Effect of Teaching Turning Operations with Fabricated Woodwork Mini-lathe on Student's Achievement in Carpentry and Joinery in Technical Colleges in Rivers State

Silverline N. Igweagbara
Department of Industrial Technical Education (Building Option), Ignatius Ajuru University of Education, Port Harcourt, Rivers State, Nigeria.

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*Corresponding Author E-mail: silverlineigweagbara@g.mail.com (+2348037069223)

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ABSTRACT: The study examined the effect of teaching turning operations with fabricated woodwork mini-lathe on students' achievement in carpentry and joinery in Technical Colleges in Rivers State, Nigeria. One research question and one hypothesis guided the research. The hypothesis was tested at 0.05 level of significance. The study adopted quasi-experimental research design. The population of the study was all the 50 National Technical Certificate 1 (NTC 1) students of the two (2) Technical Colleges offering Carpentry and Joinery Craft in Rivers State (Government Technical College Port Harcourt - 45 and Ahoada - 5). Census sampling technique was adopted and all 50 were sampled due to the manageable size of the population. The instrument used was an achievement test titled; Turning Operations with Fabricated Woodwork Mini-Lathe Achievement Test (TOFWMAT), it had 25 multiple choice questions to choose either A, B, C or D. The judgment rule was to accept mean rating and standard deviation of 3.50, and reject any mean response below 3.50. The null hypothesis was rejected when the calculated value, (F- cal) exceeded the critical value (F- cri), otherwise accept, the test instrument was judged reliable with reliability index of 0.71, 0.75 and 0.72, 0.76 respectively, through pilot tests conducted in Sapele. The findings of the study revealed that students get motivated and learn better with equipment, it was concluded that, turning operations is best taught with fabricated wood work mini-lathe than flip chart, and it recommended the improvisation of locally sourced equipment for teaching aid.

Keywords: Woodwork Mini-lathe, Carpentry and Joinery, Technical College, Rivers State

INTRODUCTION

Technical Colleges take the form of secondary schools, where the students are expected to study and at the same time acquire skills that will make them self-reliant, in order to also boast the economy of the nation, Igweagbara (2021). Technical colleges prepare and equip students with skills in carpentry and joinery amongst other careers. The growing demand for well-trained craftsmen by industries and also the need to produce technical and vocational education graduates with requisite skills to make them self-reliant by being self- employed, employers of labour and also add to the development of a nation have made researchers and policy makers to evaluate the effectiveness of these technical subjects which Carpentry and joinery is one of them. This is done putting into consideration functional equipment and infrastructure in Nigeria to ensure quality education and training. Technical colleges as planned by the federal government in national policy on education FGN (2014) was to originally house necessary requirement for the effective running of technical courses like block/brick laying and concreting, electrical installation works, metal work operations, carpentry and joinery etcetera, such infrastructures include well-equipped workshops, constant electricity for the operation of power tools, amongst others. Carpentry and Joinery as described in the National Board for Technical Education

Curriculum is one of the careers in Technical Colleges whose primary purpose is to prepare individual recipient for employment in recognized building construction firms or to establish carpentry and joinery workshop where they can employ others (NBTE, 2007). It is a sub professional trade because the graduates of this course at the technical college level are referred to as craftsmen and are awarded the NVC (National Vocational Certificate). Carpentry and Joinery is a psychomotor type of subject and its method of teaching should include engagement, demonstration, role play and hands on instructional approach for functional teaching and learning and the required equipment put in place. It was noted in the National Board for Technical Education (NBTE 2007) that the goal of carpentry and joinery is to produce competent hands with job knowledge and practical skills for a successful career in carpentry and joinery, while the Objectives are stated as follows; a product of NVC in Carpentry and Joinery should be able to: Understand the general and specific techniques in Carpentry and Joinery, Construct and erect different types of roof model, Draw and interpret constructional drawings, Apply portable hand and machine tools to process wood and wood products, Design and construct floor, wall, and stair framings, including ladders and scaffolds, Construct and install Doors, Windows, Partitions and Cabinets, and Work as a skilled Carpenter, either in Self-employment or in paid employment.

Carpentry and joinery is a very lucrative and interesting career, but is always ignored during admission, the researcher perceivedthat the reason may not be far from the layman's perspective of it being a course for the drop-outs and its reference as a cut-and join-technology, but their perception is wrong. Owning to this negative perception the students of today find it difficult to choose carpentry and joinery in school as a career, even those who may have the zeal to study it, hardly find qualified and professional teachers who will teach the skill effectively. Its importance cannot be over emphasized as without carpentry and joinery, building construction will not be functional, this is because major part of building construction activities from walls, roofs, floors, fixtures and furniture have wood components, and requires the activity of a carpenter and joiner, (Igweagbara, 2022).

