Competency Needs of Metalwork Technology Teachers for Effective Teaching in Technical Vocational Education and Training (TVET) Institutions in Nigeria

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Abstract

This study was designed to determine competency needs of metalwork technology teachers for effective teaching in Technical Vocational Education and Training (TVET) Institutions in Nigeria. Three research questions were developed and 3 null hypotheses were formulated and tested at the probability of 0.05 level of significance. Structured questionnaire was developed and used for data collection while 3 experts were engaged to face-validate the instrument. The instrument was pilot tested on 12 respondents who are not part of the population for the study and the reliability coefficient of the entire instrument was 0.80. A survey design was adopted and the respondents for the study were 120 made up of 100 Metalwork Technology Teachers and 20 Metalwork administrators. The findings of the study revealed among others that metalwork teachers needs competency in: Setting up job on the lathe using digital electronic comparator, machining jobs using dividing heads/indexing plates, using welding techniques like Tungsten Inhert Gas (TIG)/Metal Inhert Gas (MIG); Applying principles of triangulation in pattern development; perform melt treatment operations like desulphurization and alloy inoculation. It was recommended that specific areas of competency needs identified should be worked upon through capacity building in order to effectively teach metalwork technology in Technical Vocational Education and Training Institutions in Nigeria.

Keywords: *Competency, Metalwork teachers, Teaching, Technical colleges, Technology*

Introduction

The Federal Government of Nigeria being aware of the need for business/technology based environment among the Nigerian citizenry designed the national policy on education to ensure that, vocational and technical education, at sub-professional level must include the acquisition of appropriate skills and the development of mental, physical and social abilities, and competencies as equipment for the individual to live in and contribute to the development of his society [Federal Republic of Nigeria (FRN), 2004].

The main goals of vocational and technical education as stated in the Nigerian National Policy on Education (2004: 30) are to: "provide trained manpower in the applied sciences, technology and business particularly at craft, advanced craft and technical levels; provide the technical knowledge and vocational skills necessary for agricultural, commercial and economic development; give training and impart the necessary skills to individuals who shall be self-reliant economically". This therefore led to the establishment of various vocational and technical schools in all states across the country, in order to achieve these goals.

The Policy further maintained that the range of courses in the technical colleges shall be as wide as possible and include but not limited to mechanical trades, computer craft practice, electrical craft practice, electrical engineering trades, building trades, wood trades among others. Technical colleges in Nigeria therefore offer courses in various trades leading to the award of National Technical Certificates (NTC). According to Okorie (2001) technical colleges in Nigeria are established to prepare individuals to acquire practical skills and basic scientific knowledge within the confinement of a technical institution or industrial technical education unit. National Board for Technical Education (NBTE), (2004) however maintained that technical colleges in Nigeria are established to produce craftsmen at the craft level and technicians at the advanced craft 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, 2001). At the technical colleges, metalwork comprises of other sub-modular trade components such as machine shop practice, welding and fabrication, forging, heat treatment and foundry practices. Oranu, Nwoke and Ogwo (2002) explained that metalwork involves activities in occupations that entail designing, processing and fabrication of metal products; it includes activities in foundry,

forging, machine shop and welding. Ede and Ariyo (2014) emphasized that considering the various importance of metalwork to everyday life and also the overall objective of vocational and technical education (in which metalwork is one) which offers training in skill for self-reliance, self-sufficiency and employment into the world of work, metalwork becomes an important subject to be taught to students. Teachers of metalwork technology therefore need to be competent in all areas of concern to metalwork occupation.

Competency according to Olaifan (2003) is the knowledge, skill, attitudes and judgment which one required in order to perform successfully at a specified proficiency programme. Competency has been seen as ability to do something well, measured against a standard especially ability acquired through experience or training. In the context of this study, competency is knowledge, skills and attitude required of metalwork technology teacher for effective teaching in technical vocational education and training institutions in Nigeria. A metal work technology teacher must possess the requisite qualification of both the manipulative skills and other theoretical knowledge for him to carry out his duties effectively. This is because metal work by its nature requires the establishment of uniformity of technical procedures, administrative procedures, working conditions, tools, equipment, work place arrangement, operation and motion sequences, materials (consumables), quality requirements and similar factors which may affect the performance of the work (Yakubu, 2014).

