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Strategies for Enhancing Utilization of Computer Numeric Control (CNC) Machines for 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 implementation of Industrial Technical Education (ITE) programmes in public Universities of Enugu state, Nigeria. Specifically the study determined ways ITE lecturers utilize CNC machines in instructional activities; challenges that militate against utilization of CNC machines; and ways for ameliorating to the challenges. Three research questions and three hypotheses guided the study. Survey design was used. Population for the study was made up of 68 ITE educators which comprised 35 lecturers and 33 instructors. Instrument for data collection was questionnaire. Data were analyzed using mean, standard deviation and t-test. Findings the study include identified 14 ways ITE lecturers utilize CNC machines in instructional activities. These include, CNC machine finds application in a variety of industries and materials used in ITE, CNC is a vast improvement over non-computerized machining in ITE programme, ITE staff uses CNC machines to create complex designs with high accuracy and others. Other findings are 10 challenges that militate against the utilization of CNC machine. These include, poor awareness of the importance of CNC machines and operation, resistance to change pedagogical practices in ITE programme, influence of teachers culture and school culture, and others. Also 12 ways for ameliorating to the challenges were indentified. These include, there should be awareness of CNC machine operations in ITE programme, ITE stakeholders should invest into CNC training programme, there should be empowerment of learners in CNC machines, among others. It was 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.

Keyword: Industrial, Technical, Utilization, Education, Computer Numeric Control, Educators, *Machines.*

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 (Eze&Okorafor, 2012). Industrial technical education (ITE) is an academic program that looks forward to individual empowerment for employment and self-reliance after graduation. It is viewed by Ogbuanya & Okoye, (2015) as a systematic process of acquiring and upgrading requisite knowledge and skills needed for self-reliance and employment into industries. ITE programme aims towards skills acquisition in different areas of human endeavor for gainful employment leading to the wellbeing of oneself and that of the society. The objectives of the programme according to Jimoh, et,al. (2020) 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 (Jimoh, et.al. 2020).The programme focuses on 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 human and societal needs (Ruqayyah, 2013). Supporting this, Chimere, et,al. (2019) by their study indicated that the absence of technological knowledge and skills could lead to the inability of human to function well in the society. Adekoya (2018); Ewubare & Mark (2018) 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.

Davenport (2018) defined CNC machine as an electro-mechanical device that uses computer programming inputs to operate machine shop tools. Thomas (2021) also described CNC machine as a machine used for manufacturing process which typically employs computerized control to remove layers of material from a stock to produce a desired part. CNC machine is therefore a machine tool used to produce a desirable parts of facilities for human consumption. 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 for cutting, shaping, and create different parts and prototypes of metals, plastics, wood, glass, foam, and composites (Goodwin, 2018). CNC operation is a vast improvement over other machine tools operation thus it is faster, stronger and produces more efficient jobs(Goodwin, 2018). Wonacott, (2001) reported that CNC machine operations have led to a shift, from a total dependence on the objectivist paradigm to a growing adherence to the cognitivist and constructivist paradigms instruction. Despise the huge importance 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 thus producing graduates who are not fit enough for the world of work.

The digital revolution rapidly transforming the world of work of ITE made the traditional teaching and learning in ITE programmesto be inadequate in preparing workers for the 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 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, (2013) opined that it has been well documented that Nigeria's higher institutions programmes (ITE inclusive) that there is a dearth of tools to give students the skills needed for employment especially in the area of CNC machine. Edokpolor, (2018) observed that the physical facilities and instructional resources (CNC facilities) for effective teaching and learning processes in ITE in public universities in Enugu state are inadequately provided and rarely utilized. Researchers have also argued that the poor acquisition of skills and utilization of CNC machines in ITE programmes in public universities is as a result of some factors which includes poor awareness and poor infrastructure, inadequate manpower and training among other (UNESCO-UNEVOC, 2019; Akinfolarin, Ajayi & Oloruntegbe, 2012; Aworanti, 2015).The study by Deebom & Goma, 2018) indicated that effective implementation of ITE programmes occur not to 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. Frederick, (2015) 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 work shop and seminar training in CNC machine operations for their workers. Tinio, (2002) 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. Adepoju, (2020) &Uyo (2014) stated that for ITE programmesto 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.

