Capacity Building Needs for Computer Numerical Control Machines Teachers' Effectiveness in Technical Colleges in Delta State.

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ABSTRACT

The purpose of this study was to determine the capacity building needs of teachers of Computer Numerical Control Machines for effective teaching in College of Education (Technical) in Delta State. Descriptive survey research design was adopted for the study. Two research questions guided the study, while one null hypothesis was formulated and tested at 0.05 level of significance. The population of the study is 102 respondents consisting of 20 teachers of computer numerical control machines in college of education (technical) and 82 students. The instrument for data collection was a 35-item structured. The instrument was face validated by three experts. The internal consistency of the questionnaire was determined using Cronbach Alpha method and coefficient of 0.82 was obtained. Weighted mean and Improvement Need Index (INI) were used to answer the research questions while t-test was used to test the null hypothesis. The findings of the study revealed that all the 35 competencies in computer programming and machine set-up for smooth operation and effective teaching were accepted. The findings on hypotheses revealed that there was no significant difference in the mean ratings of the two groups of respondents on the competencies needed by teachers and students of computer numerical control machines in computer programming, machine set-up, threading of pipes, etc. for effective teaching in college of education (technical) in Delta State. It was therefore, recommended that the findings of this study be utilized to develop capacity building programmes for instructors of CNC machines in college of education (technical) in the area of study.

Keywords: Capacity building, needs, computer, numerical control.

INTRODUCTION

Capacity building is the act of training individuals and organizations to obtain, improve, and retain the skills, attitudes and knowledge required to perform a job without mistake Chukwuma and Okwelle (2021). It is also a preparatory stage of equipping an individual as in knowing and understanding what to do at the moment of performing task practically in order to be self-confident. Olaitan and Hassan (2010) opined that capacity building is the process of developing and strengthening the skills, instincts, abilities, processes and resources that organizations and communities need to survive, adapt, and thrive in a fast-changing world. It is responsible for cultivating professionals who, can contribute to the establishment of internal capacity that will lead to comprehensive and sustainable development for the communities, and also in reaction to the needs of communities in developing countries. According to Procter (in Olaitan & Hassan, 2010), need is a condition of lacking or wanting something necessary. It is clearly stated that whenever a particular skill is to be developed or improved someone should be safety conscious to avoid accident and ascertain one's state of mind towards the programme. To be successful in the 21st century industrial shop, one need a broad skill set

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composed of:

- **Cognitive skills**: encompasses the ability to understand complex ideas, adapt effectively to the environment, learn from experience, and reason. Foundational literacy and numeracy as well as creativity, critical thinking, and problem-solving skills.
- **Socio-emotional skills**: describes the ability to navigate interpersonal and social situations effectively, and include leadership, teamwork, self-control, and grit.
- **Technical skills**: refers to the acquired knowledge, expertise, and interactions needed to perform a specific task, including the mastery of required materials, tools, or technologies.
- **Digital skills**: are cross-cutting and draw on all of the above skills, and describe the ability to access, manage, understand, integrate, communicate, evaluate, and create information safely and appropriately.

New ideas are earnestly inculcated to the learner by the teachers, who is in charge of the skills development. They undergone a teacher preparatory programme and charged with the responsibility of managing learning behaviour of the students (Olaitan, Alaribe and Nwobu 2009). In the context of this study, a teacher is someone who has been trained technically, professionally and is capable of imparting knowledge, skills and attitudes in his subject area to the students in line with pedagogy.

Pedagogy is the arts of helping people to learn. It is also the art and science of teaching. Nwana (2008), defined teaching as a formal educational situation in which deliberate efforts is made by a teacher to convey to students predetermined knowledge, skills and attitudes aimed at changing the behaviour of students positively. Teaching, in the view of Dayilemi (2008), is the process of imparting knowledge, skills and giving instruction to students. Effective teaching, according to Lawal (2011), is a process where a teacher imparts knowledge, skills and attitudes to student by using correct methodology, techniques, and instructional materials to enhance teaching-learning process. Efficiency and competency is highly required in teaching and learning process.