In studying carpentry and joinery, the required equipment and tools must be put in place and ascertained to be functional, to avoid accident and loss of life. Most students also see the career as involving roof climbing, this poses treat as no worker will want to fall from height, and this study exposed the students that a carpenter also works conveniently in the workshop with machines to make work easer. The most frequent and easy part of carpentry and joinery seem to be the furniture making, which entails the act of turning operations for a finished and aesthetic job, and all these processes are performed with a multi-purpose machine called the lathe. A lathe is a machine tool used mainly to shape metal or wood, which earned it the name two machines, one for wood, and one for metal. According to Kumar (2021), lathe is a machine tool used to remove metals from a work piece to give a desired shape and size. He further stated that they are used in metal working, wood turning, metal spinning, thermal spraying, glass working and parts reclamation. Lathe differ from other machines in that they rotate the work piece, while other tools are fixed to the receiving end (chuck) of the lathe to work on the spinning work piece to either cut, shape, sand, drill, knurl or reamed. The job is done one after the other as the tools need to be changed to suit the required operation. The lathe is a capital intensive but highly needed machine in the carpentry and joinery machine, for this reason, the researcher improvised a lathe by constructing a woodwork mini-lathe to be used in the teaching of lathe operations such as turning. This was prepared with locally sorted materials, majorly woods and few fixtures that will still do the turning work but in smaller chunks.

A woodwork mini-lathe uses a belted motor or an electric motor to rotate the piece at various speeds, allowing a tool rest on the lathe bed to steady the cutting or scraping tools while shaping the wood. It has a live center to hold the far end of the piece, and to steady the piece when held in a chuck. Desirable features of a woodwork mini-lathe are steady, solid frame, lack of vibration, weight, variable speed and excellent machine construction. Tools for the lathe can be of carbon steel tungsten carbide, and high speed steel, (Kumar, 2021). Lathe operates by rotating the work piece around a stationary cutting tool. The main aim is to remove unnecessary parts of the material, leaving behind a nicely formed work piece. The process of working on a lathe is called turning; this is because the work turns round in the chuck.

The wood work mini-lathe, according to Saif (2014), is used to teach carpentry and joinery students of technical college lathe operations like cutting, sanding, drilling, reaming, turning and sanding. For the purpose of this study, the researcher focused only on teaching the students of carpentry and joinery in technical colleges in Rivers State on how to carry out turning operations with the teacher fabricated wood work mini-lathe. This is in order to satisfactorily attain the objectives of carpentry and joinery as stated in the NBTE curriculum, encourage students' performance and achievement of goal through provision of functional equipment for effective teaching.

Achievement according to Andrea (2014) is defined as the aggregate of each students demonstrated learning, knowledge, skills ability and indeed cognitive, affective and psychomotor domains. In other words, Hadriana (2013) saw it as the measurement of the learning outcome of a student motivated by interest, and it is measured with examination and tests.

Students 'achievement is ascertained by mastery and performance; mastery goal is focused on developing and improving ones skill or knowledge while performance goal is focused on doing better than others in the same situation (Kpolovie, et al 2014). Akinbobola cited in Wordu (2021), also opined that achievement is dependent on several factors, and top amongst them as regards this study are instructional approach and learning environment approach. The instructional approach has to do with the method of teaching, while the learning environment approach has to with the conduciveness of the environment of learning.

Turning operations with wood work mini-lathe

Turning operations in a wood work mini lathe is defined by Henderson (2016), as the process of machining cylindrical and conical surfaces. Furthermore, it was opined that basic turning operations of a lathe can rotate the work and feed the tool longitudinally for turning and can perform operations by feeding transversely. Turning operations also is described by Tumtech Precision (2020) as a process whereby a cutting tool removes material from the outer diameter of a rotating work piece. The operation have different tool feed motion depending on the direction of rotation of the work piece to be machined. For the purpose of this study, the turning operations that will be considered is the cutting which will result to shaping and sanding. The turning operations is basically classified into two namely; rough and finishing turning (Tumtech Precision 2020). Rough turning is used to remove large amount of material using depth cuts and slow speed, it requires less time (cutting). Finishing uses light passes with speeds as fine as necessary to produce the desired finish (sanding). Khayal (2019) also defined turning as the removal of wood particles from the outer diameter of a rotating cylindrical work piece. Turning is used to reduce the diameter of the work piece, usually to a specified dimension, and to produce a smooth finish on the wood.