Purpose of the study

The general purpose of this study was to investigate the strategies for enhancing utilization of computer numeric control (CNC) for proper 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 instructional programmes.
(3) ways for ameliorating to challenges to the utilization of CNC in ITE instructional programmes.

Research Questions

The following research questions were answered:

(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?

Research Hypotheses (HOs)

HO_1: There is no significant different on mean responses of lectures and instructors on the ways ITE utilize CNC in their instructional activities.

HO_2: Challenges that militate against the utilization of the CNC in ITE programmes.

HO_3: Ways for ameliorating to challenges to the utilization of CNC in ITE programmes.

Methodology

The study adopted survey research design.

***Area of the study*:** The study was carried out 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).

***Population of the study*:** The population of the study was 68 ITE educators. It was made up of 35 lecturers and 33 instructors of ITE from public universities in Enugu state, Nigeria. The ITE lecturers give the students the technical knowledge on the content of the courses they are supposed to take throughout the programme. The ITE instructors work with the students in practical work for acquisition of skills required for operations in different occupational areas of ITE programmes. Some of these instructors possess relevant high diploma certificate 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).

***Sample for the Study*:** There was no sampling considering the manageable size of the population.

***The instrument for Data Collection*:** The instrument for data collection was a structured questionnaire titled. 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. For their liability, Cronbach alpha coefficient reliability was used. The instrument was distributed to 10 ITE educators of Industrial technical education in Ebonyi state university, Abakaliki and an overall reliability coefficient of 0.82 was obtained.

***Data collection techniques*:** The 68 copies of the questionnaire were administered by the researchers and all the 68 copies were retrieved back given a 100% retune rate.

***Method of data analysis*:** Mean and standard deviation were used to answer the research questions and t-test 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 regarded as agreement while mean values less than 2.50 was regarded as not agreement. 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.

Results

Table 1: Mean, Standard, Deviation and t-test values on Ways ITE lecturers and Instructors utilize CNC in their Instructional Activities

S/N	Ways of Utilizing CNC Machines		SD_1	$_2$	SD_2	$_g$	SD_g	T	R	S
1	CNC machine finds application in a variety of industries and materials used in ITE.	2.60	0.71	2.67	2.69	2.64	0.70	0.14	A	N
2	ITE staff uses CNC machines with several programming languages to guide the operations of machine tools.	2.57	0.70	2.59	0.71	2.58	0.17	0.18	A	N
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	2.60	0.70	2.62	0.73	0.10	A	S
4	The use of CNC machining help to control a range of complex machinery.	2.72	0.60	2.71	0.65	2.72	0.63	0.15	A	S
5	CNC is a vast improvement over non-computerized machining in ITE programmes	2.63	0.78	2.70	0.75	2.67	0.77	0.10	A	N
6	CNC machine offers many production advantages over previous methods of machining in ITE programmes	2.58	0.66	2.60	0.70	2.59	0.68	0.09	A	N
7	CNC machine is used for faster and stronger production of many parts	2.53	0.72	2.56	0.69	2.54	0.71	0.12	A	N
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	0.65	2.75	0.60	2.74	0.61	0.15	A	N
9	ITE staff uses CNC programs for the development of a lifelong learning culture.	2.59	0.62	2.55	0.65	2.58	0.61	0.20	A	N
10	ITE staff uses CNC operations to empower learners with multiple	2.61	0.75	2.63	0.70	2.62	0.71	0.60	A	N

	channels to meet their education and training needs									
11	ITE staff uses CNC to create variety of products for human needs which lead to employment and self-reliance.	2.75	0.59	2.70	0.65	2.72	0.62	0.09	A	N
12	ITE staff uses CNC machine to do operation for 24 hours a day.	2.57	0.63	2.60	0.66	2.59	0.65	0.07	A	N
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	0.70	2.56	0.73	2.55	0.72	0.18	A	N
14	ITE staff uses CNC machines to create complex designs with high accuracy	2.58	0.69	2.60	0.70	2.59	0.70	0.08	A	N