Competency, according to Osinen and Nwoji (2010), is the individual ability to use, apply and demonstrate a group of related awareness, knowledge, skills and attitudes in order to perform tasks and duties successfully and which can be measured against well accepted standard required in employment as well as assessed against provided evidence at work location. From the authors cited above and with reference to the study, capacity building need is a required effort towards strengthening the competencies of teachers of Computer Numerical Control Machine for the purpose of improving their proficiency. In other to ensure effective capacity building, there is need to identify the competencies needed in Computer Numerical Control machines and then determine the gap. Therefore, this study will deal with the competencies required in Computer Numerical Control machines and also identify the areas the teachers are deficient and to be improved.

According to David (2021), Computer Numerical Control (CNC) is a method for automating control of machine tools through the use of software embedded in a microcomputer attached to the tool. It is commonly used in manufacturing, for machining metal and plastic parts. With CNC, each object to be manufactured gets a custom computer program, usually written in an international standard language called G-code, stored in and executed by the machine control unit (MCU), a microcomputer attached to the machine. The program contains the instructions and parameters the machine tool will follow, such as the feed rate of materials and the positioning and speed of the tool's components. Mills, lathes, grinders and lasers are common machine tools whose operations can be automated with CNC.

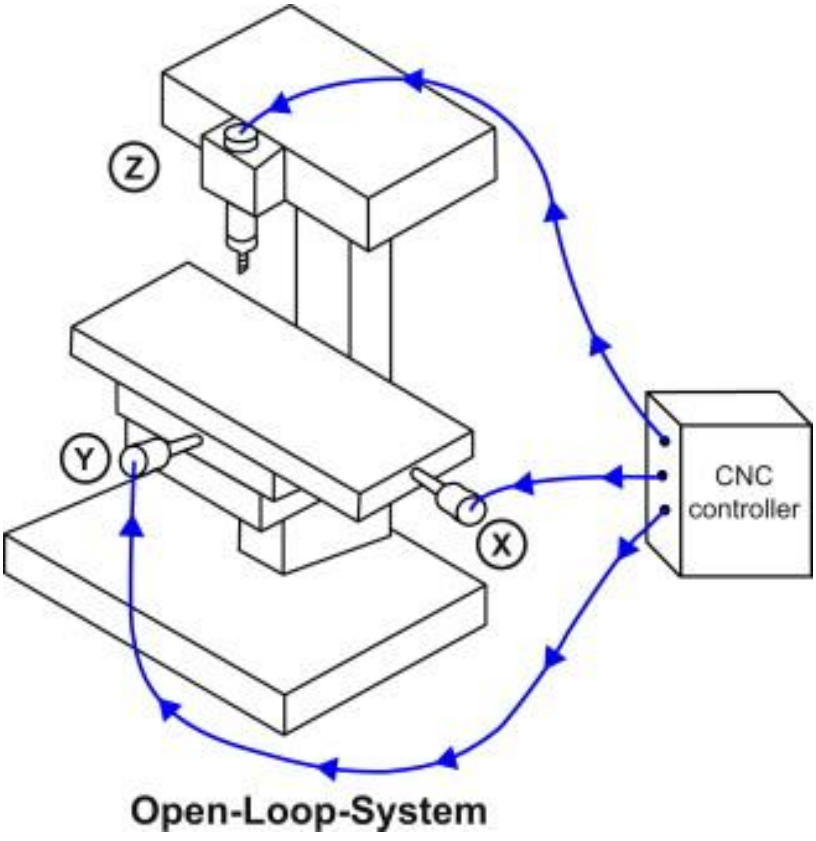
Early in the process, engineers create a computer-aided design (CAD) drawing of the part to be manufactured, then translate the drawing into G-code. The program is loaded onto the machine control unit (MCU) and a human operator performs a test run without the raw material in place, to ensure proper

positioning and performance. This step is important because incorrect speed or positioning can damage both the machine and the part. A CNC system requires motor electric drives to control both the position and the velocity of machine axes. Each axis must be driven separately, and must follow the command signal generated by the numerical control. There are two ways to activate the servo drives; the open-loop system and the closed-loop system.

