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PRACTICAL SKILLS IMPROVEMENT NEEDS OF MECHANICAL CRAFT TEACHERS FOR TEACHING DRILLING AND MILLING PRACTICES IN TECHNICAL COLLEGES

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Abstract
In order to carry out this study, two research questions and two null hypotheses were formulated. The study adopted descriptive survey research design. The population comprised 80 teachers and 54 instructors in technical colleges in South-East Nigeria and were studied without sampling. A structured and validated questionnaire containing 17 items was used for data collection. Cronbach alpha formula was used to determine the internal consistency of the questionnaire which yielded an overall reliability co-efficient of 0.77. The researchers administered the instrument with the help of five research assistants to the respondents. Data collected were analysed using weighted mean and improvement need index for both required and performance categories of the instrument in order to answer the research questions. The t-test was used to test the null hypotheses at 0.05 level of significance. Findings of the study revealed that mechanical craft teachers and instructors in technical colleges in South-East Nigeria need practical skills improvement for teaching drilling and milling practices. There is no significant difference between the mean responses of mechanical craft teachers and instructors on practical skills improvement needs for teaching drilling and milling practices in technical colleges South East, Nigeria. The study concluded that mechanical craft teachers and instructors in technical colleges in South-East Nigeria need practical skills improvement in drilling and milling practices in order to adequately prepare students to start their engineering venture upon graduation.
Keywords. Technical colleges, mechanical craft practice trade, practical skill, drilling and milling practices

Introduction

Technical colleges are educational institutions where students are trained to acquire the requisite workplace skills. Technical colleges offer trade subjects that provide enough training grounds for individuals to acquire technical awareness and useful skills necessary for mastering a particular trade. Also, in addition to general education, all the trade subjects offered by technical colleges are in two parts: theory and practice (Kumazhege & Umar, 2020). Technical colleges give prospective craftsmen full training intended to prepare them for entry into various occupations of their interest. Begi (2017) posited that technical colleges are one of the principal technical and vocational institutions saddled with the responsibility for training craftsmen in Nigeria. The major trade courses offered in technical colleges are electrical and electronics, building construction, woodwork and mechanical craft practice trade among others.

Mechanical craft practice trade is designed to produce competent mechanical craftsmen who can make concrete and manifest the engineering plans and designs of mechanical engineers in the world of work. Mechanical craft is one of the trades offered in technical colleges, aimed at training and imparting necessary skills leading to the production of craftsmen who will be self-reliant and enterprising on job areas, such as metal fitting, machining, welding and fabrication,

auto vehicle mechanics, air-conditioning and refrigeration (National Board for Technical Education, 2014). In addition, Beako (2018) stated that mechanical craft practice trade is one of the recognized engineering fields that deals with the practice of machine and mechanized processes, particularly concerned with power generation, transmission, utilization of tools and equipment. Amaechi and Thomas (2021) submitted that mechanical craft practice trade provides a post primary training and practical proficiency in machining practices; which includes drilling, milling, shaping, planning and slotting, grinding and boring. These machining practices will help graduates of mechanical craft practice trade in technical colleges to handle different machine models and types in mechanical workshops (Aleru & Logbene, 2021).

The study focused on drilling and milling practices because they are fundamental machining processes that remove unwanted materials from a workpiece in order to change the size, shape, and surface of the material. According to Amaechi and Thomas (2021), drilling is a machining practice where holes are produced or refined by bringing a rotating cutter with cutting edges at the lower extremity into contact with the workpiece. Igharo, Baridue, Opakirite and Daniel (2022) posited that drilling entails creating round holes of various sizes in different materials and helps to clear chips from the workpiece in order to prevent drifting or leading-off. Drilling is one of the most important machining processes as the holes that are created are often intended to aid in assembly (Saue, 2020). In most manufacturing operations, drilling is a preliminary step in producing finished holes, ones that are subsequently tapped, reamed, bored and so on to create threaded holes or to bring hole dimensions within acceptable tolerances (Maliki, Maidawa, Jamous & Mattew 2022).