Turning activities (cutting and sanding)

Borrowing a lieu from Naje (2019), the speed of turning wood lathe should be adjustable between the limits of 1500 and 3000 revolutions per minute (rpm) which is able to turn stock up to 3 inches in diameter. It must be noted that pieces beyond this diameter cannot be revolved safely at such high speeds since the centrifugal force will be considerable and any irregularity in the balance of the piece revolving centers would be very apt to result in an accident. Pieces beyond 3 inches in diameter are best turned at speeds in the neighbourhood of 1800 to 2000 rpm (Diwan and Singh, 2015). Spur center instead of headstock spindle is to hold the end of wood and in this way, it acts in place of a chuck as a holding to the piece of work to be turned. After the piece of work is centered on the spur center, it is brought as near as possible to strike a balance, if it is out of balance, the lathe should be run at a low speed until the cutting tool rounds it off sufficiently to bring it to balance, then the speed can be safely increased, else serious injury may occur. Always oil the back center just as it is done with metal lathe, if not done, the center will become red hot through friction and cause the wood to catch fire. Instead of a slide-rest as used in metal work, Akkush and Yaka (2022) posits that a tee-rest is used and the cutting tool is rested upon this and manipulated with both hands, to re-adjust the tee-rest, always stop the lathe. Note that, in the present fabrication, there is no tool rest, but the work can be improved upon to make provision for a tee-rest.

In turning operations, before setting the lathe in motion, ensure that the tailstock is firmly clamped in position that the binding screw which locks the tail stock is firmly clamped in position and the binding screw which locks the tail stock spindle is screwed down tight. The tools should be held firmly, but on the other hand, they should not be gripped rigidly, the right hand must grasp the handle at the extreme in order to produce such leverage as possible, which will prevent the tool from being drawn from the hand should it be caught in the work. The left hand of the operator must be held somewhere near the end of the tool so that it can act as a guide to control the movement of the cutting edge. The operator must stand firmly and far enough from the lathe to allow the passing of the tools from right to left without changing position. The cutting movement of the tool should be brought about by the arms only and not the swinging of body, Cornell University (2023).

A complete tool for cutting or shaping for an ordinary work is referred to as skew, it is of different shapes and size, example of them are round point skew, square point, right skew, left skew, parting tool, spear point and gauge, each tool must be used in the proper place if good result is expected. The skew is used to cut in both directions, it must therefore be beveled on both sides. To test for a sharp skew, run your palm on the surface, and the best grade of wood to be used for turning operations is the close-grained woods, this is to ensure smoothness and aesthetics.

Safety Measures in Turning**:** Safety measures in turning operations is almost same as in safety in handling of the wood work mini lathe, this is because, the operation of a lathe is centered around turning operations. McGill (2021) in its checklist graded safety regulations under turning operations into three (3), they are;

A. Pre-Operation

1. Task (Drawings, instructions, Specifications, Material) is clearly understood.

2. Identify ON/OFF switch and emergency stop button and test any interlocking devices
(If applicable).
3. Make sure the machine is turned off or the emergency stop switch is engaged, before comment of any work or inspection.
4. Ensure all security guards including the chuck and tool post guards are in place.
5. Ensure the work piece has been suitably prepared for the lathe operation.

B. Operation

1. Never leave the machine running while unattended.
2. Switch off the lathe and ensure it has come to a complete standstill before making any adjustments.
3. Keep the tool rest adjusted close to the work and at the correct height.

C. Post-Operation

1. Switch off the machine and reset all guards to a fully closed position.
2. Allow all part to come to stop before making alterations or at completion of work.
3. Remove work from chuck and remove chuck key.

In same vein, Cornell University listed some things that should be avoided during turning operations as: do not wear gloves, rings, watches or loose clothing, do not lean on machine, do not place hands on work turning in the lathe, and do not make adjustments while using the lathe and many others. This goes to say that the lathe is a very powerful machine and caution should be taken when operating, particularly during turning operations.