Open-loop CNC system

In an open-loop CNC system, programmed instructions are fed into the controller through an input device. These instructions are then converted to electrical signals by the controller and sent to the servo amplifier to drive the servo motors. The cumulative number of electrical pulses determines the distance each servo drive will move, and the signal frequency determines the velocity of movement. The primary characteristic of the open-loop system is that there is no feedback system to check whether the desired position and velocity has been achieved. If system performance has been affected by load, temperature, humidity, or lubrication, then the actual output could deviate from that desired. For these reasons, the open-loop CNC system is generally used in point-to-point systems where accuracy is not critical. Very few, if any, continuous-path systems utilize open-loop control.

Figure 1. Below shows the control mechanism of an open-loop CNC system.

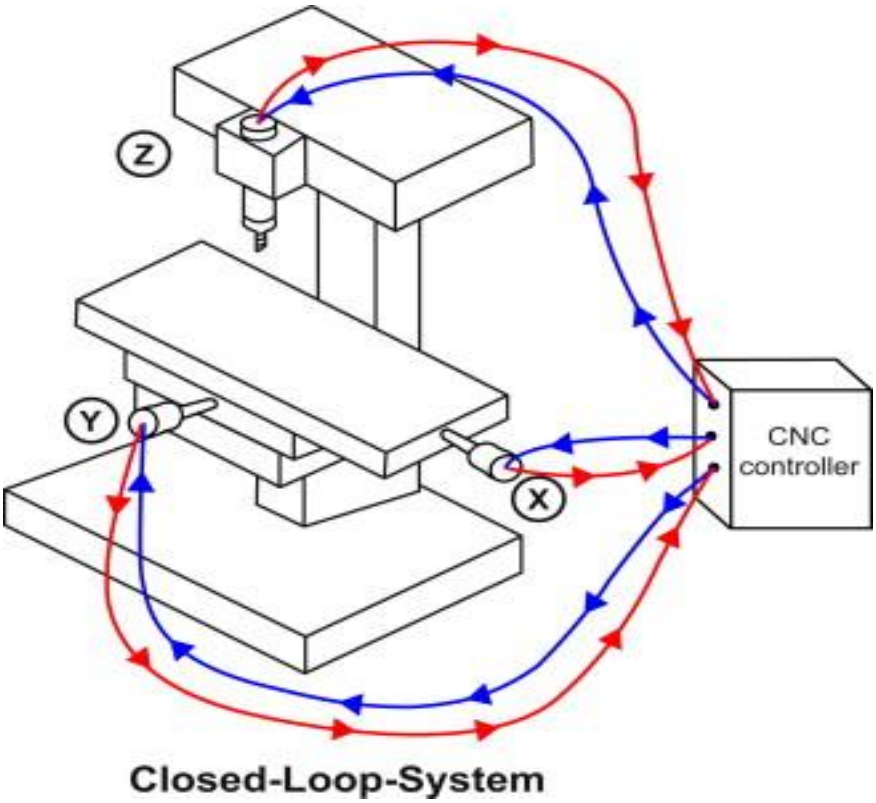


Closed-loop CNC system

The closed-loop CNC system has a feedback subsystem to monitor the actual output and correct any discrepancy from the programmed input. This can be either analog or digital. Analog systems measure the variation of physical variables, such as position and velocity, as voltages. Digital systems monitor output variations by means of electrical pulses. Closed-loop systems are very powerful and accurate because they are capable of monitoring operating conditions through feedback subsystems and can compensate for any variations automatically in real time. Most modern closed-loop CNC systems are able to provide very close

resolution of 0.0001 of an inch. Closed-looped systems would, naturally, require more control devices and circuitry in order to implement both position and velocity control. This makes them more complex and more expensive than open-loop systems.

A closed-loop CNC system is shown in Figure 2.



