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Assessing the Skills and Competencies Required for Computer Numerical Control Woodworking Machines for Furniture Crafts in Kano State, Nigeria

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Abstract

The study focused on assessing the skills and competencies required for Computer Numerical Control Woodworking Machines (CNCWMs) operations for furniture crafts in Kano State Nigeria. The study was conducted in some selected Government Technical Colleges (GTCs) in Kano State. Three objectives of the study were stated to guide the study. The population for the study was 158 furniture crafts teachers and students in the area of the study. There is a purposive sampling of teachers and students in the selected technical colleges' (TCs) furniture crafts departments due to the manageable population in the department in the area of study. The instrument for data collection was a questionnaire developed from the literature reviewed and validated by three woodwork experts from the Department of Industrial and Technology Education, Federal University of Technology, Minna, Niger State – Nigeria. The questionnaire was administered to 158 respondents which included teachers and students of the furniture crafts department in three selected TCs in Kano State, and 135 were retrieved and analyzed using mean and standard deviation (SD). The study revealed among others that the skills and competencies required for CNCWMs operations for furniture crafts should be properly put into use to enhance the effective and practicable teaching of furniture crafts to improve students' interest, understanding and comprehension in the subject, TCs to provide necessary tools and equipment that will promote the teaching and learning of furniture crafts in TCs across the country among others. Recommendations were given based on the findings from the study.

A. Introduction

The Computer Numerical Control Woodworking Machines (CNCWMs) can be defined as the computerized technology in which functions and motion of the woodworking machine tools are controlled by means of a prepared programme (software) containing coded alphanumeric programme data (Kminiak et al., 2023; Quiña-Mera et al., 2021; Wibowo et al., 2018). The CNCWMs based processes have been developed to meet extra required machining conditions. CNCWM is electro-mechanical device that manipulate tools using computer programming inputs. It is the name given to a machine containing a spindle or router that

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receives its fabricating marching orders from a computer such as laptop or desktop unit containing Computer Aided Design (CAD) software (Bachim et al., 2020; Zivanovic et al., 2024).

Furniture makers are craftsmen which normally work at a bench and are mainly concerned with construction of movable wood items of furniture (Jeong & Kook, 2023; Suandi et al., 2022). They focus on fitting of joints to produce high quality sound furniture made from specially selected figure wood to produce wood furniture. Furniture craftsmen required sound knowledge of design principles, working properties of the materials, construction method, decoration and fittings techniques. A well train furniture maker has to put all the principle of design and construction into consideration. The end product determines how skillful the worker is, that is ability to have sound knowledge of materials, hand and driving tools and their used as well as the need of the society in furniture (Juravich, 2017; Lee, 2023).

Skill is the ability to do something expertly well or perform a task to an acceptable standard when measured against. Skill is anything that an individual has learned to do with ease and precision and may be either physical or mental performance, involving manipulative proficiency in hand finger and eye coordination. Skill is the proficiency displayed by someone in performance of a given task. It is a person's ability in performing a given task well as a result of training and practice. Skill is having enough ability, experience and knowledge, to be able to do something well (Hartini et al., 2020). Ugwu et al. (2015) states that, skill is well-established habit of doing things by people. In the context of this study, skill is the ability that an individual has acquired or improve upon that will enable him performs a task efficiently in woodwork using CNCWMs. The skill that the teachers and students acquired need to be assessed for effective service delivery.

Competency is an essential ability obtained in a profession and those which the professional in the field must possess and be able to demonstrate at optimal level of functioning (Hwang & Sugiyama, 2021). Competency is knowledge, skills and attitude that are required for successful performing of the task (Hazir et al., 2018; Lane et al., 2009). Competency as applied in this study is the knowledge, skills and attitude or training ability furniture crafts teachers and students must assess the operational skills and competencies using CNCWMs for effective delivery of practical skills and competencies class without difficulties. CNCWM has revolutionized the world of highly precise woodworking.

