Indonesian Journal of Educational Research and Technology

Journal homepage: http://ejournal.upi.edu/index.php/IJERT/

Efficacy of Open Learning System on College of Education Students' Achievement in Woodwork Technology

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ABSTRACT

The study explored the effectiveness of open learning as one of the educational approaches to equip youths for job market/self-employment, thereby increasing their self-reliance and combating the ever-increasing poverty problem. The efficacy of open learning for teaching woodwork design and construction in Nigerian colleges of education was determined using a pre-test, post-test non-equivalent control quasi-experimental design. Three null hypotheses and three research questions guided the study in which the experimental group was taught woodwork design and construction using an open learning system while the control group received instruction with the conventional teaching method for ten weeks. Wood Design and Construction Achievement Test (WDCAT) comprised of drawing and practical tests with a KR-21 reliability coefficient of 0.88 employed for data collection. Results showed that students in the experimental group achieved significantly better performance in woodwork design and construction than students in the control group. Although no significant difference existed between genders taught wood design and construction using an open learning system. Based on the findings, it was recommended that an open learning system should be encouraged in teaching woodwork design and construction in Nigerian educational institutions.

ARTICLE INFO

Article History:
Submitted/Received 27 Aug 2022
First revised 22 Sep 2022
Accepted 03 Oct 2022
First available online 05 Oct 2022
Publication date 01 Mar 2024

Keyword:
Achievement,
Open learning,
Perception,
Technical vocational education and training,
Wood design and construction.

1. INTRODUCTION

The Nigerian education system is geared towards producing individuals who will not only possess the capability to solve the problem but also contribute to the development of society. Many subjects can be identified in schools curriculum at all levels of Nigerian education and the subjects are included with the expectation that when properly taught, more effective learning will result and this will bring about the realization of the goals of Nigerian education as stated in the National Policy on Education. One of such courses in colleges of education curriculum is woodwork technology. Woodwork technology teaches individuals the systematic skills, knowledge, and attitude involved in the production of specific products or services. It incorporates the total learning experiences offered in educational ideas and abilities to make mature judgments and be in a position to create goods and services in the area of carpentry and joinery, furniture/cabinet making, wood machinist, and upholstery work.

The program for woodwork technology in colleges of education in Nigeria is designed to produce competent woodwork teachers who are skilled in the art of joinery work and teachers who in turn will develop the skills in students. Woodwork technology promotes in individuals mental, affective, and psychomotor skills needed for the production of exact products from wood for human deployment and use. One of the major objectives of woodwork technology is to make an individual student self-reliant and an employer thereby reducing unemployment in society (Olabiyi & Awofala, 2019). Woodwork technology consists of three major areas i.e. theory, drawing, and practical, major activities involve psychomotor skills.

Psychomotor learning is demonstrated by physical skills such as movement, coordination, manipulation, dexterity, strength, and speed—actions that demonstrate motor skills, such as the use of precision instruments or tools. In psychomotor learning research, attention is given to the learning of coordinated activity involving the arms, hands, fingers, and feet, while verbal processes are not emphasized. Behavioral examples are eye-hand coordination tasks such as measuring, cutting, nailing, and operating machines. The motor cortices are involved in the formation and retention of memories and skills. Shmuelof and Krakauer (2014) explain that when an individual learns physical movements, this leads to changes in the motor cortex. The more practiced a movement is, the stronger the neural encoding becomes. Woodwork design and construction involve making use of psychomotor skills. These skills are first taught by the teacher then acquired, performed, and lastly learned.

Psychomotor skills may be taught using a variety of widely-accepted and available teaching strategies. However, the utility of teaching strategies to teach skill acquisition and skill retention is contestable when teaching complex skills, in contrast to simple skills (Nicholls *et al.,* 2016). Open learning strategy can be used to teach contemporary motor learning and as a cognition literature frame instructional practice that assists the teaching and learning of complex task-based skills (Agarry *et al.,* 2023). In recent times, there is an increasing pressure on technical vocational education graduates to demonstrate their worth. In response to this, lots of TVE institutions are rethinking how education can be delivered through democratizing access to learning. It is a movement called open learning that enables TVE students to have greater control over what they learn, where, and when.

