

EFFECT OF SIMULATED LATHE MACHINING PROCESSES PACKAGES ON STUDENTS' ACADEMIC ACHIEVEMENT TOWARD IMPROVED GOVERNANCE OF TECHNICAL COLLEGES IN BAUCHI STATE

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Abstract

There is strong evidence from the reviewed literature and examiner's report that the poor performance of students in General Metalwork courses at Bauchi State Technical Colleges was closely linked to the absence of good governance using the right methods of teaching by teachers in these colleges which did not encourage teachers' use of technology to teach in the classroom. Four research questions and four hypotheses guided the study. This study adopts the use of a quasi-experimental design (Non-equivalent control group design). The target population comprised 312 General Metalwork students in two Technical Colleges. Data was collected through the use of the Metal Machining Achievement Test (M.M.A.T.). Mean and Standard Deviation were used to answer the research questions, while hypotheses were tested at 0.05 level of significance, using the T-test. The study revealed a significant difference in the mean achievement of students taught Lathe Metal Machining using the Simulated Lathe Machining operation package (Experimental group). The findings revealed that the governance in General Metalwork is through improved teaching methods using simulated lathe machining operation packages. Therefore, the Ministry of Education has to streamline the governance opportunities of teachers with a view to continually upgrading teachers' technological know-how. Parents and the general public should continually encourage General Metalwork Teachers on governance in Technical Colleges for better skill acquisition through available Technology.

Key Words: Technical Colleges, Governance, Technical Skills and Simulated Lathe Machining

Introduction

The National Board for Technical Education (NBTE, 2010) syllabus outlined machining as one of the trade-related subjects offered at the Technical Colleges level (NBTE, 2007). However, machining as included in general metalwork subjects cannot be taught successfully based on mere theoretical knowledge without proper use of instructional aids and practical skills. This is because, if adequate instructional materials like machine, machine parts and some portable hand tools do not accompany the theoretical teaching and the students are not well involved in practical, students would not be equipped with the necessary skills to become craftsmen for self-employment on graduation, as stated by the National Policy on Education (FRN, 2008).

These technical skills are necessary and instrumental to the technological advancement of any nation. The emphasis of the government on skill acquisition has led to the establishment of institutions at all levels of our educational system among which is the technical college. Though the technical college has undergone several changes before assuming its present name, the basis for establishing this type of institution has not changed significantly.

Technical Colleges in Nigeria were established to produce craftsmen at the craft level and master craftsmen at the advanced craft level (Federal Ministry of Education, 2009). The courses offered at the technical colleges led to the award of National Technical Certificate (NTC) and Advance National Technical Certificate (ANTC). The curriculum programmes of technical colleges according to the Federal Government of Nigeria (FGN, 2008) are grouped into related trades. These include; computer trades, electrical/electronic trades, building trades,

wood trades, and mechanical trades. Mechanical trade is a general name used in describing trades that have direct bearing with metal welding/forming and servicing/repairs of machines or machine-related equipment and appliances. The trades in this group include agricultural implement and equipment, mechanics work, auto electrical work, auto mechanics works, auto body building, auto parts merchandising, air-conditioning and refrigeration mechanics works, mechanical Engineering craft practice, welding and fabrication engineering craft practice, foundry craft practice, instruments mechanics work and metalwork technology. Accordingly, Metalwork Technology is one of the units that constitute the field of technical education.

At the technical colleges, metalwork is offered in trades, such as welding, fabrication, automobile engineering practice, mechanical engineering craft practice, agricultural implements and equipment mechanic work. Air-conditioning and refrigeration, foundry craft practice and instrument mechanic work. According to the National Board for Technical Education (NBTE) 2010, Technical colleges in Nigeria were established to produce craftsmen at the craft (technical) level and technicians at the advanced craft (post-technical) level. Metalwork trade is one of the subjects that are taught in technical colleges in Nigeria. Metalwork trade comprises a blend of both theory and practical that leads to the production of goods and services by the use of tools, equipment and metalwork materials (NBTE, 2010).

In his study, Olaleye (2023) explains that the design of Nigeria's educational system is flawed. The neglect of technical education is an obstacle to national development. Not everyone needs a university education. In Nigeria, technical degrees are regarded as inferior to regular academic degrees. But in advanced nations, those with technical degrees are highly regarded. Individuals with years of field experience work in tandem with those with academic degrees. In fact, the worth of every worker depends on the person's skills and knowledge, and not on the stack of academic degrees one has. Nigeria must learn to blend theory and practice in its education because theories alone cannot serve any useful purpose. Olaleye also said the nation's technical schools should be brought to international standard by employing teachers with field experience in the subject areas and experienced and professional administrators to govern technical colleges. As obtained in the developed nations the technical graduates should be thoroughly certified before they could work as technicians.