Drilling operations are carried out with drilling machines but milling machines are the principal machine tools used in milling operations. Milling is the practice of machining flat, curved or irregular surfaces by feeding the work piece against a rotating cutter containing a number of cutting edges. Olaseni and Olawale (2016) posited that milling uses a rotating tool with multiple cutting edges that moves slowly relative to the material to make a straight surface. Traditional milling machines feature moveable tables on which the work pieces are mounted (Ehimen & Ezeora, 2018) and other types of milling machines feature both table and cutting tools as moveable implements. Some of the operations a milling machine is capable of performing include cutting, rabbeting, routing, die-sinking, and so on, making the milling machine one of the more flexible pieces of equipment in a machine shop (Aleru & Logbene, 2021).

Evidently, machining practices such as drilling and milling practices require practical skills before they can be carried out in machine shops. Practical skill is the ability to perform certain functions without errors. Maliki, Yashim and Jamous (2022) defined practical skill as the dexterity of accomplishing responsibilities with a combination of smoothness, speed and accuracy. Practical skill is a learned capacity to carryout professional tasks with minimum outlay of time, energy or both. According to Ezugu, Bala and Muhammad (2023), practical skills are sets of abilities or knowledge used to perform sophisticated tasks in the areas of science, technology and engineering. The authors further stressed that practical skills refer to specialized knowledge and expertise needed to accomplish complex actions, tasks, and processes relating to computational and physical technology among other endeavours. Therefore, practical skills are hands-on attributes that mechanical craft teachers must possess and master in the classroom for effective teaching to take place. In the context of this study, practical skills are technical skills required by mechanical craft teachers and instructors for effective teaching of drilling and milling practices to their students in technical colleges.

It is expected that graduates of mechanical craft practice trade in technical colleges are competent in carrying practical drilling and milling practices needed in industrial sector of the economy. However, the researchers observed that the teaching of drilling and milling practices in technical colleges in South East, Nigeria is mainly theoretical based on the explanation of concepts and principles. This form of teaching may not expose students to drilling and milling practices in technical colleges. No wonder, Maliki and Ezekiel (2022) reported that most graduates of mechanical craft practice trade in Nigeria are neither able to set up their own businesses nor become self-employed immediately after graduation, rather, they work as apprentices for some years before they can fully establish their own businesses. Correspondingly, Eze and Okonkwo (2021) illuminated that many technical college graduates of mechanical craft-practice in South East, Nigeria augment for the insufficient academic preparation in machining operations by undergoing trainings and remedial courses in different private technical workshops.

It is important to mention that adequate classroom teaching and laboratory exposure of students to the different practical drilling and milling skills in technical colleges require the efforts of competent mechanical craft practice trade teachers and instructors. In technical colleges in Nigeria, there are differences between a teacher and instructor. A teacher is responsible for imparting theory and also guiding the students into practical understanding while instructor is solely responsible for facilitating firm grip of the practical and applied skills among the students. Ayanyemi and Adisa (2016) posited that a mechanical craft practice trade teacher is one who is qualified to teach students the theoretical aspects of mechanical craft in technical colleges. On the other hand, mechanical craft instructors should have in-depth knowledge of the practical aspects of mechanical craft practice trade in technical colleges. They should instruct the students in specific technical fields and provide technical support and troubleshooting to them while conducting training sessions in mechanical workshops or laboratories (Elisha, 2014).

This suggests that, in order to prepare students for the entrepreneurial engagements in the labour market upon graduation, mechanical craft practice trade teachers and instructors in technical colleges need practical skills improvement for teaching different machining practices. Literally, need is something that is not readily available while improvement is the art of building upon something that is acquired or possessed to a more advanced or effective level. The need for improvement always arises when there is a gap to fill (Abusomwan & Osaigbovo, 2020). In this study, improvement is the process of increasing the proficiency level of mechanical craft practice trade teachers and instructors in the area of machining practices. In the context of this study, the end result of carrying out improvement needs exercise is to facilitate the acquisition of skills to a standardized level where mechanical craft practice trade teachers and instructors can effectively teach practical machining practices to students in technical colleges.