Assessment is a form of evaluation that uses collected data for estimating the work quality or effectiveness of a programme or project. Assessment involves use of empirical data on students learning (Baer, 2019). Assessment is the wide variety of methods or tools that educators use to evaluate measure and document academic readiness, learning progress, skill acquisition, or educational needs of the teachers and students. Valid assessment of people helps someone to pass judgment correctly. With reference to this study, assessment is the process of evaluating skills and competencies required with CNCWMs operations for furniture crafts in TCs through collection of data from them to determine the level of skills and competencies they possess in operating CNCWMs for effective and efficient instructional delivery, despite the availability of CNCWMs in TCs offering National Technical Certificate (NTC) furniture crafts programme. Hence, the need to assess the level of skills and competencies of teachers and students on operating CNCWMs in TCs in Kano State, Nigeria.

Furniture crafts teachers implement the prepared curricula in various TCs offering NTC programme for students' acquisition and competencies. It was noted that furniture crafts teachers in Kano State TCs are not fully prefer to operate CNCWMs for teaching students skills and competencies despites the availability of the CNCWMs in Kano State TCs and also, the CNCWMs are easy to operate by anybody in carrying-out the ripping, cross-cutting, planing, and others woodworking operations. Again, woodwork craftsmen operating the CNCWMs in their day-to-day furniture making in their respective workshops. The needs to assess their level of skills and competencies they possessed for operating CNCWMs for furniture crafts teachers and their students.

The problem of this study therefore, is to assess the extent to which the furniture crafts teachers and their students in TCs can operate CNCWMs in making furniture articles during practical skills and competencies lesson delivery in Kano State. The huge amount of money spent in purchasing the CNCWMs into their TCs is presently a source of concern to stakeholders. The time also spent in training and retraining them is also of greet worry to academics and industrialists. All these concerns therefore justify the need for this study.

The study was designed to assess the extent to which skills and competencies of furniture crafts teachers are capable to operate the CNCWMs in practical lesson delivery to their students in Kano State TCs. Specifically, the study assessed the extent to which: 1) CNCWMs enhanced the practical lessons delivery in ripping operation of furniture crafts teachers in Kano State TCs; 2) CNCWMs enhanced the practical

lessons delivery in cross-cutting operation of furniture crafts teachers in Kano State TCs; and 3) CNCWMs enhanced the practical lessons delivery in planing operation of furniture crafts teachers in Kano State TCs.

The following null hypotheses were tested at 0.05 level of significance: **HO_1**: There is no significant difference on the mean responses between furniture crafts teachers and craftsmen on their opinions on the extent to which ripping operation using CNCWMs in delivery of practical lesson to their students in Kano State TCs. **HO_2**: There is no significant difference on the mean responses between furniture crafts teachers and craftsmen on their opinions on the extent to which cross-cutting operation using CNCWMs in delivery of practical lesson to their students in Kano State TCs, and **HO_3**:There is no significant difference on the mean responses between furniture crafts teachers and craftsmen on their opinions on the extent to which planing operation using CNCWMs in delivery of practical lesson to their students in Kano State TCs.