However, the success of this policy depends on the effective governance of both human and material resources which include; monitoring the utilization of workshops, classrooms, tools and equipment. It is of no use therefore for a student of technical college to learn the theoretical aspect of technical subjects without supportive know-how. Students must be able to exhibit the expected learning outcome in the world of work. Theoretical information alone cannot guarantee efficient performance of the job skills and governance of technical colleges; it must be accompanied by practical activities. Consequently, the methods of teaching technical subjects differ more or less from literary subjects. It can be done more effectively by using computer technology and demonstration; Learning by doing is the emphasis in addition to acquiring basic knowledge of technical subjects for trades such as metalwork technology, woodwork, electrical/electronics, etc. Practically activity is paramount in developing skills in vocational technical education.

Okoro (2002) postulated that repetitive training enables the development of the right attitude and habit of thinking and doing. It is therefore important to study the utilization level of facilities that will enhance the effective teaching and learning of metalwork. In a related development, facilities on their own cannot promote teaching and learning. Teaching is a systematic transmission of knowledge, skills and ideas (Microsoft 2003). Computer simulation is a form of learning with computers in which the user may experiment with a simulated situation. This situation strongly resembles reality or is a deliberate simplification. Computer simulation enables students to make decisions without significant risks. As a result of the decisions made the computer reacts with informative feedback. This feedback is always of a visual nature. Visual feedback is an essential characteristic of computer simulation. Therefore a

computer simulation program often has the characteristics of an animation program. Computer simulation programs are multi-media programs.

Simulation is defined as the imitation of the operation of a real-world process or system over time. The act of simulating something first requires that a model be developed; this model represents the key characteristics or behaviors of the selected physical or abstract system or process. The model represents the system itself, whereas the simulation represents the operation of the system over time. It is the art of depicting the facts understood from the observations such that more experimentation can lead to a better understanding of the phenomenon or the system being studied. Simulation models are "run" rather than solved, even though there may be a few exceptions. Given a set of inputs and model characteristics, the model is run for a set of inputs and the simulated behavior observed

A report of NABTEB Chief Examiners in General Metalwork subject in technical colleges of Bauchi State in the 2014/2015 academic session revealed a failure rate of 68% (NABTEB, 2015). Students need to be encouraged to learn not only through their ears but should be able to use their eyes and hands to manipulate apparatus, and devices to acquire skillful knowledge. Therefore, in the light of these inadequacies in technical colleges, one may ask; to what extent have the goals of technical education which include giving training and imparting the necessary skills to individuals who shall be economically self-reliant been achieved? These inadequacies raised a serious concern for educational researchers. In an attempt to ameliorate the situation of inadequacy of instructional materials and poor teaching and governing habits of teachers which have been examined as some of the major factors responsible for the failure in metal machining in Technical Colleges in Bauchi state. The researcher intends to use an improvised Simulated Package to facilitate the teaching and learning lathe machining operations with a view to improving teachers' governance ability of Technical Colleges in Bauchi State.

Aims and Objectives of the Study

The main purpose of the study is to determine the effect of a simulated lathe machining operation package on students' academic achievement toward improved governance of Technical Colleges in Bauchi State.

In specific terms, the study intends to:

- i) Determine the students' scores in metal processes in both experimental and control groups when taught using traditional methods in Bauchi State Technical Colleges.
- ii) Determine the students' scores in metal processes in the experimental group when taught using the traditional method and when taught using a simulated lathe machining processes package in Bauchi State Technical Colleges.
- iii) Identify the students' scores in metal processes in the experimental group when taught using simulated lathe machining processes package and the control group when taught using the traditional method in Bauchi State Technical Colleges.
- iv) Identify the students' gain scores in metal processes in experimental and control groups in Bauchi State Technical Colleges.

Research Questions

The following research questions were formulated to address the problems

- i) What is the student's pretest scores in metal processes in both experimental and control group in Bauchi State Technical Colleges?
- ii) What are the student's pretest and posttest scores in the experimental group at Bauchi State Technical Colleges?
- iii) What are the students' post-test scores in metal processes in the control group when taught using the traditional method and post-test scores in the experimental group when

taught using simulated lathe machining processes package in Bauchi State Technical Colleges?