As new and more sophisticated machines are developed in the industrial world, mechanical craft practice trade teachers and instructors stand the risk of being declared redundant if they do not avail themselves of opportunities of improving their knowledge and skills for effective teaching of drilling and milling practices in technical colleges. In order to address gaps between the theory and practice of drilling and milling practices in technical colleges, determination of practical skill improvement needs of mechanical craft teachers and instructors becomes imperative using the deficiency analysis model. According to Michael (2019), the deficiency analysis model entails asking individuals to identify the skills, competences and resources they would need in order to move from their present situation to the desired or target situation. In a nutshell, Aremu (2015) affirmed that deficiency analysis shows the gap between performance ability/skill which a teacher possesses and the performance skill/ability which the teacher is expected to possess in order to meet the required instructional standard in the classroom. It therefore becomes imperative to examine the current skill

improvement needs of mechanical craft teachers and instructors for teaching machining practices in technical colleges in South East, Nigeria.

Mechanical craft teachers and instructors were selected for the study because mechanical craft teachers throws sufficient light on the 'what to do' aspects of the subject matter while an instructor throws more light on the 'how to do' aspects of the subject. The current emphasis on competency-based learning in technical education implies that for anybody to assume the duty of a mechanical craft teacher and instructor in technical colleges, such a person is expected to possess adequate skills for imparting practical knowledge and drilling and milling practices to students. Technically, if mechanical craft teachers and instructors in technical colleges are not skilled in drilling and milling practices, they will produce graduates of the mechanical craft practice trade who cannot perform machining processes in machine shops in the society. Against this backdrop, this study sought to find out the practical skill improvement needs of mechanical craft teachers and instructors for teaching drilling and milling practices in technical colleges in South East States of Nigeria.

Statement of the Problem

In technical colleges in South East States of Nigeria, the researchers observed that the teaching of drilling and milling practices is mainly theoretical based on the explanation of concepts and principles. In the classroom, theoretical teaching is bound to affect the acquisition of practical drilling and milling skills and at the same time, adds to huge contradiction between teaching and machining skills demanded in the labour market. In addition, the researchers observed that students are not subjected to experiential instructional experiences. With the rapid development of modern machining processes, mechanical craft teachers and instructors need to acquire the necessary new trend of practical skills for effective teaching of drilling and milling practices to enable students connect with the labour market.

The acquisition of drilling and milling skills by students of technical colleges in order to be ready-to-work is dependent on the skills possessed by mechanical craft teachers and instructors in the classroom. The problem of the study, mechanical craft teachers and instructors having been trained some years back may be deficient in teaching drilling and milling practices. If the shortcomings of mechanical craft teachers and instructors are not addressed, the students will not acquire the practical drilling and milling skills that will enable them to secure paid employment or independently run a machine shop. Hence the need to determine the practical skill improvement needs of mechanical craft teachers and instructors for teaching drilling and milling practices in technical colleges in South East States of Nigeria which is the focus of this study

Purpose of the Study

The purpose of this study was to determine practical skill improvement needs of mechanical craft teachers for teaching drilling and milling practices in technical colleges South East States of Nigeria. Specifically, the study determined the practical skill improvement needs of mechanical craft teachers and instructors for teaching:

1. Drilling practice in technical colleges in South-East Nigeria
2. Milling practice in technical colleges in South-East Nigeria

Research Questions

The following research questions guided the study

1. What are the practical skill improvement needs of mechanical craft teachers and instructors for teaching drilling practice in technical colleges in South-East Nigeria?
2. What are the practical skill improvement needs of mechanical craft teachers and instructors for teaching milling practice in technical colleges in South-East Nigeria?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

1. There is no significant difference in the mean responses of mechanical craft teachers and instructors on practical skill improvement needs for teaching drilling practice in technical colleges South East, Nigeria
2. There is no significant difference in the mean responses of mechanical craft teachers and instructors on practical skill improvement needs for teaching milling practice in technical colleges South East, Nigeria

Method

The study adopted descriptive survey research design. The researchers chose this research design for the study because the study surveyed the opinions of mechanical craft teachers and instructors in technical colleges in South-East Nigeria regarding the practical skill improvement needs for teaching drilling and milling practices in technical colleges with the use of questionnaire. The population for the study comprised 134 mechanical craft teachers and instructors in the 11 government technical colleges offering mechanical craft in South-Eastern states. This was made up of 80 teachers and 54 instructors. The entire population was studied without sampling because the population was manageable.

