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INSTRUMENT FOR ASSESSING STUDENTS' JOINERY SKILLS IN TECHNICAL COLLEGES IN NIGERIA

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Abstract:- *The study developed and validated Joinery Skills Assessment Instrument (JSAI) for technical college students based on Simpson's theory of skill development using instrumentation research. The study was carried out in Benue, Kogi, FCT and Niger states of Nigeria. The study was delimited to three out of 26 technical colleges and also 15 out of 420 students. The instrument was subjected to face, content validation and factorial validity. Face validation was carried out by three experts from the Department of Industrial and Technology Education, Federal University of Technology, Minna. The content validation was carried out by the 36 Carpentry and Joinery teachers using a table of specifications which was constructed based on Simpson's 1972 model of psychomotor domain where 106 items were retained. A pilot study produced reliability coefficient of 0.87 using Cronbach Alpha statistics. The developed Joinery Skill Assessment Instrument was trial tested in assessing 15 students in Joinery using three technical colleges. Nine research assistants (teachers of carpentry and joinery) were involved as raters (three in each school). The raters observed and assessed students while carrying out a Joinery Work Sample Practical Test (JWSPT) during the trial testing. Mean, Standard Deviations, Factorial Analysis and Spearman correlation technique (r_s) were used to answer the research questions. The results revealed that 14 tasks clusters with 101 corresponding skill items and 13 practical skills wear found valid and relevant for inclusion in the Joinery Skill Assessment Instrument. The Joinery Skill Assessment Instrument produced internal consistencies that ranged from 0.55 to 0.68 and an overall reliability of 0.64. Based on these results, it was recommended that the external examination bodies (NABTEB, NECO and WAEC) should integrate CSAI items in their examination of carpentry students, and that seminars and workshops for teachers on how to make use of the developed Carpentry Skills Assessment Instrument be organized by examining bodies.*

Keywords:- *Assessment, Instrument, Joinery Skills and TVET*

Introduction

Technical colleges basically offer skills training to learners in technical trades at the National Technical Certificate (NTC) level. Carpentry and Joinery (C&J) is one of the technical trades approved by the Federal Republic of Nigeria and included in the Technical, Vocational Education and Training (TVET) curriculum. TVET is that process of education which involves general education, the study of technologies and related sciences, and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life (Federal Republic of Nigeria, 2014). The goals of TVET are to:

1. Provide trained manpower in the sciences, technology and business particularly at craft, advanced craft and technician's levels;
2. Provide the technical knowledge and vocational skills necessary for agricultural, commercial and economic development;
3. Provide necessary skill training to individual who shall be self-reliant economically (Federal Republic of Nigeria, 2014).

Skill is an ability or expertise to perform a specific task. Joinery students in Technical Colleges (TC) are required to demonstrate skillfulness in the use of tools, materials and equipment to carry out practical tasks during training (Baird cited in Yalams, 2001, p4). Ogwo and Oranu (2006) described skilled actions in terms of sight, sound, or other impressions sent to the mind which in turn directs the muscle. Later, through practice and repetition, the actions become habitual. In this perspective the implication of education is the head, hand, heart (3H) balance to achieve

intellectual, technical and moral development. This depicts skill development in joinery as a process rather than product of training. Joinery involves the use of tools and materials such as wood, nails, screws, iron mongery and numerous chemicals in constructing doors, windows, ward robe, closets to mention but a few. To determine whether students have acquired joinery skills needed for employment and progress in joinery occupation, some assessment of performance is necessary. Performance tests are often used to measure skills. In performance test, both the process and product are measured. The National Business and Technical Examination Board (NABTEB) assess the level of skill acquired by Technical College (TC) students for certification.

Assessment is the process of manipulating and processing the results obtained from measurement to take relevant decision about what is being measured. Consequently, assessing students' skills require the use of a measurement instrument. Meaningful assessment can only be achieved with the use of a valid and reliable instrument. However, current practice by Joinery teachers of assessing the finished product alone indicates lack of valid and reliable instrument that could be used to assess joinery skills possessed by technical college students. Teachers in most cases base their assessment on completed practical tasks (Ugunduluwa, 2008). Anikweze (2005) and Okoro (2000) described three important properties of good measuring instruments: First, the instrument must be valid; secondly, the instrument must be reliable; thirdly, the instrument must be usable (it must possess the characteristics that allow it to be used by many users). In developing the Joinery Skills Assessment Instrument (JSAI) hasty attention was given to the determination of its validity and reliability.

Validity of an instrument infers that the performance attributes being measured are relevant to the skill dispositions to be judged. Reliability, a major requirement of an assessment instrument, is the ability of an instrument to measure correctly what it is designed to measure. Radhakrishna (2007) stated that it is a must to develop a valid and reliable instrument in order to reduce measurement errors. Assessing either the process or the product alone could jeopardize the whole process of skill assessment.