Several studies (Sowande, 2002; Yakubu, 2014; Ede & Ariyo, 2014) revealed that Metalwork students upon graduation from technical colleges are presently finding it hard to perform effectively in the skill areas particularly in using modern equipment's like the computer numerical control (CNC) machines, advanced welding techniques among others. This may be due to several reasons which may include use of old and obsolete equipment, teacher's

competency, students study habit among others. To effectively train students in the use of modern machines and equipment, the metalwork teachers themselves must possess the relevant technical skills which are different from the conventional technical skills already possessed. It is against this background that this study sought to determine the competency needs of metalwork technology teachers for effective teaching in technical vocational education and training institutions in Nigeria.

Research Questions

The following research questions were formulated to guide the study;

1. What are the competency needs of metalwork teachers in machining process?
2. What are the competency needs of metalwork teachers in welding and fabrication process?
3. What are the competency needs of metalwork teachers in Foundry process?

Hypotheses

The following hypotheses were formulated to guide the study and were tested at 0.05 level of confidence:

Ho_1: There is no significant difference between the mean responses of metalwork administrators and metalwork technology teachers on the competency needs of metalwork teachers in machining process.

Ho_2: There is no significant difference between the mean responses of metalwork administrators and metalwork technology teachers on the competency needs of metalwork teachers in welding and fabrication process

Ho_3: There is no significant difference between the mean responses of metalwork administrators and metalwork technology teachers on the competency needs of metalwork teachers in foundry process

Methodology

The design for the study was a survey research design. The study was carried out in the six (6) technical colleges in Niger State. The total population for this study was twenty (20) administrators (Principals, Vice Principals & Heads of Departments) and one hundred (100) metalwork technology teachers in Government Technical Colleges in Minna, Bida, New Bussa, Kontagora, Suleja and Pandogari. The entire population for the study totaled one hundred and twenty (120) respondents was not too large, the researchers decided to use all, and therefore no sampling was carried out. Forty five (45) item structured questionnaire rated on 4-point scale of Highly Needed (4), Moderately Needed (3), Needed (2) and Not Needed (1) was used to collect the necessary data for the study. Section "A" addressed the bio data of the respondents, section "B" dealt with items that addressed the competency needs of metalwork teachers in machining processes, section "C" addressed the competency needs of metalwork teachers in welding and fabrication processes and section "D" addressed the competency needs of metalwork teachers in foundry processes. The items were subjected to face validation by three experts from department of Industrial and Technology Education, Federal University of Technology, Minna-Nigeria. To establish the reliability of the instrument, a pilot test was conducted using four (4) metalwork administrators and eight (8) metalwork teachers. These sets of respondents were not involved in the main study. Cronbach alpha was used to compute the reliability coefficient and it gave a value of 0.80 which is an indication that the instrument was reliable. The research questions were analyzed using mean and standard deviation, while the hypotheses were analyzed using t – test. In deciding the acceptance level for the research questions, a criterion mean of 2.50 (mid of 4 point scale) was chosen. Therefore, any item that has a mean of 2.50 and above was considered needed while items whose mean falls below 2.50 were considered not needed. For testing the

hypothesis the value of the calculated t – test was compared with t-critical (t-table value) and null hypotheses was accepted where the value of t - calculated was less than t – critical, otherwise the null hypothesis was rejected. Table value of t was 1.98 at $P < 0.05$.

Research Question 1

What are the competency needs of metalwork teachers in machining process?