Closed-Loop-System

UNESCO as in (Chukwuma and Okwelle, 2021) defined Vocational Technical Education as those aspects of educational process, in addition to general education, the study of technologies and related sciences and the acquisitions of the economy and social life. Vocational and technical education according to Okorocha (2012) is an educational training which encompasses knowledge, skills, competencies, structure activities, abilities, capacities and all other structural experiences for securing jobs in various sector of the economy or even enabling individual to be self-dependent by being a job creator.

Vocational and technical education according to International Labour Organization as in (Oluwale Jegede Olamade, 2013) is a vehicle for the development of marketable and entrepreneurial skills and engine of development. Dokubo (2013) summed it all stressing that skill is a major distinguishing aspect of vocational education which makes it outstanding from liberal arts. In summary, vocational and technical education essentially develops in the individual, the knowledge, skills and desirable attitude for legitimate work. Vocational education at Colleges of Education (technical) serves as a preparative programme for an innovative technical or professional occupations.

Colleges of Education (Technical) train students in Computer Numerical Control either in Programming or Robotic as a trade NBTE, (2020). Computer Numerical Control machine operation is designed to expose trainees/students to the activities of programming, milling, cutting, threading, assembling materials, among others. National Board for Technical Education (NBTE) 2020, further listed the following trade components of Computer Numerical Control machine;

- Threading
- Machine set-up

- Computer Programming
- Milling
- Grinding

The most important components of Computer Numerical Control lathe operation are threading and programming, the program is majorly used in controlling the lathe machine during operation. A CNC machine operators, manage computer numeric controlled (CNC) equipment from setup to operation, producing parts and tools from different resources including metal and plastic. They're tasked with monitoring machinery, inspecting finished products, and leading test runs.From the authors cited above and with reference to the study, capacity building need is a required effort towards strengthening the competencies of instructors of computer numerical control for the purpose of improving their proficiency in imparting skills to students. In other to ensure effective capacity building, there is need to identify the competencies needed in computer numerical control machine operation and then, determine the gap. This study will focus on machine set-up, threading, and computer programming as the competencies required by instructors of computer numerical control machine as the areas needed for improvement.

Statement of the Problem

College of Education (technical) instructors are expected to be acquainted with computer numerical control machines to enable them demonstrate certain skills like, computer programming, threading, and technical thinking, machine set-up, among others as to enhance their proficiency. Okoro as (in Hassan, 2015), confirmed that the products of College of Education (Technical) are unable to take up the available jobs due to inadequate practical skills. Similarly, College of Education (Technical) graduates does not have the skills needed for computer programming, machine setup, and threading of pipes or plastics in CNC machines. Ogbuanya, Bakare and Igweh (2009), confirmed that, most of the graduates acquire little or no practical skills and find it difficult to set up their own workshop. There is no exception of this statement that, graduates of College of Education (Technical) who studied computer numerical control machines cannot perform computer programming, set-up machine and threading of pipes due to inadequate practical skills in CNC Machines.

Ogbuanya, Bakare and Igweh (2009), stated that the College of education (technical) instructors lack the necessary CNC skills that they can impart to the students. Hence the need for upgrade and capacity building which will make graduates to be self-reliant or employed in the industries, and will also translate to the students becoming self-reliance upon graduation to fulfill the objectives of Vocational and Technical Education.

Therefore, it has become necessary to identify the competencies needed by teachers of CNC Machines and determine their expected level of competencies and areas where the instructors are deficient and needs capacity building for effective teaching/training in college of Education (Technical) in Delta State.

Purpose of the Study

The purpose of the study is to determine the capacity building needs for teachers of computer numerical control machines for effective teaching in College of Education in Delta State. Specifically, the study sought to determine:

1. The computer programming skill needs for teachers of computer numerical control machines for effective teaching in College of education (Technical) in Delta State.
2. The machine set-up skill needs for teachers of computer numerical control machines for effective teaching in College of education (Technical) in Delta State.

