



Strategies for Enhancing Utilization of Computer Numeric Control (CNC) Machines for Effective Implementation of Industrial Technical Education Programme in Universities

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Abstract

The study examined the Strategies for Enhancing Utilization of Computer Numeric Control (CNC) machines for Effective Implementation of Industrial Technical Education Programmes in Public Universities of Enugu state Nigeria. Three research questions and three hypotheses guided the study. Descriptive survey design was used. The population of the study was 68 (ITE) educators which comprises of 35 lecturers and 33 instructors from public university in Enugu State. There was no sampling since the population was manageable. The instrument used for data collection was a structured questionnaire validated by three experts. Cronbach Alpha reliability was used and an overall reliability coefficient of .82 was obtained. The data was collected by the researchers. Out of 68 copies of the questionnaire administered, 60 copies were retrieved giving 88% return rate. Data generated were analysed using mean, standard deviation and t-test. The study found out among other things that Enhancement of the Utilization of Computer Numeric Control (CNC) will bring about Effective Implementation of Industrial Technical Education Programme in Universities. The paper recommended among other things that (ITE) stakeholders should collectively join hands in providing in-service training for (ITE) educators for effectual utilization of (CNC) machines and implementation of ITE programmes in universities.

Keywords: ITE, ITE programmes in universities, ITE Educator, (CNC) Machines, Utilization of (CNC) Machine in ITE programme universities.

1.0 INTRODUCTION

Technological advancement of any nation depends massively on its ability to produce functional human resource capital. There is no contention that high quality human resource is a key factor for the success of any academic programme and survival in the world of globalization [1]. Industrial technical education (ITE) is an academic program that geared towards individual empowerment for employment and self-reliance after graduation. ITE was viewed by Ogbuanya and Okafor, [2], as a systemic process of acquiring and upgrading requisite knowledge and skills needed for self-reliance and employment into industries. ITE programme is geared towards skills acquisition in different areas of human endeavor for gainful employment leading to the well-being

of oneself and that of the society. The objectives of the programme according to Jimoh, et al, [3], includes training of teachers who can occupy teaching and leadership positions in Secondary Schools, Technical Colleges, Colleges of Education, Universities and training Programmes in industrial establishments. It also involves training of entrepreneurs in the mechanical trades and graduates who can be self-employed in their various trades.

ITE programme in universities offers training in building/woodwork technology, electrical/electronic technology and metal work/ auto mechanic technology as each capacity can carry [3]. The programme is geared towards the fulfilment of the need for professionally qualified technical teachers who can impart technical knowledge and vocational skills to their students and thereby contribute to the economic development of Nigeria. The acquisition of skill in ITE programme is central to the availability of efficient and skillful work force which will in turn guarantee adequate training for

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human and societal needs [4]. Supporting this, Chimere in [5] indicated that the absence of technological knowledge and skills has largely lead to the inability of human to function well in the society.

Adekoya, [6], also revealed that ITE human resources are underdeveloped especially in line with utilization of CNC machines which has contributed to inadequate implementation of ITE programmes in universities. Implementation of industrial technical education in universities involves among other things incorporating innovation in teaching and learning and improvements in facilities and infrastructure assets that support economic growth. This is evidence in the use computer numerical control (CNC) machines in the teaching and learning of industrial technical education programs. CNC machine is an electro-mechanical device that uses computer programming inputs to operate machine shop tools. [7-8].

Thomas in [9] described CNC machining as a manufacturing process which typically employs computerized control machine tools to remove layers of material from a stock to produce a desired part. CNC machines use several programming languages to instruct and guide the step to step operations of the machine. It also employs software to ensure the optimization, precision, and accuracy of the part. The operation of CNC machining in industrial technical education programs controls a range of complex machinery, such as grinders, lathes, and turning mills to cut, shape, and create different parts and prototypes of metals, plastics, wood, glass, foam, and composites. CNC application is a vast improvement over non-computerized machining operations thus it is faster, stronger and produces more efficient jobs.

The studies of [9-11] maintained that CNC machine applications have led to a shift, from a total dependence on the objectivist paradigm to a growing adherence to the cognitivist and constructivist paradigms instruction. Despite the huge important of CNC machine tools, its utilization in industrial technical education programmes in universities is very minimal leading to low implementation of ITE programmes in universities.

