
Effect of Computer-Assisted Instructional Package on Teaching Lathe Machining Operations
at Technical Colleges in Yobe State, Nigeria

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ABSTRACT

The purpose of this study was to determine the effect of instructional software package on teaching and learning of machining processes at technical colleges. Two specific purposes and two research questions were formulated to guide the study. Similarly, two hypotheses were formulated and tested at 0.05 level of significance. The research design adopted was randomised control group post-test only design involving one treatment group and one control group. The population of the study was 95 mechanical trade students from the two Technical colleges offering mechanical trade. A simple random sampling technique was adopted to place the students into control and experimental groups. The sample consisted of 45 NTC II mechanical trade (MT) Students 2017/2018 session from Government and Science Technical College, Potiskum. The instrument used for data collection for the study was a practical test termed Metal Machining Practical Skills Achievement Test (MMPSAT). The MMPSAT was developed by the researcher and validated by experts in Technology Education. The instrument was trial tested using 11 year II MT students from Government Science and Technical College, Kumo in Gombe state for determining its reliability. The reliability coefficient of the instrument was found to be 0.76 Arithmetic percentage and mean statistics were used to answer research questions while t-test was used for testing the hypotheses of the study at 0.05 level of significance. Findings of the study revealed that students taught using Instructional software Package performed better than those taught with conventional strategy. Findings also indicated that there was significant difference between the mean performance of students taught using Instructional software Package and those taught using the conventional teaching method in the two lathe machining operations. Based on the findings of the study, there is need for mechanical engineering craft practice teachers to adopt the use of Instructional software Package in teaching since it enhances the practical skills acquisition of students in metal machining.

Keywords: Instructional Package, Lathe Machines, Operations, Technical Colleges

INTRODUCTION

The development of any nation aspiring for greatness in technological advancement depends largely on how it trains its manpower. Central to effective training in Nigeria is technical and vocational education. Practical skill activity forms a major role of technical and

vocational education. Technical Colleges are institutions generally charged with the responsibility of training skilled technical manpower for technological and economic development of the country. To achieve this objective, technical colleges were established to run programmes leading to the award of National Technical Certificate (NTC). Technical Colleges are regarded as one of the principal vocational institutions in Nigeria offering full vocational training to prepare students for entry into various occupations in industries or for self employment.

Technical college is designed specifically to prepare individual to acquire manipulative skill, basic scientific knowledge and attitude required of a craftsman and artisans at sub-professional level. Specifically, Technical College programme is aimed at making the Technical College graduates achieve among other things the following; secure employment either at the end of the whole course or after completing one or more modules of employable skills, set up their own businesses and become self employed and also be able to create employment for others and pursue further education in advance craft/technology programme in post secondary technical institutions such as Colleges of Technology, Polytechnics, Colleges of Education (Technical) or Universities (Federal Government of Nigeria, 2008).

Based on the objectives of Technical Colleges, the National Technical Certificate (NTC) programme was designed to include a multi-disciplinary curriculum, which contains various programmes in which learners acquire various technical skills. One of such programmes is the Mechanical Engineering Craft Practice (MECP). The curriculum content of MECP as spelt out by National Board for Technical Education (NBTE), (2001) includes both bench-work or fitting and metal machining. Generally, the curriculum content include seven modules which are; General Metalwork, General Fitting, Lathe Machining, Milling, Shaping/Planing, Drilling and Grinding. These modules are allocated a total of 360hours of theory and 924hours of practical to be covered in three years. This represents 28% and 72% of the time for theory and practical work respectively. Allocation of more time for practical work underscores the importance attached to the acquisition of practical skills during training. This is why Okoro (2006) asserted that a cardinal principle of vocational education requires adequate repetitive training in practical work from the occupation, this will force right habits of doing and thinking to the degree necessary for employment. This implies that students of MECP should be trained on relevant machine operations and services such as producing spare parts to specification; carry out daily maintenance of tools and equipment (Atsumbe, Okoro & Ogwu, 2012).