A structured and validated questionnaire containing 17 items was used for data collection. Clusters B1 and B2 of the questionnaire have response column with two categories of response scales of needed and performance. The required category scale had five point response scales of Very Highly Needed (VHN), Highly Needed (HN), Moderately Needed (MN), Slightly Needed (SN) and Not Needed (NN) with corresponding values of 5, 4, 3, 2 and 1. The performance category scale had five point response scales of Very High Performance (VHP), High Performance (HP), Average Performance (AP), Low Performance (LP) and Not Performance (NP) with corresponding values of 5, 4, 3, 2 and 1. The mechanical craft teachers and instructors were asked to rate the extent each skill item was needed and the extent they could perform each skill item if asked to do so. Then, the mean of their performance was subtracted from the mean of the needed, the difference constituted the improvement gap which could be filled by re-training them.

The instrument for data collection was subjected to face and content validation by three experts; two experts in technology and vocational education and another in educational foundations all from Nnamdi Azikiwe University, Awka. The reliability of the instrument was determined through a pilot test. Fifteen copies of the instrument were administered to 15 mechanical craft teachers and instructors in Delta and Edo States in South-South, Nigeria who were not part of the research population. Data collected were analyzed using Cronbach's alpha formula to determine the internal consistency of the questionnaire items and co-efficients of 0.73 and 0.80 were obtained with an overall reliability co-efficient of 0.77. A total of 134 copies of the questionnaire were administered to the respondents in their offices personally by the researchers with the help of five research assistants. The distribution and collection of copies of the questionnaire lasted for two weeks. Out of the 134 copies of the questionnaire administered, 122 copies (representing 91 percent) were successfully retrieved and used for data analysis.

Data collected from the respondents was analysed using weighted mean and improvement need index for both needed and performance categories of the instrument in order to answer the research questions. Improvement need index helped in taking decisions on the practical skills where mechanical craft teachers and instructors needed improvement. In taking the decision, the following steps were followed:

1) The weighted mean of each item under the needed column was calculated (X_n)
2) The weighted mean of each item under the performance column was also calculated (X_p)
3) The difference between the two means for each item (X_R-X_P) was determined for decision making on the practical skill improvement needed by mechanical craft teachers and instructors thus:
    a. Where the difference was zero, (0), there was no need for skill improvement because the level at which the skill was needed was equal to the level at which mechanical craft teachers and instructors could perform the skill
    b. Where the difference was positive (+), there was need for skill improvement because the level at which the skill was needed was greater than the level at which mechanical craft teachers and instructors could perform the skill
    c. Where the difference was negative (-), there was no need for skill improvement because the level at which mechanical craft teachers and instructors could perform the skill was greater than the level at which the skill was needed (Adapted from Olaitan and Ndomi, 2000),

The t-test was used to test the hypotheses at 0.05 level of significance. An hypothesis was accepted where the p-value was greater than the alpha level of 0.05 ($p > 0.05$), at an appropriate degree of freedom; otherwise, the null hypothesis was rejected. Data collected were analysed using SPSS version 23.0.

Results

Research Question 1. What are the practical skill improvement needs of mechanical craft teachers and instructors for teaching drilling practice in technical colleges in South-East Nigeria?

Table 1

Mean and standard deviation of responses of respondents on practical skill improvement needs for teaching drilling practice in technical colleges in South-East Nigeria

S/N	Statements		$\overline{x_n}$	$\overline{x_p}$	$(\overline{x_n} - \overline{x_p})$	Decision
	Ability to;					
1.	clamp work on machine vice	4.57	4.13	0.44		IN
2.	use vee block		4.18	3.29	0.89	IN
3.	use headed bolt	3.62	3.44	0.18		IN

4.	use special jigs and fixtures	3.71	3.35	0.36	IN
5.	use angle plates	3.99	3.28	0.71	IN
6.	carry out repairs on drilling machine	3.25	2.91	0.34	IN
	Grand Mean	**3.89**	**3.40**	**0.49**	**IN**

N = 122; X_n = Mean of needed; X_p = Mean of performance; PG = Performance Gap; *Xn – Xp* IN = Improvement Needed.