Research Question

The following research questions were formulated to guide the study:

1. What are the computer programming skills needed by teachers of computer numerical control machines for effective teaching in College of education (Technical) in Delta State.?
2. What are the machine set-up skills needed by teachers of computer numerical control machines for effective teaching in College of education (Technical) in Delta?

Hypothesis

One hypothesis was formulated and tested at 0.05 level of significance.

H_{01}: There is no significant difference in the mean ratings of the responses of teachers and students of computer numerical control machines in College of Education (Technical) in Delta State.

METHODOLOGY

Descriptive survey research design was adopted for the study. A survey research design according to Nworgu (2015), is one in which a group of people or items is studied by collecting and analyzing data from only a few people or items considered to be representative of the entire group. The study was carried out in College of Education (Technical) Delta State. The area of study was chosen because of the teachers of CNC machine in college of education (Technical) Delta State are not competent enough to effectively deliver lectures on CNC skills. The population of the study is 102, comprising 20 teachers and 82 students of computer numerical control machines in College of Education (Technical) Delta State. The entire population as a census was used for the study, since it is of manageable size. No sampling was done because the number was small and manageable. Structured questionnaires were used for data collection in this study. The questionnaire items were developed from the related research questions. The instrument for data collection was a 24 items close-ended questionnaire titled 'Capacity Building Needs for Teachers of Computer Numerical Control CABUNIC)' designed on a 4-point rating scale of Highly Needed (HN) = 4, Moderately Needed (MN) = 3 Slightly Needed (SN) = 2, Not Needed (NN) = 1. The hundred and two (102) copies of the questionnaire were administered and a total of 98 copies were retrieved which represented 100% return rate. The instrument was content validated by three experts. The questionnaire was tried on 10% of the population in two different colleges of education. The croubach Alpha coefficient method was used to determine the internal consistency of the instrument which gave a coefficient of 0.80. The data collected from the respondents were analyzed using mean with standard deviation for answering the research questions. Any item with a mean value of 2.50 and above was accepted while mean value below 2.49 was rejected. The data were analyzed with Statistical Package for Social Sciences (SPSS) version 13.0KM. Standard deviation value close or wide apart was used to determine homogeneity in the perception of the respondents. The hypotheses were tested at 0.05 level of significance using t-test statistics. For calculated value of t (tcal) less than the critical value of t (tcrit), the hypothesis was accepted but for (tcal) equal to or greater t (tcrit), the hypothesis was rejected.

RESULTS

The results of the data collected for the study are stated below:

Research Question 1

What are the computer programming skills needed by teachers of computer numerical control machines for

effective teaching in College of education (Technical) in Delta State?

The data for answering research question 1 are in the Table 1.

Table 1: Mean Ratings of the Responses of computer programming skills needed by Teachers of CNC for effective teaching in College of Education (Technical) Delta State.

S/N	Item Statements	$\bar{X}$	SD	Remarks
1.	Select program based on the type of work to be done.	2.94	0.72	Needed
2.	Select suitable tools for the object to be produced.	2.91	0.71	Needed
3.	Extract, interpret and evaluate pattern of pipe threads.	2.92	0.69	Needed
4.	Interpret work drawing	3.04	0.67	Needed
5.	Make form-work.	3.03	0.67	Needed
6.	Cut, thread and trace work number.	3.00	0.63	Needed
7.	Calculate tool clearance.	3.18	0.70	Needed
8.	Select tool position	3.10	0.65	Needed
9.	Make set-up.	3.03	0.67	Needed
10.	Fixing of jaws	3.04	0.73	Needed
11.	Test run machine program	2.84	0.67	Needed
12.	Centralize work piece.	3.05	0.64	Needed
13.	Carry measurement on work piece	3.09	0.72	Needed
14.	Confirm jaws close and open condition	3.13	0.66	Needed
15.	Greasing of chuck	2.85	0.74	Needed
16.	Carry out repair of jaws	3.17	0.63	Needed
17.	Check oil lube tank.	2.93	0.71	Needed

Key:

$\bar{X}$ = Mean

SD = Standard deviation

The data presented in Table 1 revealed that the 17 competencies had their mean values ranged from 2.84 to 3.18. This showed that the mean value of each item was above the real limit of 1.50, indicating that all the 17 competencies were needed by teachers of computer numerical control machines for effective teaching in College of education (technical) in Delta States. The table also showed that the standard deviations (SD) of the items were within the range of 0.63 to 0.74, indicating that the respondents were not far from the mean or from one another in their responses computer programming skills needed by teachers of CNC machines for effective teaching in College of Education (Technical) in Delta States.

