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Effect of simulation instruction on student performance in skills on drilling and milling operations at tertiary institutions in some States of North-Eastern, Nigeria

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Abstract
Technology Education is that aspect of education that gives its recipients an opportunity to acquire practical skills as well as some basic scientific knowledge. The purpose of this study was to assess Tertiary Students' Practical Metal Machining Skills in Borno and Yobe States. Two research questions were answered and an experimental research design was employed for the study. The Instrument used for data collection was the adaption of Metal Machining Practice Performance Test (MMPPT). The population of the study involved 21 NCE III (Technical) Metalwork Students. All the institutions that offers NCE (Technical) programme which were duly accredited by NCCE in Borno and Yobe states were involved. The MMPPT test instrument has a reliability coefficient of 0.80 that is strong correlation. Mean rating and percentage were used to answer the research questions. One hypothesis was tested using T- Test at 0.05 level of significant which indicated that practical skills performance of metalwork students on drilling machine operations was significantly different from their performance on milling machine operations as $t_{critical} < t - crt = df = 20$. Findings of the study shows that NCE (Technical) Metalwork Students exhibited average performance on drilling operations and below average performance on mounting the work piece, mounting milling cutter and dividing head, milling process of spur gear.

Keywords: Technology education, performance test, metal machining

Introduction

Technical education is that aspect of education that gives its recipients an opportunity to acquire practical skills as well as some basic scientific knowledge. It also involves the acquisition of skills and competence that can help individuals to function productively in industries and commercial occupations. One of the aims of technology education is to impart the necessary skills leading to the production of skilled craftsmen and personnel who will be enterprising, self-reliant and intelligent to understand the increasing complexity of technology (Federal Republic of Nigeria, FGN, 2004). These skills are acquired through teaching of theory and practical of the different subjects in the workshop. Practical lessons (practical project) are given to students which end up in producing 'projects' using simple hand tools or/and machine tools (Yalams, 2011) [24].

According to Abubakar, Mohammed and Rabiu (2013) [1], Machine tools are power driven machine, used to shape or form metals by cutting, electrical techniques or combination of these processes. Some examples of Machine tools include Lathe, Milling, Grinding and others. Metal Machining therefore, is any of the various processes in which a piece of metal is cut into the desired final shape and size by controlled removal of metals using machine tool. Drilling machines are used to produce holes on metals and they are also used in operation such as reaming, boring, countersinking, counter boring and tapping (Thomas, 2009) [22]. Milling is the process of producing machined surfaces by progressively removing a predetermined amount of material from the work piece, which is fed to a rotating milling cutter. One of the characteristics features of the milling process is that each milling cutter tooth: removes its share of stock in the form of individual chips. Working with machine tools, demands manipulative skills necessary to produce articles needed. Thus, skills acquisition becomes very vital.

Similarly, Idi (1998) observed that to have appropriate skills is to get a job, to keep a job, to improve on the job, to get better job, and to believe in the job. He added that acquisition of skills cut across the three domain of educational objectives namely, affective, cognitive and psychomotor domains. Thus, skill acquisition is cumbersome, tedious and time consuming. Obsorne (1998) observed that skills acquisition is through participation in carrying out practical work and that practical work provides feedback about students learning experience which is referred to as assessment.

Okeke (2014) [8] stated that assessment gives students and teachers appropriate feedback about their performance. Nigeria National Teachers Institute Manual (NNTI) (2006) defines assessment as a process of organizing test data into interpretable forms using variety of instruments to arrive at judgment in respect of the pupil's ability or performance. It also refers to value judgment about a learner's level of performance, using different assessment instruments. Some of these instruments include oral test, behavioral assessment test, and observational schedule, interview schedule, rating scale, checklist, questionnaire, achievement test, performance test and others. Performance test according to Okoro (2000) [9], involve practical activities designed to measure the amount of practical skills possessed by students. Achievement test attempts to assess the relative weakness and strength; to determine the areas where an individual needs remedial work. Metal Machining Practice Achievement Test (MMPAT) is one among such achievements test. Its purpose is to assess learning outcome based on mental process in metal machining at NCE (Technical) level (Mohammed, 2016) [12].