The digital revolution is rapidly transforming the world of work of ITE. The traditional teaching and learning in ITE programmes are no more adequate in preparing workers for a constantly evolving labor market. Most of the machine tools used in ITE occupational areas outside school are now computerized and ITE graduates who lack operational skill especially in CNC machines are currently faced with unemployment and low skill even to establish on their own. This has led to the development of some societal vice by the unemployed youths. This situation could be attributed to some factors including lack

of CNC facilities, lack of experienced teachers that will operate the CNC machine and lack of funds.

Okonjo-Iwuala, [12], opine that it has been well documented that Nigeria's higher institutions ITE inclusive lack the tools to give students the skills needed for employment especially in the area of CNC machine. The study of [13] observed that the physical facilities and instructional resources (CNC facilities) for effective teaching and learning processes in ITE are inadequately provided and rarely utilized. Researchers have also argued that the poor acquisition of skills and utilization of CNC machines in ITE programmes is as a result of some factors which includes poor awareness and poor infrastructure, inadequate manpower and training among other [14-16].

Deebom and Goma in [17] indicated that effective implementation of ITE programmes cannot survive in this present digital and computer age without encompassing and incorporating proper utilization of CNC machine tools thus the need to enhance the utilization of CNC machine tools for effective implementation of ITE programmes in Nigeria universities.

Frederick, [18], suggested some of the ways to enhance the utilization of CNC machine to include Empowerment of learners, Enhancement of creativity and flexibility to instructional delivery among others. The author maintained that ITE programmes should introduce workshop and seminar training in CNC machine operation for their workers.

Tinio in [19] is of the view that issues like digital culture & literacy, teacher professional development among others should be looked into for enhancement of the utilization of CNC machines and adequate implementation of ITE programmes in Nigerian universities.

The research carried out by Adepoju, [20] and Uyo, [21] stated that for ITE programmes to be effectively implemented, it must strive to meet common 21st century challenges of skill acquisition via proper provision of facilities and training in CNC machine.

It becomes necessary therefore for enhancement in the utilization of CNC machines for effective implementation of ITE programmes in universities

2.0 PURPOSE OF THE STUDY

The general purpose of this study is to determine the strategies for enhancing utilization of computer numeric control (CNC) for effective implementation of industrial technical education programme of universities in Nigeria.

Specifically, the study determined:

- (1) Ways ITE lecturers utilize CNC in their instructional activities

- (2) Challenges that militate against the utilization of the CNC in ITE programmes.
- (3) Ways for ameliorating to challenges to the utilization of CNC in ITE programmes

2.1 *Research Questions*

The following research questions guided the study:

- (1) What are the ways ITE lecturers utilize CNC in their instructional activities?
- (2) What are challenges that militate against the utilization of the CNC in ITE programmes?
- (3) What are the ways for ameliorating to challenges to the utilization of CNC in ITE programmes?

2.2 *Research Hypothesis*

1. There is no significant different on the mean response of lectures and instructors on the ways ITE lecturers utilize CNC in their instructional activities.
2. There is no significant different on the mean response of lectures and instructors on the challenges that militate against the utilization of the CNC in ITE programmes.
3. There is no significant different on the mean response of lectures and instructors on the ways for ameliorating to challenges to the utilization of CNC in ITE programmes.

3.0 **METHODOLOGY**

The study adopted survey research design and was carried out in Enugu state, Nigeria.

3.1 *Area of the study*

The study was done in Enugu state. This was due to the fact that there are two public universities offering industrial technical education in the state thus university of Nigeria Nsukka (UNN) and Enugu state university of science and technology (ESUT).

3.2 *Population of the study*

The population of the study was 68 ITE educators which comprises of 35 lecturers and 33 instructors of ITE from public universities in Enugu state, Nigeria. The ITE lecturers are the one that give the student the technical knowledge on the content of the courses they are supposed to take throughout the programme. These lecturers possess degree holders in ITE areas of study and are also made up of male and females. The ITE instructors are the teachers that guide the students in practical work for the gaining of the skills required for operations in different occupational areas of ITE programmes. Some of these instructors possess HND, OND, NCE and trade masters in different

ITE occupational areas and are made up of male and female. This study only considered their status (lecturers and instructors).