The term open learning is used to describe learning situations in which learners have the flexibility to choose from a variety of options concerning the time, place, instructional methods, modes of access, and other factors related to their learning processes. It should be understood from this perspective that a learning situation or process should be open to

DOI: https://doi.org/10.17509/ijert.v4i1.51161
p- ISSN 2775-8419 e- ISSN 2775-8427

everyone, under any circumstances, at any place, and at any time (Gambari *et al.,* 2014). Open learning is an approach to the design and facilitation of learning opportunities that are public and easily accessible, use open educational resources and practices, and encourage participation in a shared knowledge commons. It deals with equal opportunities for receiving high-quality educational content without any forms of institutional barriers or financial liabilities and it promotes a learner-centered instructional climate that deviates from the traditional assembly-line type of education models.

In open pedagogies, students are tasked with creating learning experiences that would be beneficial in their environment. Meaningful and effective learning happens when students are being active – creating, discussing, and reflecting – rather than simply memorizing and repeating (Bugarso *et al.,* 2021). Open Learning enables many people to take advantage of cost-effective and meaningful, quality education and training opportunities throughout their lives. TVE institutions are supposed to strive to make this possible through acknowledging the diversity of learning contexts of learners in Nigeria; reducing barriers to learning; sharing expertise, knowledge, and resources; and increasing access to diverse learning opportunities.

Open learning involves but is not limited to: classroom teaching methods, approaches to interactive learning, formats in work-related education and training, the cultures and ecologies of learning communities, and the development and use of open educational resources Wiley (2018), a thought leader in open learning, suggests a change from disposable assignments, which students throw away upon receiving a grade, to renewable assignments, which challenge students to create products that can be shared with the public.

The growth of open learning arises from the aspiration of employers to train staff with the least absence from work, the improvement of facilities to meet the needs of students studying in their own time, and the desire of some teachers to promote learning in areas which would not attract sufficient students for traditional methods. Open learning has focused primarily on societal and learner needs, and on descriptions or proposals for how these needs can be met. The literature on open learning at all levels has been a consistent expression of concern for a learner-oriented educational system.

Open learning as it is used in this study, refers to the open pedagogies mode which follows open learning principles. Open pedagogy is the practice of engaging with students as creators of information/facts rather than simply consumers of it. It's a form of experiential learning in which students demonstrate understanding through the act of creative activity (Barri *et al.,* 2023).

The outcome of open pedagogy is student products and openly licensed so that they may live outside the classroom in a way that has an impact on the large community. Open pedagogy is a high-impact practice that empowers students by providing them an opportunity to engage in subject matter through the generation of ideas, design, and construction of an article. As the originator of ideas, students in design and construction gain a greater understanding of the rights and responsibilities associated with information ownership so they may make informed decisions about their intellectual property and patent license. Open learning practice challenges traditional teaching roles and has the power to transform the educational experience for both teachers and students.

Open pedagogy encourages reflective practice, the sharing of ideas and resources, choice in expression, and the posing of open-ended problems that accept many diverse solutions created by diverse learners. The qualities of open pedagogy among others include that: learners are individuals and independent agents within the learning process, they are allowed to operate independently and explore with personal freedom; learners choose their own pace, their direction, and their connections; the learning network is an open-ended and ever-

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p- ISSN 2775-8419 e- ISSN 2775-8427

expanding network of nodes. Each node in the network represents is a connection, a possibility for learning, everything in the network is a project; openness translates to rich possibilities that inspire new perspectives and ideas; learners take responsibility for their learning networks and are active participants in its planning and construction; learning design is focused on process, it is about empowering students to create real solutions to real problems.

In open learning, students collaborate to encourage social skills and maintain high psychomotor attainment irrespective of their gender. Gender according to Olabiyi *et al.* (2020) refers to the socially culturally constructed characteristics and roles that are ascribed to males and females in any society. It is a social perception of being regarded as male or female within a society. Olabiyi & Awofala (2019) averred that there is evidence that gender is a major determinant of students' psychomotor performance in vocational subjects and is a recurring issue in vocational education. Therefore, this study determined if an open learning strategy would make a significant influence on students' achievement in woodwork design and construction based on gender.