Keys: $_1$ = Mean score of Lecturers; SD_1 = Standard Deviation of Lecturers; $_2$= mean score of Instructors; SD_2 = Standard Deviation of Instructors; $_g$ = Grand mean; SDg=Standard Deviation of Instructors: t=hypotheses; R= Remarks; S = Significant; N=Not Significant.

Table 1 reveals that all the 14 items have their grand mean of 2.63is above the cut-off point of 2.50 indicating that the 14 items pointed out the ways ITE lecturers utilize CNC in their instructional activities. The standard deviations of all the 14 items in table 1 range from 0.77-0.61 showing that the respondents were not far from each other in their responses. 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 2: Mean, Standard, Deviation and t-test Values on Challenges that Militate Against the Utilization of the CNC in ITE Programmes.

S/N	Challenges that Militate Against the Utilization of the CNC	$_1$	SD_1	$_2$	SD_2	$_g$	SD_g	T	R	S
1	Poor awareness of the importance of CNC machines and operation	2.79	0.71	2.82	0.73	2.80	0.72	0.13	A	N
2	Inadequate provision of CNC facilities, equipment and infrastructures	2.69	0.75	2.66	0.71	2.68	0.73	0.08	A	N
3	Inability to see CNC machine operations as ways of implementing ITE programme	2.90	0.70	2.80	0.75	2.85	0.73	0.18	A	N
4	Inadequate work shop, in service training and seminars on CNC machine operations for skill upgrading.	2.70	0.72	2.77	0.77	2.74	0.75	0.26	A	N

S/N	Challenges that Militate Against the Utilization of the CNC	$_1$	SD_1	$_2$	SD_2	$_g$	SD_g	T	R	S
5	Resistance to change pedagogical practices in ITE programme	2.82	0.74	2.80	0.76	2.81	0.75	0.08	A	N
6	Lack of access and management to CNC facilities and equipment	2.61	0.70	2.59	0.74	2.60	0.72	0.22	A	N
7	Influence of teachers culture and school culture	2.59	0.69	2.56	0.75	2.59	0.72	0.18	A	N
8	Pressure of work and habit to work	2.60	0.79	2.65	0.81	2.62	0.82	0.20	A	N
9	Lack of confident on teachers and trainer	2.60	0.80	2.68	0.82	2.64	0.81	0.28	A	N
10	Lack of CNC experienced staff, fund and maintenance.	2.59	0.80	2.58	0.83	2.59	0.82	0.17	A	N
	GRAND TOTAL					2.69	0.76			

Keys: $_1$ = Mean score of Lecturers; SD_1 = Standard Deviation of Lecturers; $_2$= mean score of Instructors; SD_2 = Standard Deviation of Instructors; $_g$ = Grand mean; SDg=Standard Deviation ofInstructors: t=hypotheses; R= Remarks; S = Significant; N=Not Significant.

Table 2 reveals that the 10 items listed as the challenges that militate against the utilization of the CNC in ITE programmes have their grand mean value of 2.69 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 are agreed by the ITE lecturers and instructors. The standard deviation of the 10 items in table 2 ranges from 0.72-0.82 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.

Table 3: Mean, Standard, Deviation and t-test Values on the Ways of Ameliorating the Challenges that Militate against the Utilization of the CNC in ITE programmes.