3.2.1 *Sample for the Study*

There was no sampling considering the manageable size of the population.

3.2.2 *Instrument for Data Collection*

The instrument for data collection was a structured Questionnaire titled, Enhancing Utilization of CNC Machine for Effective Implementation of ITE Programmes Questionnaire (EUCMEITEPQ). The instrument has four-point rating scale of Strongly Agree, Agree, Disagree and Strongly Disagree with their nominal values of 4, 3, 2 and 1 respectively. The instrument was validated by three experts.

3.2.3 *Reliability of the instrument*

The reliability of the instrument was done on 10 ITE educators in Ebonyi state university, Abakaliki and an overall reliability coefficient of 0.82 was obtained.

3.2.4 *Data collection techniques*

The 68 copies of the questionnaire were administered while 60 copies were retrieved back by researchers.

3.2.5 *Method of data analysis*

Mean and standard deviation were used to answer the research questions and t-test statistical was employed to test the null hypotheses at 0.05 level of significance. Any mean value that is greater than or equal to 2.50 was accepted while mean values less than 2.50 were rejected. However, the null hypothesis was accepted when the p-value (t-calculated) is greater than 0.05 level (t-critical) but the null hypotheses was rejected when the p-value (t-calculated) is less than 0.05 level value of the t-critical.

4.0 **RESULTS**

Table 1, 2, and 3 show the mean and standard deviation of the responses of lecturers and instructors on the ways ITE lecturers utilize CNC in their instructional activities, the challenges that militate against the utilization of the CNC in ITE programmes, and the ways of ameliorating the challenges that militate against the utilization of the CNC in ITE programmes.

On the other hand, the hypothesis showed that all the 14 items in table 1 have their p-values greater than 0.05 level of significance. The null hypothesis was therefore accepted meaning that there is no significance difference in the mean responses of the lecturers and the instructors

on the items suggested as the ways ITE lecturers utilize CNC in their instructional activities.

Table 1: Mean and standard deviation of the response of lecturers and instructors on the ways ITE lecturers utilize CNC in their instructional activities

| S/N | Item Statements | Mean | S.D. | P-values | Remarks | SIG |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------|------|------|----------|---------|-----|
| 1 | CNC machine finds application in a variety of industries and materials used in ITE. | 2.60 | 0.71 | 0.14 | Agree | NS |
| 2 | ITE staff uses CNC machines with several programming languages to guide the operations of machine tools. | 2.57 | 0.70 | 0.18 | Agree | NS |
| 3 | The use CNC machines employ software to ensure the optimization, precision, and accuracy of the product produced in ITE programmes. | 2.63 | 0.75 | 0.10 | Agree | NS |
| 4 | The use of CNC machining help to control a range of complex machinery. | 2.72 | 0.60 | 0.15 | Agree | NS |
| 5 | CNC is a vast improvement over non-computerized machining in ITE programmes. | 2.63 | 0.78 | 0.27 | Agree | NS |
| 6 | CNC machine offers many production advantages over previous methods of machining in ITE programmes. | 2.58 | 0.66 | 0.09 | Agree | NS |
| 7 | CNC machine is used for faster and stronger production of many parts | 2.53 | 0.72 | 0.12 | Agree | NS |
| 8 | ITE staff cannot do without CNC because it is an indispensable tool across many industries where their students get employment after graduation. | 2.73 | 0.60 | 0.15 | Agree | NS |
| 9 | ITE staff uses CNC programs for the development of a lifelong learning culture. | 2.55 | 0.65 | 0.20 | Agree | NS |
| 10 | ITE staff uses CNC operations to empower learners with multiple channels to meet their education and training needs | 2.63 | 0.70 | 0.26 | Agree | NS |
| 11 | ITE staff uses CNC to create variety of products for human needs which lead to employment and self-reliance. | 2.75 | 0.65 | 0.09 | Agree | NS |
| 12 | ITE staff uses CNC machine to do operation for 24 hours a day. | 2.57 | 0.66 | 0.07 | Agree | NS |
| 13 | ITE staff uses CNC operation to produce products with higher accuracy and precision than other manual machines with little time and cost. | 2.53 | 0.73 | 0.18 | Agree | NS |
| 14 | ITE staff uses CNC machines to create complex designs with high accuracy | 2.58 | 0.70 | 0.08 | Agree | NS |

Keys: SD- Standard deviation; REM-Remark; NS-Not significant.