The woodwork technology program in Nigerian colleges of education is designed to produce competent teachers who are skilled in the art of joinery work and who in turn will develop and teach the skills to students. Woodwork promotes in individuals mental, affective, and psychomotor skills needed for the production of exact products from wood for human deployment and use. One of the major objectives of woodwork technology is to make an individual student self-reliant and an employer of labor thereby reducing unemployment in the society. In most colleges of education, where woodwork technology is taught, learning occurs majorly through expository and unproductive teaching (Olabiyi & Awofala, 2019). Skills, knowledge, and attitudes are imparted and acquired through memorization without a meaningful understanding of the underlying principles.

However, several research reports have indicated that students achieve poorly in psychomotor skills, especially in woodwork design and construction (Kareem & Ma'aji, 2011). It is noted that low performance in wood design and construction may be ascribed to poor instructional strategy use and the problem may have stemmed from the traditional method being used by teachers (Olabiyi & Awofala, 2019; Olabiyi *et al.,* 2020) Without mincing words, most Nigerian technical teachers may not be pedagogically situated to teach in this modern-day schools because they were professionally-equipped compared to the modern-day constructivist teaching. Many Nigerian technical teachers were schooled in the classroom where teachers remained the authority and dispenser of knowledge and student's passive recipient of teachers' memorized information which made them unable to explain what they have learned.

To produce woodwork graduates equipped for the workplace, instructors must teach in ways that encourage the student to engage in meaningful learning, students should actively engage in a practice that allows them to generate an idea through the design and construction of tangible products. Employers in industry and business want their employees equipped with applied and generic skills, which include, sharing ideas and resources, taking responsibility, and actively participating in the expansion of the business (Sarkar, 2015). Change is needed in the methods of teaching and learning to accommodate mature learners and to provide rich possibilities that inspire new perspectives and ideas as well as focus on the process. Colleges of education that train students' teachers, have to be prepared to meet these challenges. Open learning could provide the answer, as it combines the principles of learner-centeredness, the flexibility of learning provision, the removal of barriers to access learning, the provision of learner support, the construction of learning programs in the expectation

DOI: https://doi.org/10.17509/ijert.v4i1.51161
p- ISSN 2775-8419 e- ISSN 2775-8427

that learners can succeed, and the maintenance of rigorous quality assurance over the design of learning materials and support systems (Schultz *et al.,* 2014).

The study investigates the efficacy of an open learning system for teaching wood design and construction. Specifically, the study sought to determine:

(i) The effectiveness of the open learning strategy on student achievement in woodwork design and construction,

(ii) Compare the academic achievement of male and female students in woodwork design and construction,

(iii) Compare the interaction effect of treatment (open learning system & lecturing method) and gender (male & female) on students' achievement in woodwork design and construction.

The following research questions were answered in this study:

(i) What is the outcome of treatment (open learning system vs. lecturing method) on students' achievement in woodwork design and construction?

(ii) What is the influence of gender on students' achievement in woodwork design and construction?

(iii) What are the interaction effect of treatment (open learning system & lecturing method) and gender (male & female) on students' achievement in woodwork design and construction?

Three null hypotheses tested at a 0.05% level of significance guided this study:

HO1: There is no significant difference in the main outcome of treatment (open learning system & lecturing method) on students' achievement in woodwork design and construction.

HO2: The main influence of gender on students' achievement in woodwork design and construction is not significant.

HO3: The interaction effect of treatment and gender on students' achievement in woodwork design and construction is not significant.

2. METHODS

2.1. Research Design

The study adopted a pre-test, post-test, non-equivalent control group quasi-experimental research design. Quasi-experiment is a design where we cannot randomize participants of treatment groups (Nworgu, 1991). We therefore arbitrarily allotted intact classes to experimental and control groups.

This was to prevent disruption of the lecture timetable and normal academic classes of the participants. The quasi-experimental design which involved a 2×2 factorial matrix was used to contrast the treatment's (at two levels) scores crossed with gender (at two levels) and levels (at two levels). The scheme of the study is emblematically given as follows in **Table 1**.