B. Research Methods

Descriptive survey research design was considered suitable for this study. This research design is mostly applied to real life situation in education where need to assess the operational skills and competencies of CNCWMs for furniture crafts teachers. The descriptive survey research design is the plan, structure and strategy that the researcher wants to adopt in order to obtain solution to research problems using questionnaire in collecting, analyzing and interpreting the data. Questionnaires was used to collect data from furniture crafts teachers and their students from TCs offering NTC furniture crafts programme in order to assess their operational skills and competencies in using CNCWMs in delivering their practical lesson with the students. The area of the study was Kano State TCs offering NTC furniture crafts programme as: Government Technical College (GTC) Bagauda, GTC Kano and GTC Ungogo. The population of the study is 158 respondents. 78 furniture crafts students, 30 furniture crafts teachers and 50 furniture craftsmen. The furniture craftsmen used for the study were use purposive sampling technique. This was achieved by engaging the students to give questionnaire to the furniture craftsmen that lead to engaged them during the Students Industrial Work Experience Scheme (SIWES) exercise. The instrument used for the data collection titled: Woodworking Machines Computer Numerical Control Skills and Competencies Assessment for Furniture Crafts Questionnaire (WMCNCSCAFCQ) was developed based on literature reviewed. The instrument was validated by three woodwork technology experts, from the Department of Industrial and Technology Education, Federal University of Technology, Minna, Niger State. The instrument was pilot tested for reliability by using it for 10 furniture crafts teachers and their 20 students for GTC Soba, Kaduna State which is outside the area of the study as well as 12 furniture craftsmen from Kaduna Metropolitan were also, used for reliability obtained 0.85 which is outside the area of the study. These implies that the instrument were reliable. The data were collected by using the WMCNCSCAFCQ instrument by the researcher who distributed the instruments to the students while other copies were distributed to furniture craftsmen who engaged them in the furniture crafts. One hundred and thirtyfive copies of the questionnaires were filled and returned representing about 88 percent retrieval rate to the furniture craftsmen. The one filled by students were filled by the students were all returned indicating 100 percent retrieval rate by the students. Data collected were analyzed using the Statistical Package for Social Sciences (SPSS) version 25. The mean and standard deviation was used to answer the research questions and the one-way Analysis of Variance (ANOVA) was used to analyze or test the hypotheses at 0.05 level of significance. When the mean value is less than 3.50 is Not Enhanced while, when mean value is greater than 3.50 is Enhanced. And also, hypotheses tested at 0.05 level of significance, if the level of significant is below or less than ($p<0.05$) therefore the result shows that: there is significant or accepted in the testing hypothesis while, if the level of significant is above or greater than ($p>0.05$) therefore the result shows that: there is no significant or rejected.

C. Results and Discussion

Table 1. Table of respondents of the extent to which CNCWMs had enhanced ripping operation delivery in furniture crafts in TCs workshops

Respondents	No	Mean	SD	Decision
Furniture Students	98	3.60	0.71	Enhanced
Furniture Craftsmen	50	3.35	0.86	Enhanced
Furniture Crafts Teachers	10	3.41	0.88	Enhanced

The table 1 showed above is the ripping operation using CNCWMs for furniture crafts. The mean of the opinion of the furniture crafts teachers was 3.60, furniture students was 3.41 and furniture craftsmen 3.35

and also, Standard Deviation (SD) was 0.71, 0.86 and 0.88 for furniture crafts teachers, furniture crafts students and furniture craftsmen respectively.

Table 2. Table of respondents of the extent to which CNCWMs had enhanced cross-cutting operation delivery in furniture crafts in TCs workshops

Respondents	No.	Mean	SD	Decision
Furniture Students	98	2.46	0.81	Not Enhanced
Furniture Craftsmen	50	2.52	0.92	Not Enhanced
Furniture Crafts Teachers	10	2.63	0.94	Not Enhanced

The table 2 showed above is the cross-cutting operation using CNCWMs for furniture crafts. The mean of the opinion of the furniture crafts teachers was 2.63, furniture students was 2.46 and furniture craftsmen 2.52 and also, Standard Deviation (SD) was 0.94, 0.81 and 0.92 for furniture crafts teachers, furniture crafts students and furniture craftsmen respectively.

Table 3. Table of respondents of the extent to which CNCWMs had enhanced planing operation delivery in furniture crafts in TCs workshops

Respondents	No.	Mean	SD	Decision
Furniture Students	98	2.65	0.83	Not Enhanced
Furniture Craftsmen	50	2.34	0.94	Not Enhanced
Furniture Crafts Teachers	10	2.45	0.85	Not Enhanced

The table 3 showed above is the planing operation using CNCWMs for furniture crafts. The mean of the opinion of the furniture crafts teachers was 2.45, furniture students was 2.65 and furniture craftsmen 2.34 and also, Standard Deviation (SD) was 0.83, 0.85 and 0.94 for furniture crafts teachers, furniture crafts students and furniture craftsmen respectively.