Furthermore, students of NCE (Technical) metalwork technology must acquire knowledge and skills; and application of that knowledge and skills in practical situations. Practical project is a means of developing and testing students' skills (Onele, (2014) [20]. These practical skills are measured through observation using check list or rating scale to determine the level of attainment of the course objectives. Mckingsey and Company (2012) forecasted a troubling outlook on the labour market through the year 2020. The report highlight that there will be a shortage of the skilled personnel needed for employment across the globe which include; about 40million vocational and technical education school graduate in the developing countries (Nigeria inclusive). Similarly, Dorothy (2011) [2], observed that the joblessness of the Nigeria graduates stems from non-acquisition of the require skills needed to compete in the labour market. Nurse, (2019) [16] stated that the purpose of practical projects is to develop and test students' practical skills on the basis of normal range covered by the theory lessons. He added that practical projects constructed by students' exhibit the skills they possessed and also determine the quality of the workmanship.

Moreover, the NCE (Technical) metal work students offered machine shop practice which is a practical oriented course that will provide them with required skills to perform practical work on machine tools. As stated at in the NCCE (2020) Minimum standards the contact hours are the ratio of 1hour: 3hours of theory lesson and practical respectively per week. It is therefore imperative to assess the practical skills of NCE (Technical) metal work students on metal machining, in Borno and Yobe States in order to identify their specific areas of strength or weaknesses so as to make necessary improvement in NCE (Technical) awarding institutions.

The major purpose of this study was to assess NCE (Technical) metalwork student's practical performance skills in metal machining. Specifically the study intends to:

1. Examine the NCE (Technical) metalwork students' practical skills performance on Drilling operations.
2. Examine the NCE (Technical) metalwork students' practical skills performance on Milling machine operations

The following research questions were raised to guide the study.

1. What are the practical skills performances by NCE (Technical) metalwork students on Drilling operations?
2. What are the practical skills performances by NCE (Technical) metalwork students on milling machine operations?

The research Hypothesis of the study was stated as;

HO: 1.There is no significant difference between the practical skills performances on Drilling operations and practical skills performances on milling machine operations by the NCE (Technical) metalwork students.

Research Methodology

This describes the research procedures which were employed for this study. Research Design was a one-shot case study experimental research design. One-shot case study experimental is an observation of a single group in order to assess the strength or weakness or effectiveness of the programme (Sambo, 2005) [21]. Thus, this study intended to assess the NCE (Technical) metalwork students in practical metal machining skills so as to ascertain their areas of strength and weakness towards skills possession and provide pertinent information necessary for modification.

The area of the study was Borno and Yobe states. The population of the study comprises of all the 21 NCE III (Technical) metal work Students. Thus there is no sampling, all the institutions that offers NCE (Technical) programme which were duly accredited by NCCE in Borno and Yobe states were involved. Instrument for data collection was the adaption of Metal Machining Practice Performance Test (MMPPT), from Metal Machining Practice Achievement Test (MMPAT) which was developed by Mohammed (2006). The MMPAT involves NCE (Technical) metal work students and constructed based on metal machining (machine shop practice) which is in line with NCCE (2020) curriculum. Thus the instrument was reliable and useable. To ensure the face validity of the test instrument, a draft copy of the instrument was submitted to five (5) experts in the field of metalwork Technology education. The test has a reliability coefficient of 0.80 that is strong correlation. As stated by Uzoagulu (1998) [23] that a correlation value of 0.80 indicates strong correlation. Thus the instrument was reliable and useable. A checklist was provided which contain five point liker rating scale consisting of outstanding performance (5), above average performance (4), average performance (3), below average performance (2), and unsatisfactory performance (1). In each of the test item, two assessment techniques were indicated as; (A) process assessment and (B) product assessment. And on each assessment features, there are tasks to be performed by the students which include skills to be observed and rated by an examiner. The data of the study was analyzed using mean rating and percentage.

Results

The results of the analysis of data collected have been presented based on the research questions

Research Question 1

What are the practical skills performances by NCE (Technical) metalwork students on Drilling operations?

Table 1: NCE III (Technical) Metalwork Students' Practical Skills Performance on Drilling Operations

S/N	Drilling Operation (4 practical tasks)	Mean Rating	Percentage (%)	Remark
1	Centre Punching	2.13	42.5	AP
2	Mounting a drilling bit into spindle of the drilling machine	2.38	47.5	AP
3	Drilling process	2.00	40	AP
4	Product assessment of the drilled hole	1.89	37.5	BAP
	Grand Mean	2.1	41.88	AP

Keys; AP=Average performance, BAP= below average performance.

Table 1 above shows that grand mean percentage of the four (4) practical tasks was 41.88% that is average performance.