Table 2: Mean and standard deviation of the response of lecturers and instructors on the challenges that militate against the utilization of the CNC in ITE programmes.

| S/N | Item Statements | Mean | S.D | P-value | Remarks | SIG |
|-----|------------------------------------------------------------------------------------------------------|------|------|---------|---------|-----|
| 1 | Poor awareness of the importance of CNC machines and operation | 2.82 | 0.73 | 0.13 | Agree | NS |
| 2 | Inadequate provision of CNC facilities, equipment and infrastructures | 2.69 | 0.71 | 0.08 | Agree | NS |
| 3 | Inability to see CNC machine operations as ways of implementing ITE programme | 2.95 | 0.75 | 0.18 | Agree | NS |
| 4 | Inadequate workshop, in service training and seminars on CNC machine operations for skill upgrading. | 2.77 | 0.77 | 0.26 | Agree | NS |
| 5 | Resistance to change pedagogical practices in ITE programme | 2.80 | 0.76 | 0.08 | Agree | NS |
| 6 | Lack of access and management to CNC facilities and equipment | 2.59 | 0.74 | 0.22 | Agree | NS |
| 7 | Influence of teachers culture and school culture | 2.56 | 0.75 | 0.18 | Agree | NS |
| 8 | Pressure of work and habit to work | 2.65 | 0.81 | 0.20 | Agree | NS |
| 9 | Lack of confident on teachers and trainer | 2.68 | 0.82 | 0.28 | Agree | NS |
| 10 | Lack of CNC experienced staff, fund and maintenance. | 2.58 | 0.83 | 0.17 | Agree | NS |

Keys: SD- Standard deviation; REM-Remark, NS-Not significant.

The data in table 2 revealed that the 10 items listed as the challenges that militate against the utilization of the CNC in ITE programmes have their mean values all above the cut-off point of 2.50 indicating that the items suggested are the challenges that militate against the utilization of the CNC in ITE programmes. The standard deviation of the 10 items in table 2 ranges from 0.71-0.83 which shows that the respondents were not far from each other in their

responses. On the other hand, the hypothesis showed that all the 10 items in table 2 have their p-values greater than 0.05 level of significance. The null hypothesis was therefore accepted meaning that there is no significance difference in the mean responses of the lecturers and the instructors on the items suggested as challenges that militate against the utilization of the CNC in ITE programmes of public universities in Enugu state.

Table 3: Mean and standard deviation of the response of lecturers and instructors on the ways of ameliorating the challenges that militate against the utilization of the CNC in ITE programmes.

| S/N | Item Statements | Mean | S. D | P-value | Remarks | SIG |
|-----|---------------------------------------------------------------------------------------------------------------------------|------|------|---------|---------|-----|
| 1 | ITE programme should integrate computer literacy in training | 2.65 | 0.64 | 0.14 | Agree | NS |
| 2 | ITE stakeholders should provide workshop, in service training and seminars on CNC machine operations for skill upgrading. | 2.58 | 0.71 | 0.09 | Agree | NS |
| 3 | There should be awareness of CNC machine operations in ITE programme | 2.66 | 0.66 | 0.19 | Agree | NS |
| 4 | ITE stakeholders should invest into CNC training programme. | 2.54 | 0.67 | 0.27 | Agree | NS |
| 5 | There should be equity in the distribution of CNC facilities in universities | 2.62 | 0.79 | 0.07 | Agree | NS |
| 6 | Acquisition of CNC machine skills in ITE should be addressed in pre-service and in-services training of educators | 2.76 | 0.65 | 0.24 | Agree | NS |
| 7 | There should be empowerment of learners in CNC machines | 2.54 | 0.72 | 0.16 | Agree | NS |
| 8 | There should be enhancement of creativity and value in CNC of ITE programme | 2.58 | 0.66 | 0.21 | Agree | NS |
| 9 | There should be flexibility in teaching and learning of ITE programmes | 2.58 | 0.77 | 0.21 | Agree | NS |
| 10 | There should be monitoring and evaluation as it concerns CNC machine training | 2.36 | 0.80 | 0.17 | Agree | NS |
| 11 | There should be quality assurance system as it concerns CNC of ITE programmes. | 2.72 | 0.64 | 0.23 | Agree | NS |
| 12 | There should be enhancement of curriculum as it concerns CNC training in ITE programs | 2.66 | 0.66 | 0.20 | Agree | NS |