The Lathe Machine is the most fundamental of all metalwork machine tools. This is because the basic operation skills necessary for lathe machine operations apply to the operation of other machine tools, most of which are modifications or adaptation of the lathe machine (Repp & McCarthy, 1984). Therefore, competence in manipulating the lathe machine is advantageous in carrying out other machine processes as well. Lathe machine operation is the act of shaping metal which is accomplished by removing material from a work piece or by pressing it into the desired shape. Major operations carried out on the lathe machine include: Facing which is the removal of material from the end of a bar to give it a flat and smooth surface finish; Drilling which is the process of cutting cylindrical holes into or through material with a rotating tool called a drill; Boring which is the process of enlarging an already drilled hole; Turning; which is the process of removing metal while the main piece of metal is being rotated in the lathe to produce cylindrical shapes; Knurling which is the process of roughening the surface of a piece of work by making a series of indentations or depressions on

it and Threading which is the process of cutting internal or external threads on the surface of a work piece.

Lathe operations are required to make different kind of cylindrical shapes, such as axles, gear blanks, pulleys, and threaded shafts which are used in the manufacture of parts needed in industries. Therefore, a basic understanding of the metalworking lathe and its operations is fundamental to the development of a broad knowledge of machine shop theory and practice. Practical projects play an important role in teaching/learning in technical and vocational subjects, especially in Mechanical Engineering Craft Practice. Projects stimulate learning, improve students handling of tools and materials and also help in positively developing their attitude to work (Ogwo and Oranu, 2006). Computer-Assisted Instruction (CAI) can be applied in acquisition of practical skills. In CAI learning materials are programmed into computer so that teaching in classroom can be simplified.

Computer-Assisted Instruction (CAI) is an interactive instructional technique whereby a computer is used to present the instructional material and monitor the learning that takes place. CAI uses a combination of text, graphics, sound and video in enhancing the learning process. The computer has many purposes in the classroom, and it can be utilised to help a student in all areas of the curriculum. Computer-Assisted Instructional package can be useful in teaching practical-based subjects like metal machining. It requires the user to perform each step before going to the next.

Computer Assisted Instruction uses the computer to facilitate and improve student learning. Students interact with computers at their own pace and the role of the teacher becomes a facilitator or coach. CAI programs direct the learner's attention to different sections in a learning sequence without the direct contact between students and a teacher (Petrakis, 2000). With the development of CAI, the teaching and learning patterns have now changed from teacher-centred to student-centred learning.

Computer assisted instruction (CAI) is an automated instructional technique in which computer (an electronic machine) is used to present an instructional programme to the learners through an interactive process in the computer (Ajelabi, 2000). Sani (2011) on the other hand described CAI as a new teaching and learning strategy in which the topics to be taught is carefully planned, written and programmed in a computer which could be run at the same time in several computer units and it allows each students to one computer terminal. Sani went further to explained that the instructions are programmed in a computer disc (CD), which could be played in either audio or video system for the student to learn the programmed at his /her leisure time and at his/her own pace.

On the effectiveness of CAI, Gonzalez and Birch (2000) claimed that CAI has the ability to promote active learning in a wide variety of disciplines from literature to the social sciences and beyond. Jimoyiannis and Komis (2001) maintained that CAI transforms learners' alternative conceptions. Fagbemi, Gambari, Gbodi and Oyedum (2011) reported that CAI is more beneficial to younger students than to older ones. Their findings revealed that CAI was beneficial to students in general but the degree of impact decreases from the lower level to higher levels. Though, CAI is normally designed for individualised learning, but it has been found to be more effective with small groups than individualised alone (Yusuf and Afolabi, 2010).

CAI has been tagged with many advantages, including the capacity to provide high-quality images, active learner involvement, and flexibility by allowing students to learn at their

own pace (Palanikumar, 2012). Several researches have shown that using Computer-Assisted Instruction (CAI) has a positive effect on students achievement compared to traditional methods. Okoro and Etukudo (2001) found that CAI is effective in enhancing students' performance in chemistry. Ahiatrogah, Madjoub and Bervell (2013) found that CAI was also an effective mode for teaching Pre-Technical skills. Similarly, Palanikumar(2012) insisted that the contributions of CAI in educational and instructional process are so significant.

Jenk and Springer (2005) believed that how CAI is delivered can affect its effectiveness, and they suggested that new studies are needed to clarify the effect of CAI in contemporary student environment. Researchers experience revealed that CAI in lathe machine operations which are consistent with the practical content required for skill acquisition and tested for effectiveness is important for teachers in technical colleges. This is especially so when the unit to be taught involves specifying tools, materials and equipment and operational sequence of carrying out a practical exercise. The implication of the lack of a reliable instructional strategy for technical teachers is that teachers will teach according to their dictates which will likely yield undesirable results (Ahiatrogah, Madjoub & Bervell, 2013). Therefore, the use of an instructional software package in the teaching and learning of metal machining module at NTC level in technical colleges will help the students to learn the concept of machine tools and how to operate it. By so doing, it will improve their performances in the trade, provide them with the necessary skills needed for machining parts which will make the students to become self-reliant or self-employed.