Research Question 2

What are the practical skills performances by NCE (Technical) metalwork students on milling machine operations?

Table 2: NCE III (Technical) Metalwork Students' Practical Skills Performance on Milling Machine Operations

S/NO	Milling a flat surface of mild steel/Milling a spur gear/Cutting key way	Mean Rating	Percentage (%)	Remark
5	Mounting the work piece in the milling bed	1.75	35	BAP
6	Mounting a milling cutter on milling machine	1.5	30	BAP
7	Milling process of a flat surface	1.38	27.5	BAP
8	Product assessment of a completed flat surface	1.63	32.5	BAP
9	Mounting the work piece in the mandrel	1.38	27.5	BAP
10	Mounting a milling cutter and mounting a dividing head	1.35	25.5	BAP
11	Milling process of a spur gear	1.00	20	BAP
12	Product assessment of the gear teeth	1.00	20	BAP
13	Mounting a work piece to cut a key in its surface	1.13	22.6	BAP
14	Mounting a key way milling cutter	1.25	25	BAP
15	Process of cutting key way	1.25	25	BAP
16	Product assessment of the completed key way	1.33	27.5	BAP
	Grand mean	1.33	26.51	BAP

Table 2 shows the result of calculated percentage of milling machine operations. The grand mean percentage of the 12 practical tasks was 26.51% that is below average performance**.**

The research Hypothesis was

HO: 1.There is no significant difference between the practical skills performances on Drilling operations and Practical skills performances on milling machine operations by the NCE (Technical) metalwork students.

HO: There is no significant difference between the practical skills performance on drilling machine operations and the practical skills performance on milling machine operations.

Table 3: Comparison of NCE (Technical) Metalwork Students Practical Skills Performance on Drilling machine Operations and Milling Machine Operations (N = 21)

Variable	M	SD	T	DF	p
Practical skills performance on Drilling Operations – Practical Skills Performance on Milling Machine Operations			10.62	20	.000
Performance on Drilling Operatons	2.10	0.18			
Performance on Milling Operations	1.33	0.24			

From the practical task on drill operations, the NCE (Technical) students exhibited different performance.

a. Average performance in centre punching, mounting of drilling bit into the spindle of the drilling machine, while below average performance on product assessment of drilled hole.
b. Average performance in tightening the work piece to be counter bore, drilling a hole to be counter bore. While below average performance in counter boring process and product assessment of the counter bored hole.

The NCE (Technical) metal work students exhibited same performance on milling machine operations in 12 practical tasks these are

a. Below average performance in mounting the work piece, mounting milling cutter, milling process, product assessment of completed milled flat surface.
b. Below average performance in mounting the work piece, mounting milling cutter and dividing head, milling process of spur gear, product assessment of gear teeth.
c. Below average performance in mounting work piece, mounting milling cutter, milling process of cutting key ways and product assessment of completed key ways.

Discussion of the Findings

The findings in respect to research question one indicate that the NCE (Technical) metal work students possessed practical skills on drilling operations. This could be as a result of simplicity that is involved in its operations, which is in line with the findings of Thomas (2009) [22], that the process of drilling was always feeding the drilling bit by pressing the handle downwards. And only requires the changing of cutting tool to provide different operations.

Findings of research question two indicate that the NCE (Technical) metalwork students perform below average. This is also same as that of Francis, (2017) [7] as setting up of the work piece on milling is the most difficult part of the job. Set up require critical thinking because not only does that part have to be fastened to the table, but the part must be positioned so that the proper surfaces can be machined using the correct features of the work piece for positioning to ensure a good set up, the operator must become aware of the types and proper use of work holding devices associated with milling machines. This could also be as a result of lack of intensive practical work on milling machine, or lack of qualified personnel or equipment and consumable materials as rightly stated by (Mayer, 2018) [8].

Conclusion

Based on the results of this study: despite the fact that the NCE (Technical) metalwork students performed below average in some practical tasks. It can be concluded that; NCE (Technical) metalwork students exhibited satisfactory performance on drilling machine operations while unsatisfactory performance on milling machine operations. The findings implied the need to comply with the NCCE minimum standard that machine shop practice II should be taught in the ratio of 1hour: 3hours theory and practical respectively per week. There is also the need look into the

method of teaching practical projects on metal machining especially milling machine. The finding implies that if measures were not taken so as to provide the NCE (Technical) metalwork students with required skills, this would lead to set back in achieving the objectives of technical education by producing haft-baked graduates.

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