning enriches the learning process by bringing together people with diverse experiences, abilities, and perspectives. Because they are actively engaged in the learning process, students may develop their critical thinking and comprehension skills. During a collaborative practicum, students can impart information to one another while also supporting others. Peer feedback can be obtained quickly through collaboration, and learning can be improved by reflecting on group dynamics and individual contributions. Empirical data has demonstrated that collaborative learning is an effective pedagogical approach for a variety of topic areas (Ajaja, 2013). Will collaborative learning, as opposed to experimental demonstration, improve students' proficiency in basic technology, though?

An educational strategy that places a strong emphasis on active engagement and hands-on learning is the experimental demonstration teaching technique. 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 Dienye and Gbamanja (2019), is a bilateral procedure involving one or more individuals who employ both exercise and experimental techniques. This approach is advantageous in the instruction of science. In order to acquire knowledge, students are have the opportunity to utilise experimental methodologies. Careful data analysis and observation are required for this process. 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.

In fields like science, technology, engineering, and mathematics (STEM), where students can participate in experiments and demonstrations to better comprehend topics, experimental demonstration is very beneficial (Coskun & Eker, 2018). Instead of just passively absorbing information, students actively engage in experiments or demonstrations. This involvement supports the learning process by providing real-world experience. Because of the method's frequent use of real-world settings, learning is applicable and relevant. Students may be able to see the significance of what they are learning as a result. Students are encouraged to investigate results, formulate hypotheses, and pose questions. This encourages analytical reasoning and problem-solving abilities. Students collaborate in groups frequently, which fosters communication and cooperation abilities. Students who work together can share ideas and insights, which can improve understanding. Students conduct experiments or demonstrations, evaluate their findings, and get feedback. They then reflect on their experiences. This promotes a growth mentality and solidifies their comprehension.

According to recent research, active learning techniques like cooperative practicum and experimental demonstration can greatly improve students' comprehension and retention of difficult subjects (Freeman et al., 2024). Nevertheless, little is known about the precise effects of these techniques in the context of Edo State's basic technology teaching. By investigating how different instructional strategies impact students' retention of Basic Technology information, this study seeks to close this knowledge gap.

Statement of the Problem

Even though it's widely acknowledged that good teaching methods improve students' retention, a lot of teachers in Edo State still mostly rely on the lecture method (Eze & Lasisi, 2018). This dependence could be the result of inadequate training, resources, or knowledge of other teaching pedagogies. As a result, students could find it difficult to remember important information and abilities that are essential to their academic and career success.

The issue is made worse by the growing need for qualified workers in industries connected to technology. Students may find themselves unprepared for future difficulties in a quickly changing technology landscape if they fail to retain the knowledge and abilities they learnt in basic technology. In order to find practical solutions that can improve learning outcomes, it is crucial to look into how various teaching methods affect students' memory of basic technology. Thus, the study's central question, is: will using collaborative practicum and experimental demonstration improve students' retention of basic technology more than using lecture method?

Purpose of the Study

The primary purpose of the study was to find out how Edo State's basic technology students retained basic technology knowledge after exposure to collaborative practicum, experimental demonstration, and lecture method. In particular, the research aimed to ascertain:

1. the variation in the average retention scores between students in Edo State who were taught basic technology by collaborative practicum (CP), experimental demonstration (ED) and lecture method (LM);
2. the interaction between sex and teaching method on students' retention of basic technology in Edo State.

Research Questions

Two research questions served as the study's guidelines:

1. What is the variation in the average retention scores amongst students in Edo State who are taught basic technology utilising CP, ED, and LM?
2. How does sex and teaching methods interact to affect students' retention of basic technology in Edo State?

Hypotheses

The following hypotheses served as a guide for the research:

1. The mean retention 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 a student's gender on their retention of basic technology.

Research Method

This study employed a 3x2 pretest, posttest, control group quasi-experimental 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. Furthermore, the construct and content validity of the BTAT study were confirmed. The Kuder-Richardson 21 test was employed to quantify the dependability of the BTAT. The BTAT was administered to 30 JSII students at a junior secondary school in Delta State, which is located outside the study's geographical limits. The students' responses were evaluated, and the scores were analysed using Kuder-Richardson 21. The statistical analysis yielded a reliability coefficient of 0.80. The primary intervention for the study involved instructing JSII basic technology students in their assigned groups utilising the three instructional methods (lecture, experimental demonstration, and collaborative practicum). Following a six-week course of treatment, the students in each of the three groups took the BTAT again, which was scored and rearranged. The BTAT was rearranged and given again as a delayed posttest four weeks following the posttest. Analysis of Covariance was then used to compare the data from the pretest, posttest, and delayed posttest for the three groups.