- iv) What are the students' gain scores in metal processes in experimental and control groups in Bauchi State Technical Colleges?

Hypotheses

The following null hypotheses were formulated to guide the study:

- H₀₁:** There is no significant difference between students' pretest scores of the experimental and the control groups in metal machining at Bauchi State Technical Colleges.
- H₀₂:** There is no significant difference between students' pretest scores and the posttest scores of the experimental group in metal machining at Bauchi State Technical Colleges.
- H₀₃:** There is no significant difference between students' posttest scores of the experimental and control groups in metal machining at Bauchi State Technical Colleges.
- H₀₄:** There is no significant difference between students' gain scores of the experimental group and the control group in metal machining at Bauchi State Technical Colleges.

The study will be helpful to teachers as a professional, students and the Government; The study will improve teachers' governance and teaching skills in metal processes by improving the methods used for students' performance in metal machining. The impact that technology has had on today's technical schools has been quite significant. This widespread adoption of technology has completely changed how teachers govern and teach while students learn. Teachers are learning how to teach and govern students in their classrooms with emerging technologies such as lathe machine simulation and others while students are using advanced technology to shape how they learn. By embracing and integrating technology in the classroom, we are setting our students up for a successful life outside of school. It will increase teachers' capacity and professionalism in teaching metal machining at the Technical College level.

Methodology

This study adopted Quasi-Experimental Designs. The use of this design is basically due to a lack of full laboratory control and laboratory isolation, they are the designs researchers use outside the laboratory settings (Sambo, 2008). The Non-equivalent Control Group Design was used because existing classrooms in the schools were used for the study. The designs are dependent upon the natural setting in which the researcher finds himself.

This design was diagrammatically presented as follows:

Experimental Group	Y ₁₁	X	Y ₁₂
Control Group	Y ₂₁		Y ₂₂

Where: Y₁₁ = Pre-test of experimental group; Y₂₁ = Pre-test of control group;

X = Treatment given only to experimental group; Y₁₂ = Post-test of experimental group;

Y₂₂ = Post-test of the control group

Results

Data collected from the test is presented in this part. The presentation of each table is done in tables under the research question and the analysis using the SPSS statistical package;

Research Question One

What are the students' pretest scores in metal machining in both experimental and control groups in Bauchi State Technical Colleges?

The data presented in Table 3 shows that students in metalwork technology in Technical Colleges needed improvement in lathe metal machining technology. The mean score of 37.90

for the experimental group and 37.39 for the control group was established. This means that there was a need to introduce more strategies for instructions to improve students' achievement in metal machining. Therefore the use of a simulated lathe machining operation package would be introduced to aim at improving students' achievement in lathe metal machining in Technical Colleges.

Table 3: Mean performance of students in both experimental and control groups at pretest in Technical Colleges of Bauchi State.

Group	N	Mean	SD	Min.	Max.
Experimental	46	37.90	6.99	24.00	55.00
Control	44	37.39	7.82	20.00	51.0

Research Question Two

What are the student's pretest and posttest scores in the experimental group at Bauchi State Technical Colleges?

Table 4 shows that students who were taught metal machining in the experimental group, before using the simulated package had a pretest mean score of 37.90 with an SD of 6.99 while the posttest mean score of this experimental group was 49.77 with an SD of 10.93. This shows that the Mean Achievement of the students in the experimental group is 11.87 and SD is 3.94.

Table 4: Students' pretest and posttest scores in the experimental group at Bauchi State Technical Colleges

Group	N	Mean	SD	Min.	Max.
Pretest Experimental	46	37.90	6.99	24.00	55.00
Posttest Experimental	46	49.77	10.93	30.00	78.00

Research Question Three

What were the students' post-test scores in metal machining in the control group when taught using the traditional method and post-test scores in the experimental group when taught using a simulated lathe machining operation package in Bauchi State Technical Colleges?

Table 5 shows that students who taught Metal Machining using the Simulation package had a mean score of 49.77 with an SD of 10.93 and those students who taught General Metalwork, using the conventional method also had a mean score of 41.57 with an SD of 8.25

Table 5: Students' post-test scores in metal machining in the control group and post-test scores in experimental group Bauchi State Technical Colleges.

Group	N	Mean	SD	Min.	Max.
Experimental	46	49.77	10.93	30.00	78.00
Control	44	41.57	8.25	25.00	57.00

Research Question Four

What are the students' gain scores in metal machining in experimental and control groups in Bauchi State Technical Colleges?