Where X1 represents the open learning system and C represents the lecture method. The mean difference scores between O_1 and O_2 and O_3 and O_4 were subjected to statistical significance using Analysis of Covariance statistics.

Table 1. The research design.

O_1 X_1 O_2	$X_{1gain} = O_2 - O_1$	O_1O_3 pre-tests
O_3 C O_4	$C_{gain} = O_4 - O_3$	O_2O_4 post-tests

2.2. Participants

The participants in this study comprised one hundred and twenty-six-year two technical education students from two colleges of education that offer technical education (75 males

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p- ISSN 2775-8419 e- ISSN 2775-8427

and 51 females). Simple random sampling was used to select one intact class each from two colleges of education offering technical education that was distantly located from one another within the city of Lagos, Nigeria. We arbitrarily allowed Federal College of Education (Technical) Akoka, to the open learning strategy with 71 students (43 males and 28 females) and Adeniran Ogunsanya College of Education Otto/Ijanikin to lecture method with 55 students (32 males and 19 females). The mean ages of the students in the open learning college and conventional teaching college were 18.6 years and 18.5 years respectively.

2.3. Instrument for Data Collection

The instrument for data collection was Wood Design and Construction Achievement Test (WDCAT). The WDCAT, which was used to test the achievement of students in design and construction, was developed by us. The WDCAT used as pretest and posttest comprised of 20 multiple choice, drawing, and practice tests covering topics related to design, working drawing, construction, and finishing process as contained in the year two woodwork design and construction course content. The course was chosen because students performed poorly generating design ideas, and construction, and carried out market survey and their relevance in becoming a successful entrepreneur.

The WDCAT was subjected to face and content validation by two woodwork technology Lecturers at the University of Lagos, Akoka, Lagos, and another one from Tai Solarin University of Education, IJagun, Ogun, Nigeria. The validation entailed checking the WDCAT question items against the topic and content of the lesson plan, language editing, and appropriateness of the test to the target participants. few questions were reworded based on experts' recommendations. Based on this, the question was pilot tested in Emmanuel Alayande College of Education, Oyo. The reliability coefficient of the WDCAT was found to be 0.85 using Kuder-Richardson 20 formulae. The objective question scored 20 marks, the compulsory question scored 30 marks and the other questions has scores of 20 marks each, thus, a total score of 100 marks was obtainable. The WDCAT covered the first three levels (knowledge, comprehension, and application) of Bloom's taxonomy of cognitive domain called the lower–order cognitive domain as contained in the table of specification **Table 2**.

2.4. Procedure

We prepared two sets of lesson plans based on the topics set out for the study in the table of specifications. These lesson plans were prepared from the units in the test blueprint. Each set contains twelve (12) lesson plans that can be taught in twelve weeks s of which each lesson plan is of two hours. The first set of lesson plans written by we was based on an open learning system and this was applied in teaching students of the experimental group. The second set of lesson plans deployed in teaching students of the control group was written with the lecture method in mind. The lecturers of the experimental group were trained for one week to ensure the fidelity of the treatment and the research was carried out during the normal school hour.

On the first day, before the lesson begin, WDCAT was administered as a pre-test to both the experimental and control groups, and proper teaching commenced using the lesson plans prepared from the table of specifications. The experimental group was taught with open learning lesson plans while the control group was taught using lecture method lesson plans. Each lesson lasted for two hours and the treatment is for twelve weeks. At the end of the treatment, the re-arranged and re-construction WDCAT was administered to both groups as a post-test in order to prevent the halo effect which might result from over-familiarity with the pre-test. The scores obtained from both groups were compared to determine the efficacy

DOI: https://doi.org/10.17509/ijert.v4i1.51161
p- ISSN 2775-8419 e- ISSN 2775-8427

of the teaching strategies that were used in the study (Isah *et al.,* 2021). As a prelude to treatment in the experimental group, the students were divided into low and high-ability groups using the results of the pre-test. The high ability students should score 50% and above on the pre-test while the low ability students should score below 50% on the pre-test using the score of pre-test from TED 222 (course title) results from each college.