Results

- ✓ What is the variation in the average retention scores amongst students in Edo State who are taught basic technology utilising CP, ED, and LM?

Table 1: The Mean Retention Scores of Students who Were Taught Basic Technology Using CP, ED, and LM

Group	N	Posttest		Delayed test		%Retention = (DTM/PM) x 100
		Mean	SD	Mean	SD	
CP	112	65.98	10.43	59.98	10.43	90.91
ED	103	63.08	9.59	55.06	9.92	87.29
LM	97	56.87	8.23	44.87	8.26	78.90

DTM = Delayed Test Mean, PM = Posttest Mean

According to Table 1, the percentage retention of students in the three groups—collaborative practicum, experimental demonstration, and lecture—was 90.91, 87.29, and 78.90, respectively. This suggests that students in the lecture group retained 78.90% of the core technology principles presented, while those in the collaborative practicum group maintained 90.91%. Students in the experimental demonstration group retained 87.29%. This indicates that the three groups' mean retention ratings differ from one another.

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

Table 2: Comparing the Mean Retention Scores of Students Taught Basic Technology with CP, ED, and LM Using ANCOVA

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	39884.857[a]	3	13294.952	4358.782	.000
Intercept	502.497	1	502.497	164.745	.000
Pretest	27705.425	1	27705.425	9083.290	.000
Methods	1671.293	2	835.646	273.969	.000
Error	939.447	308	3.050		
Total	939097.000	312			
Corrected Total	40824.304	311			

Table 2 indicates that the computed F is 273.969 with a P-value of 0.000, which is less than 0.05, at the 0.05 level of significance, with a 2 degree of freedom numerator and a 308 degree of freedom denominator. This suggests a considerable difference in the retention scores. The null hypothesis is thus disproved. As a result, the average retention scores across students who were taught fundamental technology through CP, ED, and LM, differ significantly.

Table 3: Scheffe Post-hoc Analysis of the Mean Retention Differences between Groups' Significance

(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	2.032*	.240	.000	1.559	2.505
	LM	6.039*	.260	.000	5.527	6.551
ED	CP	-2.032*	.240	.000	-2.505	-1.559
	LM	4.007*	.255	.000	3.505	4.510
LM	CP	-6.039*	.260	.000	-6.551	-5.527
	ED	-4.007*	.255	.000	-4.510	-3.505

The data presented in Table 3 demonstrates a statistically significant disparity (in favour of CP) in the average retention 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 retention scores of students who received instruction in basic technology utilizing LM and CP. Table 3 provides additional evidence of a statistically significant disparity, in favour of ED, in the average retention scores of students who were instructed in basic technology using ED and LM. Therefore, the order of relevance changes from CP to ED and LM.

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

Table 4: Mean of Teaching Method and Sex Interaction on Students' Retention Scores

Methods		Collaborative			Experimental			Lecture	
	N	Mean	SD	N	Mean	SD	N	Mean	SD
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
Delayed test									
Male	49	61.10	9.84	46	54.00	9.30	40	46.30	6.35
Female	63	59.11	10.86	57	55.91	10.40	57	43.86	9.29
Total	112	59.98	10.43	103	55.06	9.92	97	44.87	8.26

The results shown in Table 4 do not indicate a sex-CP interaction effect, as the male students who performed higher on the posttest also scored higher on the delayed test when compared to the female students. Given that the female students with higher posttest scores also scored higher on the delayed test when compared to their male counterparts, Table 4's results do not indicate an interaction effect between ED and sex. Further, evidence of no sex-LM interaction effect was found in Table 4, where male students who scored higher on the posttest also recorded higher delayed test scores than female students.