Statement of problem

Several researchers have investigated the reasons why technical education is losing its focus, amongst them are Owaifor (2010), Okoye and Arimonu, (2016), Odo, et al (2017), Kennedy, et al (2017) to mention but a few, they all came up with the conclusion that lack of infrastructure, equipment and functional facilities, amongst other reasons like lack of fund, personnel and government involvement are the reasons for poor performance amongst the students of technical colleges, precisely, the carpentry and joinery students. This problem of lack of equipment, have resulted to gradual extinction of carpentry and joinery in technical colleges as evidenced in the list of approved technical colleges in Rivers State and the subjects they offer (NBTE 2007). Suffice it to say that, lack of functional equipment leads to lack of interest on the part of the learner and frustration on the part of the teacher, and its resultant effect is poor performance. The researcher, therefore trying to solve the problem of lack of equipment, improvised a woodwork mini lathe, used it as an instructional material in order to determine to what extent it can affect the achievement of students of carpentry and joinery while teaching turning operations in technical colleges in Rivers State.

Aim and objective of the study

The aim of this study is to determine the effect of teaching turning operation with fabricated woodwork mini-lathe on students' achievement in carpentry and joinery craft in technical colleges in Rivers State.

Research Question: What is the effect of teaching turning with teacher fabricated wood work mini-lathe on students' achievement in turning operations in technical colleges in Rivers State?

Hypotheses: The null hypotheses was tested at 0.5 significant level

H_O: There is no significant difference between the achievement mean scores of students taught turning operations using teacher fabricated woodwork mini-lathe and those thought turning with flip chart in technical colleges in Rivers State.

MATERIALS AND METHODS

Research design

This study adopted the quasi-experimental research design, this is because Quasi- experimental design involved the use of pre-test and post-test design with experimental and control groups Ogundu (2011). The Quasi-experimental design was used since it was impossible for the researcher to randomly sample the students without disrupting the classes, hence the classes were intact.

Population for the study

The population of the study comprised of 50 NTC 1 Carpentry and Joinery students in two out of the four Technical Colleges in Rivers State (Government Technical College Port Harcourt and Ahoada). NTC 1 students were used here because wood processing and wood work machining (machine tools) is in their scheme of work and this has to do with lathe operations. The population for each school is as follows: Government Technical College, Port Harcourt 45 Students; Government Technical College, Ahoada 5 Students.

Sample and sampling techniques

The sample size for this study was all 50 NTC1 carpentry and joinery craft students in the two technical colleges covered, it is a census type of sample because the entire population was used due to its manageable size. However, the sampling technique was the purposive sampling technique which is described by Borg in Wordu (2021) as one in which the researcher relies on his or her own judgment when choosing members of population in the study. Alphabet X for Experimental Group and Y for Control Group were written on pieces of paper folded and tossed. Four students were asked to pick for each school. GTC Port Harcourt formed the experimental group having a population of 45 students while GTC Ahoada constituted the control group with a population of 5 students. This also is because the researcher wanted the larger chunk of the students to have the experience practically.

Instrument for data collection

The instrument for data collection was the Turning Operations with Fabricated Woodwork Mini-Lathe Achievement Test (TOFWMAT) developed by the researcher. The TOFWMAT was used to test for the students' achievement in carpentry and joinery craft with wood work mini-lathe as instructional material to teach the students turning operations. The TOFWMAT contained 25 multiple choice items, The researcher, in constructing TOFWMAT, prepared two lesson plans (one for the control group and another for the experimental group) to guide the development of the test items.

Method of data collection

The researcher administered the instrument to the respondents with the help of the teachers as research assistants. The research assistants were briefed on how to distribute the instrument. A total of 50 copies of the instrument were administered to the respondents and were retrieved on the spot hence the 50 copies were retrieved and none was missing. The test scores obtained from the pre-test and post-test were computed and analysed using descriptive and inferential statistics of mean and standard deviation. The mean and standard deviation were used to analyse the result of the achievement test and standard deviation values were used to determine the homogeneity in the opinion among the respondents. Invariably, the pre-test and post-test mean gain of the control group was computed to determine the effect of woodwork mini lathe on the achievement of students in carpentry and joinery craft (lathe turning operations). The null hypothesis was tested using ANCOVA at 0.05 level of significance. This is because ANCOVA is a statistical tool which stabilizes the effect of independent variables such that it is not unduly affected by unknown variables (Field, 2016). The null hypothesis was rejected if the calculated value, (F- cal) exceeded the critical value (F- crit), if otherwise the null hypothesis was accepted, the Statistical Packages for Social Sciences Version 23 (SPSS 23) was used for final computation. The value of f-ratio at 0.05 level of significance and above was accepted while the value of f-ratio less than 0.05 level of significance was rejected.

RESULTS AND DISCUSSION

Research Question

What is the effect of teaching turning with teacher fabricated wood work mini-lathe on students' achievement in turning operations in technical colleges in Rivers State?