Tabie 1

Mean Responses of Administrators and Metalwork teachers on the competency needs of metalwork teachers in machining process

S/No	*ITEMS*	M_1	SD_1	M_2	SD_2	*Remark*
1	Set the proper cutting speeds and feeds on the machine tools	2.42	1.00	2.39	0.81	Not Needed
2	Set up job on the lathe using digital electronic comparator	3.45	0.99	3.56	0.88	Needed
3	Perform alignment test for different machine	3.22	0.90	2.94	0.93	Needed
4	Perform eccentric turning on the lathe	2.34	1.06	2.48	0.88	Not Needed
5	Mount steadies, jigs and fixtures on machines	2.47	0.97	2.10	0.95	Not Needed
6	Mount vertical head attachment to horizontal milling machine	3.88	0 99	3.68	0.74	Needed
7	machining jobs using dividing heads/indexing plates	3.54	0.96	3.12	0.81	Needed
8	Perform basic milling operations	2.05	0.94	2.15	0.74	Not Needed
9	Grind tapers set between centers on the universal grinder	3.96	1.06	3.42	0.90	Needed
10	Perform grinding operation using sensitive grinding machine	2.32	1.06	2.01	0.77	Not Needed
11	Perform basic drilling operations	1.54	1.09	2.04	0.89	Not Needed
12	Use of multi-spindle drilling machine for drilling operations	3.65	0.99	3.24	0.59	Needed
13	Prepare flat and plane surfaces on shaping machining	2.04	0.97	2.16	0.70	Not Needed
14	Cutting slots with shaping machine	1.16	0.93	2.09	0.73	Not Needed
15	Perform machining operations using horizontal/vertical boring machine	2.22	0.98	1.88	0.63	Not Needed
	Grand Average	**2.68**	**0.99**	**2.62**	**0.77**	

Key: M_1 = Mean Response of Administrators, M_2 = Mean Response of Teachers
SD_1 = Standard Deviation of Administrators, SD_2 = Standard Deviation of Teachers

Table 1 revealed that out of 15 items presented as competency needs of metalwork technology teachers in machining process, respondents maintained that teachers need competency in only 5 (items 2, 3, 6, 7 and 12). Teachers were adjudged competent in the remaining items with mean

scores less than criterion mean of 2.50. The table also revealed that standard deviation (SD) ranges from 0.74 to 1.09 for the two categories of respondents indicating they were not too far from the mean and each other.

Research Question 2

What are the competency needs of metalwork teachers in welding and fabrication process?

Table 2

Mean Responses of Administrators and Metalwork teachers on the competency needs of metalwork teachers in welding and Fabrication process

S/No	*ITEMS*	M_1	SD_1	M_2	SD_2	*Remark*
16	Bending sheet metals into various shapes using power folding machine	3.98	0.59	3.40	0.62	Needed
17	Perform leftward or rightward welding operation	1.89	0.67	2.03	0.59	Not Needed
18	Adjust the voltage or light up the torch and adjust for appropriate flame	1.98	0.64	2.06	0.49	Not Needed
19	using welding techniques like Tungsten Inert Gas (TIG)/Metal Inert Gas (MIG)	3.58	0.72	3.86	0.58	Needed
20	Setting up the welding equipment	1.06	0.77	2.12	0.55	Not Needed
21	Applying principles of triangulation in pattern development	3.33	0.63	3.46	0.58	Needed
22	Clean the weld surface before each fresh run is made	2.00	0.66	1.92	0.60	Not Needed
23	Select welding electrode rod or welding filler rod	0.98	0.72	1.04	0.68	Not Needed
24	Perform basic welding using manual metal arc welding process (MMAW)	2.45	0.66	2.07	0.60	Not Needed
25	Perform basic welding using oxy-acetylene welding process	2.34	0.70	2.11	0.56	Not Needed
26	Undertake fabrication, forming, bending and shaping	1.42	0.66	2.08	0.58	Not Needed
27	Perform advanced welding using oxyacetylene welding process (OAW)	3.96	0.61	2.99	0.47	Needed
28	Select appropriate material for fabrication purposes	3.10	0.67	3.46	0.52	Needed
29	Use of power guillotine to cut various thickness of metals	3.75	0.81	3.02	0.74	Needed
30	Preparing self secured joints in metal fabrication	2.74	0.88	3.12	0.81	Needed
	Grand Average	**2.57**	**0.69**	**2.58**	**0.52**	

Table 2 revealed that teachers need competency in items 16, 19, 21, 27, 28, 29 and 30 while they possessed competency in the other items. Standard deviation (SD) ranges from 0.47 to 0.88 for the respondents, this also showed that there was less dispersion from the mean and from one another in their responses.