Research Question 2

What are the machine set-up sills needed by Teachers of computer numerical control for effective teaching in College of education (Technical) in Delta State?

The data for answering research question 2 are presented in the Table 2.

Table 2 Mean Ratings of the Responses of Teachers and Students of Computer Numerical Control Machines on effective teaching at Set-up Skills for Smooth operation.

N = 102 (20 Teachers + 82 Students)

S/N	Item statements	$\bar{X}$	SD	Remarks
1.	choose correct work piece	3.10	0.76	Needed
2.	Fix equipment correctly	3.16	0.69	Needed
3.	Note and regulate the required voltage	3.11	0.74	Needed
4.	Put ON the pneumatic line.	3.11	063	Needed
5.	Select jaw size	3.25	0.62	Needed
6.	Check slide-way lube flow.	2.97	0.76	Needed
7.	Load the required work program.	3.02	0.76	Needed
8.	Cross- check machine parameters.	2.77	0.72	Needed
9.	Hydraulic oil level check	2.96	0.63	Needed
10.	Mounting of tools.	3.02	0.70	Needed
11.	Use of die-indicator.	2.96	0.70	Needed
12.	use of filer gauge	2.95	0.70	Needed
13.	Grinding stone needed	3.06	0.66	Needed
14.	Use of measuring gauge.	3.08	0.66	Needed
15.	Setting of pipe-in sensors.	3.17	0.71	Needed
16.	Check coolant spray level.	3.00	0.68	Needed
17.	Put on Machine light.	3.18	0.64	Needed
18.	Put on blower fan.	3.14	0.66	Needed

Key:

$\bar{X}$ = Mean

SD = Standard deviation

The data presented in Table 2 revealed that the 18 competencies had their mean values ranged from 2.77 to 3.25. This showed that the mean value of each item was above the real limit of 2.50, indicating that all the 18 competencies were needed by teachers of CNC Machines for effective teaching in College of education (Technical) in Delta State. The table also showed that the standard deviations (SD) of the items were within the range of 0.62 to 0.76, indicating that the respondents were not far from the mean or from one another in their responses on machine set-up competencies needed by Teachers of CNC Machines for effective teaching in College of education (Technical) in Delta State.

Testing of Hypotheses

Hypothesis 1

There is no significant difference in the mean ratings of the responses of teachers and students of computer numerical control machines on the skills needed for effective teaching.

Data for this hypothesis are presented in table 3.

Table 3: The t-test Analysis of the Mean ratings of the Responses of the Respondents on computer programming skills needed by Teachers of CNC for effective teaching in College of Education (Technical) Delta State.

N = 102 (20 Teachers + 82 Students)

S/N	Item Statements	$\bar{X}$	SD	Remarks
19.	Select program based on the type of work to be done.	2.94	0.72	Needed
20.	Select suitable tools for the object to be produced.	2.91	0.71	Needed
21.	Extract, interpret and evaluate pattern of pipe threads.	2.92	0.69	Needed
22.	Interpret work drawing	3.04	0.67	Needed
23.	Make form-work.	3.03	0.67	Needed
24.	Cut, thread and trace work number.	3.00	0.63	Needed
25.	Calculate tool clearance.	3.18	0.70	Needed
26.	Select tool position	3.10	0.65	Needed
27.	Make set-up.	3.03	0.67	Needed
28.	Fixing of jaws	3.04	0.73	Needed
29.	Test run machine program	2.84	0.67	Needed
30.	Centralize work piece.	3.05	0.64	Needed
31.	Carry measurement on work piece	3.09	0.72	Needed
32.	Confirm jaws close and open condition	3.13	0.66	Needed
33.	Greasing of chuck	2.85	0.74	Needed
34.	Carry out repair of jaws	3.17	0.63	Needed
35.	Check oil lube tank.	2.93	0.71	Needed