Data gathered to answer the question are in (Table 1). Table 1 shows the pre-test and post-test mean score of students' achievement of both experimental and control groups on turning operations in technical colleges in Rivers State. The results shows that the students in the experimental group comprised of 45 NTC 1 students had a pre-test mean score of 9.08 with a standard deviation of 2.06 and a post-test mean score of 15.46 with a standard deviation of 3.76. The difference between the pre-test and posttest mean for the experiment group was 6.38 The control group comprised of 5 NTC1 students had a pre-test mean score of 9.14 with a standard deviation of 1.82 and a post-test mean score of 13.34 and a standard deviation of 2.23. The difference between the pre-test and post-test mean score for the control group was 4.2, when you subtract the mean difference of the control group from that of the experimental group, the result which is 2.20 is referred to as the mean gain.

This results show that the mean score for the experimental group is higher than the control group, indicating that those taught turning with the teacher fabricated wood work mini-lathe performed better. The findings of the study revealed that there is a significant difference in the mean scores of students taught turning operations using teacher fabricated woodwork mini-lathe and those taught turning with flipchart.

The finding of the study is in harmony with Obodo, et al (2020) who agreed that students taught using improvised teaching-learning materials performed better than students taught without improvised teaching-learning materials. The improvised instructional material was more effective because the parts were locally sourced, readily available and flexible in used and above all, it allowed the students to practice on their own during teaching, a

Table 1: Pretest and post test means scores on the effect of teaching turning with teacher fabricated wood work mini-lathe on students' achievement in turning operations.

Groups	No	Pre-test		Post-test		Mean difference	Mean gain
		$\bar{X}$	SD	$\bar{X}$	SD		
Experimental	45	9.08	2.06	15.46	3.76	6.38	2.20
Control	5	9.14	1.82	13.34	2.23	4.2	

Source: Field Survey 2023

Table 2: The analysis of covariance (ANCOVA) between students taught turning operations using teacher fabricated woodwork mini-lathe and those taught turning with flip chart.

Source	Type III sum of squares	Df	Mean Square	F	Sig
Corrected Model	17427.722[a]	2	8713.861	13.167	.000
Intercept	105512.685	1	105512.685	159.438	.000
Postest1	117.320	1	117.320	.177	.676
Group	17262.576	1	17262.576	26.085	.000
Error	31103.658	47	661.780		
Total	7299725.000	50			
Corrected Total	48531.380	49			

a. R Squared = .359 (Adjusted R Squared = .332)

process which leads to maximizing comprehension of the subject matter.

H_O: There is no significant difference between the achievement mean scores of students taught turning operations using teacher fabricated woodwork mini-lathe and those taught turning with flip chart in technical colleges in Rivers State. Table 2 is the result of the analysis of covariance on students taught turning operations using teacher fabricated woodwork mini-lathe and those taught turning with flip chart. The result showed that f-calculated ratio in the two groups is 26.085 at 0.000 significant level. It therefore implies that the null hypothesis is rejected since the significant value (P) is less than .05 (P <.05). Thus, there is a significant difference in the mean scores of students taught turning operations using teacher fabricated woodwork mini-lathe and those taught turning with flip chart.

Conclusion

Carpentry and joinery craft is a very important craft or career that should launch a country out of poverty due to the various job prospects imbedded in it, but it has been discovered that no one wants to choose the career due to lack of equipment and infrastructure to teach and learn it the way it ought to be. The researcher in conjunction with the teachers of carpentry and joinery in technical colleges in Rivers State, taught carpentry and joinery students turning operations using the improvised wood work mini-lathe (experimental group) and discovered that the experimental group of students performed better than the control group who were taught with the demonstration instructional approach using flip chart as an instructional material. The study further revealed that there was significant difference in the mean achievement of students taught turning using teacher fabricated wood work mini lathe and those taught using flipchart at a 0.05 level of significance. Hence, students' achievement in carpentry and joinery craft can be improved by teaching them turning operations in lathe with the teacher fabricated wood work mini-lathe, instead of the traditional demonstration approach where the demonstrator takes authority of the classroom. Invariably, it has been proved that part of the problem people are having to indulge in courses like carpentry and joinery craft is as a result of lack of equipment.

Recommendations

The researcher then recommends that Periodic trainings and workshops should be organized by the government and institutions for all teachers in technical colleges to acquaint them on how to fabricate functional instructional material or aids with available and locally sourced materials to enhance their teaching, particularly in lathe operations.

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