Research Question 3

What are the competency needs of metalwork teachers in Foundry process?

Table 3

Mean Responses of Administrators and Metalwork teachers on the competency needs of metalwork teachers in Foundry process

S/No	*ITEMS*	M_1	SD_1	M_2	SD_2	*Remark*
31	Dress moulds and cores using wet and dry methods	2.50	0.52	3.20	0.49	Needed
32	Removing the casted metal object from the mould	2.13	0.49	2.41	0.57	Not Needed
33	perform melt treatment operations like desulphurization and alloy inoculation	3.88	0.59	3.92	0.54	Needed
34	Pouring the molten metal into the mould	2.22	0.48	1.46	0.52	Not Needed
35	Preparing the mould for casting	2.09	0.55	1.82	0.67	Not Needed
36	Extruding heated metal through a die or wedge block	2.90	0.48	3.72	0.53	Needed
37	Making casting patterns with sand, wood, plastic or metal	3.40	0.60	3.62	0.56	Needed
38	Assemble and maintaining patterns for foundry work	2.04	0.58	2.48	0.62	Not Needed
39	Ability to provide appropriate gating for mould	2.03	0.50	2.24	0.56	Not Needed
40	Sand preparation and mixing	2.44	0.46	2.11	0.60	Not Needed
41	Casting simple machine component	2.36	0.58	1.98	0.56	Not Needed
42	Maintaining all foundry tools	2.35	0.47	2.10	0.51	Not Needed
43	Melting and pouring metals in mould	3.04	0.42	2.52	0.57	Needed
44	Understanding of the definition of parameters used in casting activities	2.46	0.60	2.25	0.64	Not Needed
45	Knowledge of safety precaution during casting process	2.02	0.56	1.68	0.54	Not Needed
	Grand Average	**2.52**	**0.53**	**2.50**	**0.49**	

Table 3 showed that teachers are competent in most of the skill areas in foundry process; they only needed competency in items 31, 33, 36, and 37 with the criterion mean ranging from 2.50 to 3.72 for two categories of respondents. A grand average showed a standard deviation (SD) of 0.49 and 0.53 indicating that respondents were not too far from the mean and from one another in their responses.

Hypothesis One

There is no significant difference between the mean responses of metalwork administrators and metalwork technology teachers on the competency needs of metalwork teachers in machining process

Table 4

t-test analysis on the competency needs of metalwork teachers in machining process

Respondents	*N*	*Mean*	*SD*	*df*	t_{cal}	t_{tab}
Administrators	20	2.68	0.99	118	0.26	±1.98
Teachers	100	2.62	0.77			

Key: ***N*** *= Number of Respondents,* ***SD*** *= Standard Deviation,* ***df*** *= Degree of freedom,* t_{cal} *= t-test calculated,* t_{tab} *= t-test table value*

Hypothesis Two

There is no significant difference between the mean responses of metalwork administrators and metalwork technology teachers on the competency needs of metalwork teachers in welding and fabrication process

Table 5

t-test analysis on the competency needs of metalwork teachers in welding and fabrication process

Respondents	*N*	*Mean*	*SD*	*df*	t_{cal}	t_{tab}
Administrators	20	2.57	0.69	118	- 0.06	±1.98
Teachers	100	2.58	0.52			

Hypothesis Three

There is no significant difference between the mean responses of metalwork administrators and metalwork technology teachers on the competency needs of metalwork teachers in foundry process

Table 6

t-test analysis on the competency needs of metalwork teachers in Foundry process

Respondents	*N*	*Mean*	*SD*	*df*	t_{cal}	t_{tab}
Administrators	20	2.52	0.53			
Teachers	100	2.50	0.49	118	0.16	±1.98

Tables 4, 5 and 6 revealed that t-calculated were less than their t-table values. These indicated that there is no significant difference in the mean responses of metalwork administrators and metalwork teachers on competency needs of metalwork teachers in machining process, welding and fabrication process and foundry process. The null hypotheses were therefore accepted for the three hypotheses.