Key:

SD_1^2 = Variance of Teachers of Computer Numerical Control Machines

SD_2^2 = Variance of Students of Computer Numerical Control Machines

$\overline{X_1}$ = Mean of Teachers of Computer Numerical Control Machines

$\overline{X_2}$ = Mean of Students of Computer Numerical Control Machines

df = 100

t-tab = 1.96

S = Significant

NS = Not Significant

The data presented in Table 3 revealed that the 17 CNC competencies had their calculated t-values ranged from -2.78 to 1.72 which are less than t- table value of 1.96 (two tailed test) at 0.05 level of significance and 100 degree of freedom. This indicated that there was no significant difference in the mean ratings of the responses of the teachers of computer numerical control machines and students on skills needed for machine computer programming for effective teaching in College of Education (Technical) in Delta State. Therefore, the null hypothesis of no significant difference in the mean ratings of the responses of the teachers and

students of CNC on the machine computer programming skills required was upheld.

DISCUSSION OF FINDINGS

The data presented in Table 1 revealed that the 17 competencies had their mean values ranged from 2.84 to 3.18. This showed that the mean value of each item was above the real limit of 1.50, indicating that all the 17 competencies were needed by teachers of computer numerical control machines for effective teaching in College of education (technical) in Delta State. The table also showed that the standard deviations (SD) of the items were within the range of 0.63 to 0.74, indicating that the respondents were not far from the mean or from one another in their responses computer programming skills needed by teachers of CNC machines for effective teaching in College of Education (Technical) in Delta State. These findings are in agreement with Dokubo (2013) who opined that capacity building need is a required effort towards strengthening the competencies of teachers of computer numerical control for the purpose of improving their proficiency in imparting skills to students.

The data presented in Table 2 revealed that the 18 competencies had their mean values ranged from 2.77 to 3.25. This showed that the mean value of each item was above the real limit of 2.50, indicating that all the 18 competencies were needed by teachers of CNC Machines for effective teaching in College of education (Technical) in Delta State. The table also showed that the standard deviations (SD) of the items were within the range of 0.62 to 0.76, indicating that the respondents were not far from the mean or from one another in their responses on machine set-up competencies needed by teachers of CNC Machines for effective teaching in College of education (Technical) in Delta State. The finding is in line with the opinion of Ogbuanya, Bakare and Igweh (2009) who stated that the College of education (technical) teachers lack the necessary CNC skills that they can impart to the students, hence the need for upgrade and capacity building of the teachers in the area of machine set-up skills and computer programming skills will which translate to the students becoming self-reliance upon graduation to fulfill the objectives of Vocational and Technical Education.

CONCLUSION

The purpose of this study was to determine the capacity building needs for teachers of computer numerical control machines for effective teaching in College of Education (Technical) in Delta States. It was found out from the study that all the competencies identified in machine computer programming, machine set-up, were needed by teachers and students of computer numerical control machines for effective teaching in College of Education (technical) in Delta State. The study also found out that teachers and students of computer numerical control machines need capacity building in the areas of computer programming, machine set-up and threading of pipes and pedagogy for effective teaching in college of education (technical) in the area of study. This, in effect, will help to improve the quality of their graduates in terms of practical skills.

RECOMMENDATIONS

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

1. The government should employ instructors of computer numerical control machines who are competent to teach in college of education (technical) in the area of study.
2. Teachers of computer numerical control machines should from time to time identify their areas of strength and weakness and improve where necessary.
3. The government should always organize capacity building programme for teachers of computer numerical control machines for ‘Robotic’ training.
4. The government of Delta States should encourage instructors of computer numerical control machines

by giving incentives and financial support in re-training/capacity building programmes.

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