Practical activities in Mechanical Engineering Craft Practice (MECP) are geared towards providing students with opportunities for acquiring practical skills in machining operations so that they can graduate with the skills necessary for employment. Inadequate mastery of practical skills among Technical College graduates is on the increase, because important components of vocational and technical subjects are taught using conventional methods which impedes acquisition of skills by the students (NABTEB, 2012; Chado & Okwori, 2015). The practical content for Mechanical Engineering Craft Practice (MECP) requires students to develop skills in selection of materials, as well as desirable habits and knowledge in producing mechanical engineering products before graduation. These noble objectives can be achieved using computer softwares and applications. Yet, at the moment, there are no specific studies made in respect to application and effect of computer instructional package on teaching practical content of MECP especially lathe machine operations.

For effective teaching of practical skills in mechanical engineering craft practice, the use of suitable instructional strategy that will assist teachers in carrying out the teaching of practical skills activities in an effective manner is imperative. The present practice is teaching practical skills in MECP with conventional method only. This practice leaves the trade teachers to teach technical trades according to their dictates resulting in students graduating without pre-requisite technical skills in their trades. Therefore, for effective teaching of practical content in machining as contained, in the National Technical Certificate Curriculum for MECP, the use of insructional package will be tested to find its positive effect on student's performance and hence the thrust of this study.

Purpose of the Study

The purpose of this study was to determine effect of Computer-Assisted Instructional package on teaching lathe machining operations at technical colleges in yobe state. Specifically, the study sought to:

1. To determine the performance of students on Knurling Operation when taught using Computer-Assisted Instructional Package
2. To determine the performance of students on Parting-off Operation when taught using Computer-Assisted Instructional Package

Research Questions

The following research questions were formulated to guide the study:

1. What is the performance of students taught Knurling Operation using Computer-Assisted-Instructional Package?
2. What is the performance of students taught Parting-off Operation using Computer-Assisted Instructional Package?

Hypotheses

The null hypotheses below were tested at 0.05 levels of significance:

1. There is no significant difference in the performance of students taught Knurling operation using Computer-Assisted Instructional Package and those taught using conventional method
2. There is no significant difference in the performance of students taught parting-off operation using Computer-Assisted Instructional Package and those taught using conventional method.

METHODOLOGY

The design of this study was randomised control group post-test only. The post-test-only randomised control group experimental design has been described as one of the best design for assessing cause-effect relationship (William, 2006). This study adopts a two-group post-test only randomized experiment involving one treatment group and one control group. The study was carried out in Yobe State, Nigeria which is located between latitude 12° 00' N and 11° 30' E of the Greenwich Meridian (World Atlas Map, 2015). Yobe State has eight Government Science and Technical Colleges spread across the state. Only one of the eight technical Colleges offer Mechanical Engineering Craft Practice (MECP) Trade. This is Government Science and Technical College, Potiskum.

The population of this study consisted of all Technical College year two (NTC II) MECP students in Government Science and Technical College(GSTC) Potiskum. The sample of the study was 45 Year II MECP students, purposive sampling technique was used to select GSTC Potiskum because it is the only college that offers MECP among the technical colleges in Yobe state. A random sampling technique was used to assigned students into experimental and control groups. The experimental group has 22 students while the control group has 23 students.

Instrument used for data collection was a researcher made Metal Machining Practical Skills Achievement Test (MMPSAT). The MMPSAT was a practical test based on NTC II curriculum on Lathe machine for Knurling and Parting-off operations. These topics were

selected from the National Technical Certificate year two Mechanical Trade syllabus. Students' performance was rated and recorded. The students' achievement rating for the test, based on NABTEB standard was categorized in to four rating grade as follows: Distinction (70 - 100%), Credit (50 - 69%), Pass (40 - 49%) and Fail (0 - 39%).

The data collected was analysed using Statistical Package for Social Sciences (SPSS) version 20.0 for windows. Arithmetic percentage and Mean statistic were used to answer research questions while, t-test statistic was used to test the twom null hypotheses at 0.05 level of significance.