Hypotheses Testing

Table 4. One-way Analysis of Variance (ANOVA) for ripping operation using CNCWMs for furniture crafts in TCs

	Sum of Squares	Df	Mean Square	f	Significance
Between Groups	.218	3	.218	.597	.444
Within Groups	17.562	956	.366		
Total	17.780	959			

Result: F (959) = 0.597, P = 0.444. The ANOVA Table 4 above showed the null hypothesis was accepted. This implied that the furniture teachers, students and craftsmen in practice are all in the opinion that ripping operation using CNCWMs in furniture crafts skills and competencies assessment for TCs in Kano State.

Table 5. One-way Analysis of Variance (ANOVA) for cross-cutting operation using CNCWMs for furniture crafts in TCs

	Sum of Squares	Df	Mean Square	f	Significance
Between Groups	.2517	3	.258	23.875	.028
Within Groups	15.263	956	.325		
Total	17.780	959			

Result: F (959) = 23.875, P = 0.028. The ANOVA Table 5 above showed the null hypothesis was rejected. This implied that the furniture teachers, students and craftsmen in practice are all in the opinion that cross-cutting operation using CNCWMs in furniture crafts skills and competencies assessment for TCs in Kano State.

Table 6. One-way Analysis of Variance (ANOVA) for planing operation using CNCWMs for furniture crafts in TCs

	Sum of Squares	Df	Mean Square	f	Significance
Between Groups	.2517	3	.258	9.001	.000
Within Groups	15.263	956	.325		
Total	17.780	959			

Result: F (959) = 23.875, P = 0.028. The ANOVA Table 6 above showed the null hypothesis was rejected. This implied that the furniture teachers, students and craftsmen in practice are all in the opinion that planing operation using CNCWMs in furniture crafts skills and competencies assessment for TCs in Kano State.

The CNCWMs which had become the new trend in woodworking operations had not so far obtained its desired outcomes. Many of the woodworking operational skills and competencies using CNCWMs had failed to enhance the delivery of practical lessons of woodworking operations, such as ripping, cross-cutting, planing and others. Furniture crafts students graduated from TCs and instead of being work ready using CNCWMs, would display ignorance or lack of experience about the activities that carried-out under their chosen profession in the woodwork occupation, such as furniture craft. This finding corroborates the assertion by Omoh et al. (2019) that the ripping operation using CNCWMs is a means of enhancing relevant skills and competencies for furniture crafts teachers and students as well as furniture craftsmen. They however recommended that TCs should be actively involved in assisting students in getting organizations where they can seriously carry-out furniture crafts using CNCWMs practical, seminars, and where they would be engaged during their cross-cutting operations. CNCWMs had been known all through the years to TCs efforts at making students and fresh TCs furniture crafts graduates (craftsmen) to be work ready and immediately employable. It had been noted that inability of furniture craftsmen to create jobs and be employable had been attributed to the failure of CNCWMs skills and competencies.

Workshop establishment are to relate their activities to the TCs to enable students upon graduation think out what they are able to create wooden articles using CNCWMs in furniture crafts workshop. Students were not been trained to acquire hands-on-the job skills and competencies to provide necessary services that are required in the furniture crafts workshops in TCs.

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

1. Furniture craftsmen should be trains and retrain the ripping operation and related operational skills and competencies using CNCWMs in furniture crafts workshops.
2. Government should organized regular workshops, seminars and conferences on cross-cutting operation using CNCWMs to suit the furniture making efficiently and effectively.
3. Furniture workshops employers (Master Craftsmen) should supervised their craftsmen on planing operation using CNCWMs because is complex operation unlike others woodworking operations.

D. Conclusion

It has become pertinent to note that CNCWMs to note that CNCWMs operational skills and competencies is a way forward to go in enhancing the effective delivery of furniture crafts, the components of CNCWMs delivery the ripping, cross-cutting and planing operations. The aspects of students activities tends to relate job experiences active fields of study so as to attain work ready status to our TCs graduates. This study head proved that more work still have to be done in making furniture using CNCWMs to effectively and efficiently enhance the delivery of ripping, cross-cutting and planing operations.

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