Table 2. Test Item Specifications in Woodwork on WDCAT.

No	Topics	Level of Psychomotor domain			
		Knowledge	Comprehension	Application	Total
1	Design, characteristics, and reasons for designing woodwork article	4	5	6	15
2	Use of hand tools, machines	5	4	6	15
3	Preparation of working drawing	3	3	9	15
4	Preparation of cutting list and selection of materials	3	3	4	10
5	Marking and cutting out process	3	3	9	15
6	Trial and final assembly process	3	3	4	10
7	Finishing, application of finishes	5	5	10	20
	Total	**26**	**26**	**48**	**70**

Two colleges of education that offered technical education in Lagos state were involved in the study. A simple random sampling technique was used in determining the Federal College of Education (Technical) Akoka which was given the experimental treatment and Adeniran Ogunsanya College of Education which served as the control group. Both the pre-test and post-test were administered under similar conditions in both experimental and control groups. In the experimental group, 71 students were divided into two groups to reduce costs in the construction of the design article. Each group consisted of a mixture of high and low-ability students with unequal numbers of boys and girls. The rationale for forming a heterogeneous group was to maximize strength (Yusuf *et al.,* 2012). Each group had a task to design and construct an article. A lesson in the experimental group commenced as an entire class teaching in which the teacher introduced, the course title: woodwork design and construction; course code: TED 222. The teacher leads students to understand the meaning of the design, types of designs, reasons for the design and construction, and fundamentals of design.

The teacher then asks students to identify the difficulties they are experiencing in wood design and construction, and students came up with a series of answers to the question, then teachers ask students to indicate the most significant problem or challenges they faced in design and construction. Among those listed were inability to generate design ideas, inability to prepare preliminary drawings; final working drawings, cutting list, marking and cutting out accurately, and lack of skill in preparing sound joint construction, finishing, and finishing process. Then the teacher uses these as the major lesson objectives and therefore, set out clear and achieves objectives that include all based on the student's responses. The teacher breaks down the objectives and the lesson plan into progressive and feasible steps that facilitate progress and psychomotor learning; the teacher encourages students to use activities that provide different sensory approaches and outcomes; select, the teacher assists students to develop and use a wide range of resources to meet the various needs of all.

The teacher ask students to come up with a design idea and to identify the problem that the design will solve, and the design was listed on the board, teacher ask students to enumerate reasons why student suggest those articles, and the teacher encouraged the students to articulate why their chosen design was important and the cutting list. The teacher

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p- ISSN 2775-8419 e- ISSN 2775-8427

then asked students who were interested in the same problems to join into teams of five, and in these teams, they prepared preliminary sketches for approval before preparing the final working drawing and the cutting list. The teacher's role in all this was one of initiator, encourager, respondent, and ensuring availability of training resources such as hand tools, and consumable materials (wood, sandpaper, polish, and fittings).

After students began working on their particular project, the teacher moves from group to group with the assistance of the instructor to observe the progress of what students are doing. Because of the high level of interest in the subject matter, however, the teams more or less competed themselves. The project was open-ended and individualized, but it was a planned and organized experience. The learning proficiencies of the students in the experimental group were assessed through tests, process, and product assessments of the final project.

The assessment covered the various learning tasks that students worked through in their groups to accomplish and students' scores in each group were computed for comparison. Two colleges of education offering technical education were involved in the study and the first college was randomly assigned the experimental treatment while the second college was assigned the control treatment using a simple random sampling technique. The conditions for administering the pre-test and post-test in the two colleges were the same.

Students in the experimental group were constituted into a heterogeneous group form teams thereby consisting of both high and low-ability students of both genders to maximize strength. Students in the control group were treated with the lecture method. Deploying the lecture method in this study, the teacher made a whole class presentation on the topics with minimal student participation and interaction. In other words, students in the control group remained passive while the teacher was regarded as the sole authority to be contacted for information. In this approach, students were unable to take charge of their learning. Students in the control group consisted of 51 students who were treated with the lecture method. Using this method, the teacher presented the information on the topics to the whole class while learners listened and carry out the assignment at the end of each lesson. The topics taught in the experimental and control groups lasted for twelve weeks.