The researchers visited the school several times. During the first visit the researchers were able to be familiarised with the environment, sought approval from the school management to carry the study and to identify and sought the cooperation of both the teachers and students to be involved in the study. During the second visit, teachers in the experimental group were trained in the use of Computer Assisted Instructional (CAI) Package and the conduct of practical and assessment of their students while teachers in the control group were instructed to coordinate their students for conventional teaching and for assessment. The third visit was to monitor the progress made in the use of CAI Package for treatment by the teachers, and the fourth and last visit was used to collect the score sheet from the teachers.

The study involved the post-test-only randomized experimental design. The administration of post-test was a practical skills test on lathe machines that was administered at the same time to the two groups. The study was conducted for a period of six weeks during which Knurling and Parting-off operations was taught. All sessions was held in the selected technical college. Students in the experimental group were taught using the CAI Package. The second group which was students in the control group were taught using the conventional teaching method. Both groups were taught by the help of two research assistants who were trained by the researchers. The teaching process lasted for six weeks after which the post-test was administered to all the students in both experimental and control groups.

RESULTS AND DISCUSSION

Research Question 1: What is the Performance of Students Taught Knurling Operation with Computer-Assisted Instructional Package and those Taught without Computer-Assisted Instructional Package?

Table 1: Performance of Students Taught Knurling Operation with CAI Package and those Taught with Conventional Teaching Method

S/No	Item	Experimental Group (%)	Control Group (%)
1.	Observing safety precautions (workshop coat, safety boot, hand gloves, calmness).	75	75
2.	Correct set-up (setting a compound rest to 90°, tightening of workpiece on the chuck, avoiding over-hanging of workpiece).	50	50
3.	Correct selection of tool (using a Knurling tool)	100	50
4.	Correct mounting of tool (no over-hanging of tool, Firm tightening of Knurling tool)	50	25
5.	Correct alignment of tool (on-centering)	50	25
6.	Correct Interpretation of working drawing (correct Knurling of the designated portion)	75	50
7.	Finished part (correct Knurled surface)	75	25
8.	Accuracy of dimension (exact dimension, correct distance)	75	50
9.	Accuracy of Knurled part (complete part)	75	50
10.	Removal of burs (smoothness of the surface)	75	50
Mean		70.00	42.50

Table 1 has 10 items on which the students' performances were presented. The results showed that in all the items, the experimental students performed better the control group. The highest performance of the experimental group was 100% while the least was 50%. For the control group the highest was 50% while the least was 25%. The results showed that students that were taught knurling operation using computer assisted instructional package performed better than those taught using conventional teaching method an indication that CAIP was effective in teaching knurling operations.

Research Question 2: What is the performance of students taught Parting-off operation with Computer-Assisted Instructional Package and those taught without the Computer-Assisted Instructional Package?

Table 2: Performance of Students on Parting-off Operation with CAIP and those Taught with Conventional Teaching Method

S/No	Item	Experimental Group (%)	Control Group (%)
1.	Observing safety precautions (workshop coat, safety boot, hand gloves, calmness).	100	75
2.	Correct set-up (setting a compound rest to 90°, tightening of workpiece on the chuck, avoiding over-hanging of workpiece).	100	50
3.	Correct selection of tool (using parting-off tool)	75	50
4.	Correct grinding of tool (sharp cutting edge, correct rake angle, good side and rake angles)	50	50
5.	Correct mounting of tool (no over-hanging of cutting tool, firm tightening of turning tool, on-centering of turning tool).	50	25
6.	Correct Interpretation of working drawing (Part-off at the designated mark)	75	25
7.	Finished part (correct portion removed)	75	50
8.	Accuracy of dimension (exact dimension, correct tolerance)	75	50
9.	Accuracy of length (complete part removed)	75	50
10.	Removal of burs (smoothness of the surface)	50	50
Mean		72.50	47.50

Table 2 has 10 items on which the students of both experimental and control groups performance were presented. The table showed that in all the items, experimental group students performed better the control group. The highest performance of the experimental group was 100% while the least was 50%. For the control group the highest was 75% while the least was 25%. The results indicated that students that were parting off operation with CAIP performed better than the students who were taught using conventional teaching method an indication that CAIP was effective in teaching parting-off operations.

Hypothesis 1: There is no significant difference in the mean performance of students taught knurling operation with computer assisted instructional package and those taught using conventional method.