Keys: SD- Standard deviation; REM-Remark, NS-Not significant

The data in table 3 revealed that the 12 items listed as the ways of ameliorating the challenges that militate against the utilization of the CNC in ITE programmes have their mean values all above the cut-off point of 2.50 indicating that the items suggested are necessary ways for ameliorating the factors hindering the utilization of CNC machine in ITE programmes in public universities in Enugu states. The standard deviation of the 12 items ranges from 0.64-0.80 showing that the respondents were not far from each other in their responses. The hypothesis also showed that all the 12 items have their p-values greater than 0.05 level of significance. The null hypothesis was therefore accepted meaning that there is no significance difference in the mean responses of the lecturers and the instructors on the ways of ameliorating the challenges that militate against the utilization of the CNC in ITE programmes in public universities in Enugu states.

4.1 Discussion

The finding of the study in table 1 revealed that the 14 items that were pointed out as the ways ITE lecturers utilize CNC in their instructional activities were all accepted by the respondents. The implication of this finding is that there is necessity for enhancing utilization of CNC machine for effective implementation of ITE programmes in universities. This is in line with [1] who emphasized that there is no contention that high quality human resource in operation of machine tools is a key factor for survival in the world of globalization and knowledge economy. Also, Thomas, in [9] noted the utilization of CNC machines has vast improvement over non-computerized machining.

The finding of the study in table 2 revealed that the 10 items that were pointed out as the challenges that militate against the utilization of the CNC in ITE programmes were all accepted by the respondents. The

implication of this finding is that there are hindrances to effectual utilization of CNC machine in ITE programmes which should be looked into for successful implementation of the programme. This is in line with [14] that indicated some of the challenges to the use of innovation facilities in ITE programmes to include internal resistance to change teaching methods, pedagogical practices, the lack of access to new pedagogical equipment and others. Edokpolor, in [13] also observed that the physical facilities and instructional resources for effective teaching and learning processes in ITE are inadequately provided and rarely utilized, which in turn lead to inadequate implementation of the programme. There is need therefore to look into ways of eradicating these challenges for proper utilization of CNC machines and implementation of ITE programmes.

The finding of the study in table 3 revealed that the 12 items that were suggested as ways for ameliorating the challenges that militate against the utilization of the CNC in ITE programmes in universities in Enugu state were all accepted. The implication of the finding is that the possibility of effectual utilization of CNC machines for good implementation of ITE programmes depends on ameliorating the challenges that militate against the utilization of the CNC in ITE programmes. This is in line with [19] who is of the view that issues like digital culture & literacy, teacher professional development among others should be looked into for proper utilization of innovation facilities. More so, Frederick, in [18] suggested some way of taking care of the factors that hinders the utilization of innovation equipment to include empowerment of learners, enhancement of creativity and flexibility to instructional delivery etc. It is therefore necessary that these prospects should be used to address the factors hindering the effectual utilization of CNC machines for effective implementation of ITE programmes of public universities in Enugu state Nigeria.

5.0 CONCLUSION

The digital revolution is rapidly transforming the world of work and the skills of ITE programmes in universities. These changes ushered in the use of CNC machines in the teaching and learning of ITE programmes which gears towards adequate implementation of ITE programmes in universities. However, the utilization of CNC machine tools is faced with many challenges which should be looked into. Effective implementation of ITE programmes in universities cannot be sustained in this present digital and computer age without encompassing and incorporating effectual utilization of CNC machine tools. There is need therefore for enhancing utilization of

CNC machines for effective implementation of ITE programmes in universities.

5.1 Recommendations

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

- a. ITE educators should employ effectual utilization of CNC machines in teaching and learning of ITE programmes in universities.
- b. ITE stakeholders should collaboratively ensure that CNC equipment and facilities in public universities in Enugu state is provided for.
- c. ITE stakeholders should organize training in form of in-service training, conference and workshop for update of skills of ITE educators.
- d. ITE stakeholders should ensure adequate funding of ITE programs and empowerment of learners.

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