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

Table 5: ANCOVA for Assessing the Interaction Between Teaching Method and Sex on Students' Retention of Basic Technology

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	39917.174[a]	6	6652.862	2236.860	.000
Intercept	513.410	1	513.410	172.621	.000
Pretest	27395.420	1	27395.420	9211.029	.000
Methods	1628.440	2	814.220	273.761	.000
Sex	10.932	1	10.932	3.676	.056
Methods * Sex	21.289	2	10.645	2.579	.079
Error	907.130	305	2.974		
Total	939097.000	312			
Corrected Total	40824.304	311			

Table 5 demonstrates that the computed F is 2.579 with a P-value of 0.079, which is greater than 0.05, at the 0.05 level of significance, with a 2 degree of freedom numerator and a 305 degree of freedom denominator. This suggests that the interaction effect is not statistically significant. As a result, the null hypothesis is accepted. Thus, there is no discernible interaction effect between the mode of instruction and a student's gender on the retention of basic technology.

Discussion

A key discovery of the study revealed that students who received instruction in basic technology through collaborative practicum, experimental demonstration and lecture method had markedly different average retention scores. Based on Scheffe's post-hoc test, the importance order proceeds from the collaborative practicum to the lecture technique, and then to the experimental demonstration. The apparent preference for collaborative practicum over experimental demonstration may be attributed to the fact that it allows students to actively participate in the teaching content and apply their knowledge in a practical environment. This could result in better information retention than passive observation in experimental demonstration. Once more, collaborating with peers in a collaborative practicum environment may inspire students to discuss and work through problems with one another, which could result in a deeper comprehension of the subject matter and improved idea retention.

The fact that collaborative practicum allows students to actively engage with the material through hands-on activities may account for the observed finding favouring it over the lecture method. This can be explained by the fact that active engagement with the material can lead to better information retention than passive listening in a lecture. Students can see the real-world uses of the technology they are learning and form connections that help with retention when they participate in collaborative practica, which frequently entail problem-solving and real-world scenarios. The outcome of this study confirms the conclusions of Eze and Lasisi (2018), who observed that students who received instruction in fundamental technologies using cooperative learning approaches achieved higher retention scores compared to those who were taught using conventional lecture methods. The outcome of this study confirms the conclusions of Chianson, Kurumeh, and Obida (2011), who observed that students who employed a cooperative learning approach demonstrated superior retention of circular geometry concepts compared to those who were taught using a conventional lecture method.

The fact that experimental demonstrations encourage active involvement and hands-on activities may account for the observed finding favouring them over lecture methods. When students actively participate in practical exercises and experiments as opposed to simply listening to lectures, they may have a greater grasp and memory of the content. When students actively participate in experiments and demonstrations as opposed to only listening to lectures, they may be more motivated and involved in the learning process. This result corroborates the findings of Bilesanmi-Awoderu, Afuwape, and Jolaosho (2017), who found that the demonstration approach outperforms the lecture method in terms of increasing biology achievement and retention. This result is consistent with that of Zudonu and Njoku (2018), who found that the demonstration technique was superior than the lecture method in terms of improving student retention.

The study also found no evidence of a significant interaction effect between sex and the method of instruction (collaborative practicum, experimental demonstration and lecture method) on students' retention of basic technology. This suggests that a student's sex has no bearing on how well they retain basic technology in relation to a teaching method. This result supports the findings of Eze and Lasisi (2018), who found no significant connection between gender and teaching approaches and students' academic achievement and retention in basic technology. This result corroborates the findings of Zudonu and Njoku (2018), who found no statistically significant interaction between gender and instructional approaches and students' retention mean scores.

Conclusion

Based on the study's findings, it was concluded that, at Edo State, collaborative practicum improved students' retention of basic technology more than experimental demonstration and lecture method did. Additionally, it was concluded that improving students' retention of basic technology in Edo State was better accomplished through the use of experimental demonstration than through the lecture method. The study comes to the same conclusion once more: students' retention of basic technology in Edo State was unaffected by their sex in combination with collaborative practicum, experimental demonstration, and lecture method.

Recommendations

The study's conclusions led to the following recommendations being made:

1. To increase students' active participation and interaction during instruction, basic technology teachers at the junior secondary school level should implement the usage of collaborative practicum.
2. When teaching basic technology in junior secondary schools, educators should also use experimental demonstration as a backup strategy in case collaborative practicum isn't practical. This will help to make the concepts more understandable and less abstract.
3. 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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