Table 3: t-test Analysis of Mean Performance of Students Taught using CAIP and Conventional Teaching Methods on Knurling Operation

Category	N	Mean	t-cal	t-crit(2-tail)	Remark
Experimental Group	23	70.00			
Control Group	22	42.50	5.425	1.956	Significant

Table 3 above showed that the calculated t-value (5.425) was greater than t-critical (1.959) which revealed that, there is significant difference in the mean performance of students taught knurling operation with computer assisted instructional package and those taught using conventional method. The results revealed that the use of CAIP in teaching of knurling operation is significantly better than the use of conventional method in technical colleges in Yobe State.

Hypothesis 2: There is no significant difference in the mean performance of students taught parallel turning operation with computer assisted instructional software package and those taught using conventional teaching method.

Table 4: Table 4: t-test Analysis of Mean Performance of Students Taught using CAIP and Conventional Teaching Methods on Parting-off Operation

Category	N	Mean	t-cal	t-crit(2-tail)	Remark
Experimental Group	23	77.50	4.837	1.96	Rejected
Control Group	22	45.00			

Table 4 showed that computed t-value (4.837) was greater than t-critical (1.959). This indicated a significance difference in the mean performance of students' taught parting-off operation with CAIP and those taught with conventional teaching method.

FINDINGS OF THE STUDY

The following are the findings of this study:

1. Post-test mean difference in performance scores of students taught Knurling operation using CAIP and Conventional Teaching Method revealed that those taught using CAIP performed better than those taught with conventional teaching method.
2. Performance scores of students taught parting-off operation with CAIP were better than those taught using a conventional teaching method.
3. There was significant difference in the mean performance of students taught knurling operations with CAIP and those taught using conventional method.
4. There was significance difference in the mean performance of students' taught Parting-off operations with CAIP and those taught with conventional teaching method

DISCUSSION

Knurling is the process of roughening the surface of a piece of work by making a series of indentations or depressions on it. The mean performance of students in knurling operation as shown in table 1 indicates that the experimental group has a mean score of 70.00 and the control group has 42.50. However, the results indicated that those taught with CAI Package has better than those with conventional teaching method. This findings were in line with Chado and Okwori (2015) which revealed that, the students in the experimental group taught metalwork technology with CAI package performed better than those students in the control

group that were not exposed to the CAI lesson. In this case, the results had indicated that CAI Package has a positive effect on the performance of students in knurling operation.

Parting-off operation is the process of cutting away an excess part from a workpiece. This operation is very important, is the basic lathe operation as most operation are carried out on a workpiece that is mostly larger than the part required. With proper set-up and detailed operational procedures this operation can successfully be carried out. Results in table 2 indicated that the mean performance of students taught parting-off operation with CAI Package was 72.50 and those taught without CAI Package was found to be 47.50. This, do not come as a surprise; because Computer-Assisted teaching do not only improve success but also develop higher level thinking abilities in students (Kara and Yakar, 2012). This finding is consistent with that of Ndudi (2011) which revealed that students taught Basic Electricity with CAI performed better than students taught using conventional teaching method.

CONCLUSION

Based on the findings of this study, the use of an instructional software package in teaching machining processes at technical colleges improves students' performance at NTC examinations. The CAI Package used in this study for teaching Knurling and Parting-off operations improves students' academic performance in practical skills; which showed a significant difference between the experimental and control groups. This therefore reinforced the usefulness of Computer Assisted Instructional Package in teaching of lathe machining practical skills.

The findings of this study provided some far reaching implications in the process of teaching and learning of practical skills in general, and mechanical trade in particular. Some of which are as follows:

1. The study revealed that CAI Package has significant effect in students' academic achievement in lathe machine practical skills. It would suggest that the adoption of CAI Package in teaching Machining by teachers in Technical Colleges will enhance students' academic performance in lathe machining practical skills.
2. Computer-Assisted Instruction encourages student-centered learning, student can learn even if there is no teacher present. It also makes learning interesting and easy.

RECOMMENDATIONS

Going by the findings of the study the following recommendations were made:

1. Since the use of CAI Package was found to be effective in teaching practical skills, Mechanical Trade teachers should be encouraged as much as possible to develop the habit of teaching their students using CAI Package.
2. Yobe and Federal Governments should organize sensitization workshops and seminars for MECP teachers to create awareness on the efficiency of computer-assisted instructions towards adopting the strategy in their teaching process.

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