Discussion

findings of this study on the competency needs of metalwork teachers in machining process revealed that metalwork teachers need competency on Setting up job on the lathe using digital electronic comparator, Mounting vertical head attachment to horizontal milling machine, machining jobs using dividing heads/indexing plates, Grind tapers set between centers on the universal grinder among others. This was a unanimous decision of respondents as Ho1 was not rejected at 0.05 level of significance (Table 4). This is in agreement with work of Miller (2006) who found out that, teachers of metalwork needed improvement in technological skills for teaching metalwork effectively in colleges of education. Likewise Olaitan and Hassan (2010) maintained that metalwork teachers require skills in carrying out machine shop practices. In the same vein,

Sowande (2002) emphasized that technological skill competence is required by metalwork teachers in the use of machine tools.

Findings of the study on competency needs of metalwork teachers in welding and Fabrication process revealed that metalwork teachers need competency in using welding techniques like Tungsten Inert Gas (TIG)/Metal Inert Gas (MIG), Performing advanced welding using oxyacetylene welding process (OAW), Selecting appropriate material for fabrication purposes. These findings have serious implications if TVET institutions must live to satisfy the purpose for which they were established. This is in agreement with Okoro (1993) who emphasized that technical competency is an important factor for effective teaching of vocational education. The null hypotheses (Table 5) further attest to this as the two groups of respondents unanimously accept the Ho_2 at 0.05 level of significance.

Findings on the competency needs of metalwork teachers in foundry process revealed that metalwork teachers possessed majority of the foundry skills. However, competency were required in Dressing moulds and cores using wet and dry methods, performing melt treatment operations like desulphurization and alloy inoculation, Extruding heated metal through a die or wedge block and Making casting patterns with sand, wood, plastic or metal. These skills are relevant for effective teaching of metalwork in TVET institutions in Nigeria. This is why Obeng, Adjaloo, and Amrago (2013) maintained that training to the level of full-competency is needed for all the skills considered important for future endeavours. Attesting to this fact is Green (1954) in Sowande (2002) who emphasized that a comprehensive knowledge of the competencies in metalwork is essential for teachers of metalwork in higher education. The work explained that a competent metal work teacher must be skilled in the selection of appropriate materials, in

guiding the students to carry out successful projects and using the selected materials through a planned practical activity.

Conclusion

In conclusion, the findings of this study revealed that metalwork teachers needs competency in some aspects of machining process like setting up jobs on lathe using digital electronic comparator in order to be able to teach effectively in TVET Institutions. The study revealed that metalwork teachers needs competency in using modern welding techniques like Tungsten Inert Gas (TIG)/Metal Inert Gas (MIG) in welding and fabrication process. Some foundry process competencies like performing melt treatment operations like desulphurization and alloy inoculation were identified as competency needs of metalwork technology teachers to be able to teach effectively in TVET Institutions in Nigeria.

Recommendations

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

1. All the specific areas of competency needs identified should be worked upon through capacity building workshop/seminars for metalwork teachers.
2. In house training should be organized to teach metal work teachers how to setup jobs on the lathe using digital electronic comparators and machining jobs using dividing heads/indexing plates.
3. Collaborations between industries and TVET Institutions should be sought in order to engage metalwork teachers in the use of welding techniques like Tungsten Inert Gas (TIG)/Metal Inert Gas (MIG) which are visible school workshops.

4. Metalwork teachers should be exposed to AUTO-CAD activities in order to be able to apply it in principles of triangulation in pattern development.

5. Government should supply modern foundry process equipment to TVET Institutions in order to be able to perform melt treatment operations like desulphurization and alloy inoculation.

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