Table 6: Gain Achievement of Students When Taught Using Simulated Metal Machining Processes Packages in Technical College in Bauchi State

Group	N	Mean	SD	Min.	Max.
Experimental	46	49.77	10.93	30.00	78.00
Control	44	41.57	8.25	25.00	57.00
		8.20	2.68		

Table 6 shows that students who were taught Metal Machining, using Simulation package had a mean gain score of 8.20 with SD 2.68.

Hypothesis One

H_{01} : There is no significant difference between students' pretest scores of the experimental and the control groups in metal machining at Bauchi State Technical Colleges.

In Table 7, the calculated t value was 0.36 while the critical value was 1.96. Since the calculated value of t was less than the critical value, this shows that there was no significant difference between students in both the experimental group and the control group. Therefore, the null hypothesis was accepted.

Table 7: T-test Results of Pretest Mean Scores of Both Experimental and Control Group

Group	N	Mean	SD	T-cal	t-crit	Decision
Experimental	46	37.90	6.99	0.36	1.96	H_0 Accepted
Control	44	37.39	7.82			

Hypothesis Two

H_{02} : There is no significant difference between students' pretest scores and the posttest scores of the experimental group in metal machining at Bauchi State Technical Colleges.

The data presented in Table 8 shows that the T-calculated value for the experimental group before the treatment was 5.80 while the T-calculated value for the experimental group after treatment was 0.36. This shows significant difference existed between the pretest and posttest of the experimental group. Therefore the alternative hypothesis was rejected.

Table 8: T-test Result of Mean Gain Scores between Experimental Group Before and After the Treatment

Group	N	Mean	SD	T-cal.	t-crit.
Experimental	46	37.90	6.99	0.36	1.96
Experimental	46	49.77	10.93	5.80	1.96

Hypothesis Three

H_{03} : There is no significant difference between students' posttest scores of the experimental and control groups in metal machining at Bauchi State Technical Colleges.

The data presented in Table 9 shows that the T-calculated value was 5.80. Since the calculated T value exceeded the critical or table t value, there was a significant difference between the mean score of General Metalwork students who were taught using simulated lathe metal machining process packages and those taught using the conventional method. Therefore the alternative hypothesis was accepted.

Table 9: T-test Result on Post-test Mean Scores Between Experimental Group and Control Group

Group	N	Mean	SD	T-cal.	t-crit.	Decision
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Experimental	46	49.77	10.93	5.80	1.96	H ₀ : Accepted
Control	44	41.57	8.25			

Hypothesis Four

H₀4: There is no significant difference between students' gain scores of the experimental group and the control group in metal machining at Bauchi State Technical Colleges.

The data presented in Table 10 shows that the T-calculated value is 5.80. Since the calculated T value exceeds the critical or table t value, there is a significant difference between the mean score of General Metalwork students who were taught using the Simulation package and those taught General Metalwork, using the conventional method. Therefore the alternative hypothesis was accepted.

Table 10: T-test Result on Post-test Mean Gain Scores Between Experimental Group and Control Group

Group	N	Mean	SD	T-cal.	t-crit.	Decision
Experimental	46	49.77	10.93			
Control	44	41.57	8.25			
				5.80	1.96	H ₀ : Accepted

Major Findings of the Study

The following are the findings of the study;

1. It was found that the scores recorded from the pretest of both the control and Experimental) groups used for this study were closely related which means that the two groups were academically balanced.
2. Students from the experimental group scored higher grades when taught using a simulated lathe machining operation package than students from the control group taught using traditional methods.
3. The two groups (Control and Experimental Groups) increased their academic achievement at the posttest level but the effect of the simulated lathe machining operation package was higher than the effect of traditional methods.
4. The result of the study indicated that there was a higher mean gain achievement of students when taught using simulated lathe machining operation package than when taught using traditional methods.

Discussion of Findings

Data collected to answer research question one shows the results of the analysis on mean ratings of General Metalwork students on both experimental and control groups in both Technical Colleges. From the data, the pretest group had a mean score of 37.90 with a minimum score of 24%, and a maximum score of 55%, and 37.39 with a minimum score of 20% and a maximum score of 51%.

The results imply that the students in the pretest group were found to be not significantly different in their learning stage. Nevertheless, students who were taught General Metalwork, using the Simulation package had a mean score of 49.77 in the posttest, with a minimum score of 30% and a maximum score of 78 %, and the control group also had 41.56 mean scores with a minimum of 25 % and 57% maximum score respectively. The result shows that the experimental group students obtained a higher percentage of mean score in M.M.P.T. as shown in Table 5. These results were similar to those of Umunadi (2007), Ogundola, Popoola and Oke (2010), and Medugu (2011). Medugu (2011) maintains that the use of instructional aids improved students' understanding and their achievement in Mechanical and General Metalwork courses than those who are not exposed to such instructional aids.