2.5. Method of Data Analysis

Data collected were analyzed using descriptive and inferential statistics to answer the research questions and test the null hypotheses respectively. Mean and standard deviation was used to answer the research questions while the Analysis of Covariance was used to test the null hypotheses at a 0.05 level of significance, through the Statistical Package for the Social Sciences (SPSS) Package.

3. RESULTS AND DISCUSSION

3.1. Research Question One

This section is focused on the outcome of treatment (open learning system vs. lecturing method) on students' achievement in woodwork design and construction. Null Hypothesis One used is no significant difference in the main outcome of treatment (open learning system & lecturing method) on students' achievement in woodwork design and construction.

Results presented in **Tables 3** and **4** show the answer to research question one and test null hypothesis one respectively. **Table 3** showed that the students of the experimental group taught woodwork design and construction with open learning strategy pooled a pre-test mean score of 32.51 (SD=10.63) and a post-test mean score of 48.31 (SD=5.90) with a mean difference of 15.80. Meanwhile, the control group taught woodwork design and construction

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p- ISSN 2775-8419 e- ISSN 2775-8427

with the lecture method scored a pre-test mean score of 32.22 (SD=11.25) and a post-test mean of 34.95 (SD=11.04) with a mean difference of 2.73. This showed that the experimental group that taught woodwork design and construction with the open learning strategy achieved better performance than the control group treated with the lecture teaching method. Hence, the lecture teaching method was less effective when compared with the open learning system.

A further close look at the post-treatment achievement scores of both groups (control and experimental) using Analysis of Covariance as discovered in **Table 4** pictured that the disparity in means between the experimental and control groups was meaningfully weighty (F(1, 249)=433.25, p=0.000, η2 p=0.64). The partial eta squared (η2 p) (Olabiyi & Awofala, 2019) of .639 showed that treatment alone accounted for 63.9% of the variability in achievement in woodwork design and construction. This outcome points out that treatment has a large effect on achievement in woodwork design and construction (Cohen, 1988). Therefore, it was concluded that there was a significant main effect of treatment on students' achievement in woodwork design and construction in favor of the open learning group.

Table 3. Results of statistical analysis of pre-treatment and post-treatment achievement scores based on gender.

Treatment	Gender	N	Pre-test		Post-test		Mean difference
			Mean	SD	Mean	SD	
Open Learning	Male	43	31.84	10.40	48.53	6.02	16.69
	Female	28	33.18	10.89	48.12	5.82	14.94
	Total	71	32.51	10.63	48.31	5.90	15.80
Lecture Method	Male	32	30.92	11.06	33.89	10.04	2.97
	Female	19	33.59	11.38	36.19	11.96	2.60
	Total	51	32.22	11.25	34.95	11.04	2.73
Total	Male	75	31.34	10.95	40.67	11.14	9.33
	Female	51	33.37	10.87	42.07	11.16	8.70
	Total	126	32.32	10.93	41.36	11.16	9.04

3.2. Research Question Two

This section is focused on the influence of gender on students' achievement in woodwork design and construction. We used Null Hypothesis Two: the main influence of gender on students' achievement in woodwork design and construction is not significant.

The results that were used to answer research question two and test null hypothesis two were presented in **Tables 3** and **4** respectively. In **Table 3**, it was shown that the male students taught design and construction in woodwork with an open learning system scored a pre-test mean score of 31.84 (SD=10.40) and a post-test mean score of 48.53 (SD= 6.05) with a mean difference of 16.69. Meanwhile, the female students who underwent instruction in woodwork design and construction with open learning system pooled a pre-test mean score of 33.18 (SD=10.89) and a post-test mean score of 48.12 (SD= 5.82) with a mean difference of 14.94. This showed that male students taught woodwork design and construction performed slightly better than female students in the post-test. Hence, there can be a slight gender difference in students' achievement in woodwork design and construction in favor of the male students. Further investigation of the post-treatment achievement scores of both genders (male and female) utilizing Analysis of Covariance as revealed in Table 3 depicted that the disparity in means between the male and female groups was not meaningfully weighty (F(1, 249)=0.31, p=0.58, η2 p=0.001). Thus, it was resolved that gender had no significant main influence on students' achievement in woodwork design and construction.