S/N	Ways of Ameliorating the Challenges that Militate Against the Utilization of the CNC	$_1$	SD_1	$_2$	SD_2	$_g$	SD_g	t	R	S
1	ITE programme should integrate computer literacy in training	2.65	0.60	2.61	0.64	2.63	0.62	0.14	A	N
2	ITE stakeholders should provide work shop, in service training and seminars on CNC machine operations for skill upgrading.	2.58	0.75	2.60	0.71	2.59	0.73	0.09	A	N

S/N	Ways of Ameliorating the Challenges that Militate Against the Utilization of the CNC	$_1$	SD_1	$_2$	SD_2	$_g$	SD_g	t	R	S
3	There should be awareness of CNC machine operations in ITE programme	2.66	0.61	2.62	0.66	2.64	0.54	0.19	A	N
4	ITE stakeholders should invest into CNC training programme.	2.54	0.61	2.58	0.67	2.56	0.64	0.27	A	N
5	There should be equity in the distribution of CNC facilities in universities	2.65	0.72	2.62	0.79	2.64	0.71	0.07	A	N
6	Acquisition of CNC machine skills in ITE should be addressed in pre-service and in-services training of educators	2.70	0.60	2.76	0.65	2.73	0.63	0.24	A	N
7	There should be empowerment of learners in CNC machines	2.57	0.78	2.54	0.72	2.56	0.75	0.16	A	N
8	There should be enhancement of creativity and value in CNC of ITE programme	2.52	0.60	2.58	0.66	2.55	0.63	0.21	A	N
9	There should be flexibility in teaching and learning of ITE programmes	2.53	0.70	2.58	0.77	2.56	0.74	0.21	A	N
10	There should be monitoring and evaluation as it concerns CNC machine training	2.56	0.81	2.59	0.80	2.58	0.81	0.17	A	N
11	There should be quality assurance system as it concerns CNC of ITE programmes.	2.72	0.69	2.78	0.64	2.75	0.67	0.23	A	N
12	There should be enhancement of curriculum as it concern CNC training in ITE programs	2.64	0.63	2.66	0.66	2.65	0.65	0.20	A	N
	GRAND TOTAL					2.62	0.68			

***Keys**: $_1$ = Mean score of Lecturers; SD_1 = Standard Deviation of Lecturers; $_2$= mean score of Instructors; SD_2 = Standard Deviation of Instructors; $_g$ = Grand mean; SDg=Standard Deviation ofInstructors: t=hypotheses; R= Remarks; S = Significant; N=Not Significant.*

Table 3 shows 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 grand mean value of 2.62 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 0.81-0.54

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.

Discussion

The finding of the study in table 1 revealed that the 14items 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 the utilization of CNC machines helps in fast productions, good accuracy of production and in skill acquisition. More so there is necessity for enhancing utilization of CNC machine for effective implementation of ITE programmes in universities. This is in line with Eze & Okorafor, (2012b) 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. Adekoya (2018); Ewubare & Mark (2018) 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. Thomas, (2021) also noted that the utilization of CNC machines has vast improvement over non-computerized machining. The finding of the study in table 2 revealed that the 10items 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 UNESCO-UNEVOC, (2019) 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, (2018) 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. Ruqayyah, (2013) by his study indicated that acquisition of skill especially in CNC machines in ITE programme is central to the availability of efficient and skillful work force which will in turn guarantee adequate training for human and societal needs. Supporting this, Chimere, Iheonu, Nathaniel & Urama (2019) by their study indicated that the absence of technological knowledge and skills in CNC machines could lead to the inability of human to function well in the society. 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 12items 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 thatthe 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 Tinio (2002) 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. The study by Deebom & Goma, (2018) indicated that effective implementation of ITE programmes occur not to 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. More so, Frederick, (2015) 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.

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 whose interest is inadequate 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.

Recommendations

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

1. ITE educators should utilization of CNC machines in teaching and learning of ITE programmes in universities.
2. ITE personnel should collaboratively ensure that CNC equipment and facilities in public universities in Enugu state is provided for.
3. Universities should organize training inform of in service training, conference and workshop for update of skills of ITE educators.
4. ITE personnel should ensure adequate funding of ITE programs and empowerment of learners.

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