Table 8 also presents the analysis of whether there is no significant difference between the mean rating of General Metalwork students who were taught using Simulation and those taught, using the conventional method. The results show that the experimental group had a mean score of 49.77 with a minimum score of 20% and a maximum score of 60%, while the control group also had a 41.57 mean score with a minimum of 20% and a maximum of 56%. From Table 6, the calculated T-value shows that there is no significant difference between the mean achievements of the pretest group.

The analysis in Table 7 further shows that there was a significant difference between the experimental group that was exposed to the Simulation package and mean achievement when not exposed to the Simulation package. The results imply that the treatment had an influence on student achievement. Also, the control group of students taught lathe machine operation using traditional methods scored lower by -2.36 than the experimental group. This indicates that simulated metal lathe machining operation packages have a higher effect on the students taught metal lathe machining using simulated packages.

These differences in the mean gain score from the Metal Machining Achievement Test (MMAT) imply that the simulated lathe metal machining operation package was capable of improving the students' performance at their different ability levels, but the effect of the package was noticeable in favour of the students. This slight superiority of high scores of the experimental group over other control groups may be due to the fact that their classification into each group is done based on random assignment of groups.

The finding of this study indicates that the experimental group performed better than the control group which is in conformity with Scanlon and Newcomb (1994); Ohaeri (1995); Udoetuk (2007); Adesoji (2008); Adeyemo (2010) and Olayinka, Oyenuga and Owoso (2011). Also, the finding that revealed the higher effect of the simulation method of teaching on the mean performance score of the traditional method in the MMPT is in agreement with Okebukola (1992) and Lavoie where the authors found that the method of instruction influenced the performance of students.

Summary

The main purpose of the study was to determine the effect of simulated lathe machining operation package on students' academic achievement toward improved governance of Technical Colleges in Bauchi State with regard to operations of CNC Lathe machine which is mostly not found in our technical colleges. The experimental method was used and Test Questions were adopted from NABTEB General Metalwork past questions which served as research instruments. Descriptive statistics such as Mean and Standard Deviation were used in analyzing the general characteristics of the sample; T-test was used in testing the hypothesis raised.

This helped to check the effect of introducing a new teacher basically because of this study. The teaching takes place within six weeks with lessons done twice every week. Treatments were given to the experimental group while the control group was taught without treatment. In all, data were collected which shows that there was an effect of the treatment on the performance of the students. This is evidenced in the result analyzed by the researcher.

Recommendations

In view of the findings, the following recommendations were made:

- i. The programmes for General metalwork teachers should incorporate technology such as lathe machine simulations to help in governance, teaching and learning of dangerous and expensive tools like machine tools for practical purposes which will improve students' academic performance.

- ii. The Ministry of Education is advised to streamline the training opportunities of teachers with a view to continually upgrading the governance, monitoring and management of their classrooms using technology.
- iii. Parents and the general public should continually encourage General metalwork teachers on the use of technology in the technical colleges for easier control, governance and better skill acquisition through practical work.

Implications of the Study

Based on the result of this study, it was concluded that the implementation of the technical colleges' programme necessitates adequate governance and utilization of simulated lathe machining operation packages by the teacher to improve students' achievement in line with the goals of technical education programmes. This implies the provision of the necessary and adequate General Metalwork components and materials to display simulated lathe machining operation packages for effective governance, teaching and learning of metal machining in Bauchi State Technical Colleges. Also, apart from the necessity to employ more General Metalwork components, educational personnel and inspectors trained with vocational and technical education backgrounds, there is a need to find ways of motivating the inspectors in the field of Mechanical trades to show interest in visiting the technical colleges regularly to help in the implementation of programme.

The findings of the study revealed that the Simulation method leads to considerable improvement in students' cognitive achievement in general metalwork and lathe machining operation practice than the traditional method. The implication of this finding is that students will learn better, develop self-confidence in the process of performing a given task, retain the learning and also develop similar general metalwork topics for teaching basic contents of machining in Technical colleges after graduation. Also, the findings revealed that this type of instructional technique adopted by metalwork teachers in Technical Colleges affected the students' performance, therefore general metalwork teachers should adopt simulation methods for teaching contents of machining in general metalwork in the workshop. This will facilitate students' active participation in learning, consequently improving their psychomotor achievement.

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