DOI: https://doi.org/10.17509/ijert.v4i1.51161
p- ISSN 2775-8419 e- ISSN 2775-8427

Table 4. Summary of Analysis of Covariance of Achievement in Woodwork Technology Scores by Treatment and Gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig	Partial Eta Squared
Corrected model	24889.880a	4	6222.470	249.397	0.000	0.803
Intercept	9821.187	1	9821.187	393.633	0.000	0.616
Pre-test	13552.279	1	13552.279	543.175	0.000	0.689
Treatment	10809.587	1	10809.587	433.248	0.000	0.639
Gender	7.802	1	7.082	0.313	0.577	0.001
Treatment×Gender	58.110	1	58.110	2.329	0.128	0.009
Error	6112.776	245	24.950			
Total	458996.000	250				
Corrected Total	31002.656	249				

a. R Squared = .803 (Adjusted R Squared = .800)

3.3. Research Question Three

This section is focused on the interaction effect of treatment (open learning strategy & lecture method) and gender (male & female) on students' achievement in woodwork design and construction. We used Null Hypothesis Three: The interaction effect of treatment and gender on students' achievement in woodwork design and construction is not significant.

The results in **Tables 3** and **4** present answers to research question four and test null hypothesis four respectively. Also, a close look at **Table 3** revealed that the male students taught design and construction in woodwork with an open learning system scored a pre-test mean score of 31.84 (SD=10.40) and a post-test mean score of 48.53 (SD= 6.05) with a mean difference of 16.69.

Meanwhile, the female students who underwent instruction in woodwork design and construction with open learning system pooled a pre-test mean score of 33.18 (SD=10.89) and a post-test mean score of 48.12 (SD= 5.82) with a mean difference of 14.94. However, male students who underwent tutelage in woodwork design and construction with the lecture method pooled a pre-test mean score of 30.92 (SD=11.06) and a post-test mean score of 33.59 (SD=10.04) with a mean difference of 2.97. For the moment, female students who undergone tutelage in woodwork design and construction with the lecture method pooled a pre-test mean score of 33.59 (SD=11.38) and a post-test mean of 36.19 (SD=11.96) with a mean difference of 2.73. With these outcomes, both genders that underwent instruction in woodwork design and construction through the open learning strategy gained comparably and maximally from the instruction than the male and female students that underwent instruction in woodwork design and construction through the lecture method. Thus, the open learning strategy and the lecture method could be used to lessen the disparity between both genders' achievements in woodwork design and construction.

A further close look at the post-treatment achievement scores of students by treatment and gender utilizing Analysis of Covariance as revealed in **Table 4** depicted that the interaction effect of treatment and gender was not meaningfully weighty ($F(1, 249)=2.33$, $p=0.13$, $\eta 2$ $p=0.009$). Thus, it was concluded that the interaction effect of treatment and gender on students' achievement in woodwork design and construction was not statistically significant.

The results presented in **Table 4** indicated a weighty main effect of treatment on students' achievement in woodwork design and construction in which treatment alone accounted for 63.9% of the variability in students' achievement in woodwork design. This outcome revealed that the adoption of an open learning strategy in teaching woodwork design and construction greatly improved the achievement of students than when students were treated with the

DOI: https://doi.org/10.17509/ijert.v4i1.51161
p- ISSN 2775-8419 e- ISSN 2775-8427

lecture method. This outcome supported previous outcomes by Wiley (2018), which linked enhanced content learning and achievement to students having equal opportunities for receiving high-quality educational content without any forms of institutional barriers or financial liabilities.