Data in Table 1 reveal that the performance gap value of all the six skills items ranges from 0.18 to 0.89 and are positive. The Table summarizes that mechanical craft teachers and instructors need practical skill improvement for teaching drilling practice in technical colleges in South-East Nigeria.

Hypothesis 1. There is no significant difference in the mean responses of mechanical craft teachers and instructors on practical skill improvement needs for teaching drilling practice in technical colleges South East, Nigeria

Table 2
Summary of t-test analysis of the mean responses of respondents on practical skill improvement needs for teaching drilling practices in technical colleges South East, Nigeria

Variable	N	$\bar{x}$	SD	df	t-value	p-value	Decision
Teachers	73	1.07	0.37	120	0.74	0.15	Not Significant
Instructors	49	1.16	0.46				

Table 2 shows that there is no significant difference between the mean responses of mechanical craft teachers and instructors on practical skill improvement needs for teaching drilling practice in technical colleges South East, Nigeria. This is shown by the p-value of 0.15, which is greater than the significance level of 0.05. The null hypothesis of no significant difference between the two groups is therefore accepted.

Research Question 2. What are the practical skill improvement needs of mechanical craft teachers and instructors for teaching milling practice in technical colleges in South-East Nigeria?

Table 3
Mean and standard deviation of responses of respondents on practical skill improvement needs for teaching milling practice in technical colleges in South-East Nigeria

S/N	Statements

			$\overline{x_n}$	$\overline{x_p}$	$(\overline{x_n} - \overline{x_p})$	Decision
	Ability to;					
1.	clamp directly on the table		4.32	3.85	0.47	IN
2.	use milling machine vice	4.43	3.61	0.82	IN	
3.	use dividing head		3.84	3.29	0.55	IN
4.	cut flat surfaces	2.98	3.54	-0.56	INN	
5.	bore holes INN		3.10	4.07	-0.97	
6.	cut slots		4.35	3.82	0.53	IN
7.	cut keyways		4.49	3.75	0.74	IN
8.	cut racks		3.61	4.04	-0.43	INN
9.	mill helix		3.87	3.41	0.46	IN
10.	gear cutting		4.23	3.66	0.57	IN
11.	carry out repairs on milling machine		4.16	3.43	0.73	IN
	Grand Mean		**3.94**	**3.68**	**0.26**	**IN**

N = 122; X_n = Mean of needed; X_p = Mean of performance; PG = Performance Gap; *Xn – Xp* IN = Improvement Needed; INN = Improvement Not Needed.

Data in Table 3 reveal that the performance gap value of eight skills items ranges from 0.46 to 0.82 and are positive while three skill items ranging from –0.43 to -0.97 are negative. The Table summarizes that mechanical craft teachers and instructors need practical skill improvement for teaching milling practice in technical colleges in South-East Nigeria.

Hypothesis 2. There is no significant difference in the mean responses of mechanical craft teachers and instructors on practical skill improvement needs for teaching milling practice in technical colleges South East, Nigeria

Table 4

Summary of t-test analysis of the mean responses of respondents on practical skill improvement needs for teaching milling practices in technical colleges South East, Nigeria

Variable	N	$\bar{x}$	SD	df	t-value	p-value	Decision
Teachers	73	1.09	0.40	120	0.63	0.24	Not Significant
Instructors	49	1.13	0.56				

Table 4 shows that there is no significant difference between the mean responses of mechanical craft teachers and instructors on practical skill improvement needs for teaching milling practice in technical colleges South East, Nigeria. This is shown by the p-value of 0.24, which is greater than the significance level of 0.05. The null hypothesis of no significant difference between the two groups is therefore accepted.