The lecture method for overemphasizing the teacher as the authority in the classroom and neglecting students' participation, is a one-way communication affair that is autocratic and encourages students' passivity, relegates to the background individual differences amongst the learners in the classroom, and students with impairment cannot gain from lecture method which could have a damaging influence on students' achievement (Olabiyi, 2020) in woodwork design and construction. Open learning promotes a learner-centered instructional climate that deviates from the traditional assembly-line type of education model. The open learning approach was more efficient in sustaining and increasing students' achievement in woodwork design and construction than the lecture method because the strategy enabled the learners to take responsibility for their learning networks and are active participants in its planning and growth, thereby empowering learners to create real solutions to real problems which aided their ability to be creative in creating design and construct article to solve a particular problem.

The learners are individuals and independent agents within the learning process, they are allowed to operate independently and explore with personal freedom, they choose their own pace, their direction, and their connections; the learning network is open-ended (Tiong & Bakar, 2022). Some related investigations have shown that the efficacy of open learning strategy as a form of experiential learning in which students demonstrate understanding through the act of creation hinged on the opportunity it affords students to collaborate in finding a solution to problems, share ideas, and enhance achievement. The finding of the study is in agreement with past results because the structure of open learning allows students' active participation and social interaction. However, students were convinced that an open learning strategy made lessons.

meaningful and effective learning happens when students are being active – creating, discussing, and reflecting – rather than simply memorizing and repeating. In open learning, students are tasked with creating learning experiences that would be beneficial to their environment and keep students busy and lively. Since open learning engages students' cognitive and affective skills and makes learning alive. Wiley (2018), suggests that students should be given renewable assignments, which challenge students to create products that can be shared with the public.

The non-important key influence of gender on students' achievement in wood design and construction recorded (**Table 4**) agreed with previous results in science, technology, and mathematics (Olabiyi & Awofala, 2019). From these studies, we noted no statistically meaningful gender disparities in students' learning outcomes. The result of no statistically significant gender difference in achievement in woodwork design and construction was in contradiction with the perennial beliefs that gender stereotypes are prevailing in schools in Nigeria. According to Schiefele & Csikszentmihalyli (1995), gender disparities in learning outcomes are a function of personal conviction of capabilities and sex role labeling. The present study outcome on gender suggested that both genders had similarly rich experiences and exposures within and outside the school system and that statistically significant gender differences in achievement in woodwork design and construction could be disappearing.

DOI: https://doi.org/10.17509/ijert.v4i1.51161
p- ISSN 2775-8419 e- ISSN 2775-8427

4. CONCLUSION

Through a quantitative research paradigm, the study investigates the efficacy of an open learning system for teaching wood design and construction in Lagos State, Nigeria. It also examined the influence of gender as a moderator variable on the dependent measure. The study established that the compass method was less effective when compared with the open learning strategy in enhancing and sustaining students' achievement in woodwork design and construction. More so, this study established that gender was not an important variable in students' achievement in wood design and construction. Thus, regardless of gender students will maintain enhanced achievement in design and construction when an open learning strategy is employed for teaching design and construction in woodwork.

The result, therefore, showed that an open learning strategy proved to be a worthwhile substitute for the compass method for teaching design and construction in colleges of education students in Nigeria. The study concluded that the adoption of an open learning strategy in teaching woodwork design and construction in colleges of education in Nigeria would not only combine the principles of learner-centeredness, lifelong learning, the flexibility of learning provision, the removal of barriers to access learning but would enhance their achievement in both internal and public examinations in woodwork design and construction.

In line with the study's results, a few recommendations were made:

(i) Woodwork technology lecturers should acquaint with the nitty-gritty of open learning strategy in the teaching of design and construction in colleges of education in Nigeria for enhanced academic achievement.

(ii) Students in colleges of education should be allowed to actively participate in classroom and workshop activities and freely interact with their teachers and their peers to engender creativity in them and enhance their academic prowess in woodwork design and construction.

(iii) Administrators in Colleges of Education in Lagos State should support lecturers by making available the required training facilities for teaching design and construction in the woodwork to enhance students' achievement in courses like woodwork technology education.

The government through the Ministry of Education in Lagos State should assist lecturers by organizing workshops and seminars for them on open learning strategy and its variants and other teaching strategies that could improve students' academic achievement in woodwork technology.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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