Discussion of findings

The outcome of the study revealed that mechanical craft teachers and instructors in technical colleges in South-East Nigeria need practical skill improvement for teaching drilling practice. This finding could be attributed to that fact that mechanical craft teachers and instructors need to be trained with drilling skills for effective teaching of drilling practices in technical colleges in South-East Nigeria. The study clearly showed that mechanical craft teachers and instructors in technical colleges in South-East Nigeria needed practical skill improvement in the ability to clamp work on machine vice, use vee block, use headed bolt, use special jigs and fixtures, use angle plates and carry out repairs on drilling machine. The finding of this study agrees with Maliki, Maidawa, Jamous and Mattew (2022) that teachers and instructors needed practical skill improvement for carrying out drilling machines operations. The fact that mechanical craft teachers and instructors in technical colleges in South-East Nigeria needed practical skill improvement for teaching drilling practice means that mechanical craft teachers and instructors need to undergo training and development programme on drilling operations in order to teach students in technical colleges how to carry out drilling operations and operate lathes machines.

In addition, the study revealed that there was no significant difference between the mean responses of mechanical craft teachers and instructors on practical skill improvement needs for teaching drilling practice in technical colleges South East, Nigeria. This finding means that mechanical craft teachers and instructors in technical colleges in South-East Nigeria shared the same position on practical skill improvement for teaching drilling practice. This finding supports, Maliki and Ezekiel (2022) who reported no significant difference in the mean responses of technical teachers and instructors on skill improvement needs of technical teachers in drilling operations in technical colleges. The researchers are of the opinion that drilling practice is the most widespread metal process and it is very useful and highly sought in mechanical and manufacturing industry. Hence, mechanical craft teachers and instructors in technical colleges in South-East Nigeria need practical skill improvement in order to adequately expose students to drilling practices.

Also, the findings of the study showed that mechanical craft teachers and instructors in technical colleges in South-East Nigeria need practical skill improvement for teaching milling practice. This finding could be attributed to that fact that mechanical craft teachers and instructors in technical colleges in South-East Nigeria need to keep abreast of modern milling skills for effective teaching of milling practices. The study reported that mechanical craft teachers and instructors in technical colleges in South-East Nigeria needed practical skill

improvement in the ability to use milling machine vice, use dividing head, gear cutting, mill helix, clamp directly on the table and carry out repairs on milling machine among others. This finding is consistent with Ede and Ariyo (2015) who reported that mechanical craft teachers and instructors need skill improvement in the use of computer numerically controlled milling machines. The fact that mechanical craft teachers and instructors in technical colleges in South-East Nigeria need practical skill improvement for teaching milling practice means that mechanical craft teachers and instructors are not competent in teaching the two principal milling operations (slab milling and face milling) to students in technical colleges.

Additionally, the study disclosed that there was no significant difference between the mean responses of mechanical craft teachers and instructors on practical skill improvement needs for teaching milling practice in technical colleges South East, Nigeria. This finding means that mechanical craft teachers and instructors in technical colleges in South-East Nigeria collectively agree that they needed practical skill improvement for teaching milling practice. The findings corroborate the findings of Bassey and Saue (2021) who reported no significant difference between the mean responses of mechanical craft teachers and instructors on milling skills needs of mechanical engineering craft practice teachers for sustainable livelihood. The researchers are of the opinion that mechanical craft teachers and instructors in technical colleges in South-East Nigeria collectively agree that they needed practical skill improvement for teaching milling practice because milling is one of the flexible machining operations in a machine shop that is capable of cutting, rabbeting, routing and die-sinking metals.

Conclusion

From the findings of this study, it is concluded that mechanical craft teachers and instructors in technical colleges in South-East Nigeria need practical skills improvement in drilling and milling practices in order to adequately prepare students to start their engineering venture upon graduation.

Recommendations

Based on the findings of the study, the following recommendations are made.

1. Mechanical craft teachers and instructors should attend workshops/seminars regularly to keep abreast with current happenings in drilling and milling practices in order to adequately prepare their students for effective performance in machine shops
2. Administrators of technical colleges in South-East Nigeria ensure a progressive training and retraining of mechanical craft teachers and instructors in line with the areas of skill deficiencies of drilling and milling practices to equip them with professional and technical skills for effective teaching of drilling and milling practices

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