Statement of the problem

Assessments of the objectives of practical lessons require the use of a valid and reliable assessment instrument. Lack of valid and reliable instrument for assessing the joinery skills acquired by technical college students' during practical work has made the achievement of the objectives of joinery in Technical, Vocational Education and Training difficult (Mohammed, 2006). The implications of using invalid and unreliable instruments for assessing students' performances is that no meaningful and reliable inferences can be made from such assessment. There is need for valid and reliable instrument in order to improve the assessment of joinery skills at the technical college level. Hence the problem of the study was what valid and reliable instrument could be used for assessing technical college students' joinery skills at National Technical Certificate (NTC) level?

Research questions

1. What are the relevant operational tasks performed by joinery students for inclusion in the joinery skills assessment instrument?
2. What are the relevant joinery skills required for inclusion in the joinery skills assessment instrument?
3. How valid is the joinery skills assessment instrument?
4. How reliable is the joinery skills assessment instrument?

Hypothesis

H_{01}: There will be no significant difference among three independent raters in their scoring of students' performances using Joinery Skills Assessment Instrument (JSAI).

Methodology

A Joinery Skill Assessment Instrument (CSAI) was developed for technical college students based on Simpson's theory of skill development using instrumentation research. The study was carried out in Benue, Kogi, FCT and Niger states of Nigeria. The study was delimited to process measurement of the basic skills in design, planning, construction and finishing stages of joinery work at NTC level, with major emphasis on the use of hand and machine tools, safety practices and maintenance of tools. Practical projects were not covered because of their diversity in joinery. The study was also delimited to three out of 26 technical colleges and also 15 out of 420 students because of cost of administering the Joinery Work Sample Practical Test (JWSPT). The study was carried out using final year technical college students because they have completed the CCJ 11 & CCJ 12 joinery modules included in the NBTE syllabus. To answer research questions one and two, the mean ($\bar{x}$) was computed for every item. Items that produce a mean score of 3.0 or higher were accepted while items with scores below 3.0 were rejected and consequently not included in JSAI. To answer research question three, the data collected from trial test were subjected to factorial analysis on three components; where two of the three components are in agreement and produced a factor loading of 0.50 and above, the item was considered valid and included in the instrument. The assessment data obtained using JSAI during the trial test were correlated using Spearman Rank Correlation r_s to determine the reliability of the JSAI and provided answer to research question four. The values of the r_s were subjected to ANOVA to test the correlation of raters' scores of students' performance for significance at five percent level of probability using Statistical Package for Social Sciences (SPSS version 22.0).

Results

Table 1: Mean of Joinery Teachers on the Relevance of Operational Tasks Required for Inclusion in the Joinery Skills Assessment Instrument

S/N	Operational Tasks	Mean	SD	Remarks
1	Interpret drawing/Instructions and plan work	3.27	0.85	Required
2	Measuring and Laying out timber	3.27	0.83	Required
3	Testing for squareness	3.46	0.74	Required
4	Sawing timber	3.22	0.82	Required
5	Shaping timber	3.24	0.84	Required
6	Dressing or planning timber	3.21	0.81	Required
7	Boring and drilling	3.21	0.84	Required
8	Construction	3.36	0.97	Required
9	Assembling	3.32	0.94	Required
10	Finishing	3.30	0.86	Required
11	Maintenance of tools/equipment	3.39	0.85	Required
12	Nailing and screwing	3.60	0.73	Required
13	Setting up and using portable electric tools	3.29	0.96	Required
14	Adopting safe working practices	3.45	0.84	Required

Where: N = Number of validates (Joinery teachers); SD = Standard Deviation.

The results show that all the 14 tasks had mean values above the 3.0 value for acceptance. Evidently the respondents agreed that all the 14 tasks are relevant for inclusion in to the JSAI. The SD values for the 14 tasks ranged from 0.73 to 0.97 and were less than 1.96, 95% confidence limits. This implied that the responses of the respondents are close to one another and to the mean. This added some values to the reliability of the mean.

Table 2: Mean of Joinery Teachers on the Joinery Skills Required by Students for Practical Work

S/N	Practical Skills	N	Mean	SD	Remarks
1	Selecting appropriate tools	36	3.36	0.99	Required
2	Promptness in starting a given task	36	3.30	0.62	Required
3	Correct use/manipulation of tools	36	3.50	1.10	Required
4	Care of tools during and after work	36	3.44	0.93	Required
5	Composure when carrying out tasks	36	3.52	0.87	Required
6	Body movement/skillfulness in carrying out task	36	3.47	0.73	Required
7	Ability to complete task within a given time	36	3.80	0.82	Required
8	Demonstrate safe work habit during work	36	3.50	0.81	Required
9	Economy in the use of materials/supplies	36	3.44	0.99	Required
10	Enthusiasm/hard work in performing a given task	36	3.47	0.84	Required
11	Correct layout of shapes and sizes	36	3.52	0.87	Required
12	Systematic approach to task execution	36	3.55	0.86	Required
13	Correct handling of materials	36	3.61	0.96	Required

Where: N = Number of validates (Joinery teachers); SD = Standard Deviation.

Data showed the 13 items had mean values ranging from 3.30 to 3.80 and are above the cut-off value of 3.00. The respondents agreed that all the 13 skills are required for inclusion in the JSAI. The SD ranged from 0.62 to 1.10 and are less than 1.96 at 95% confidence limit which implied that the responses of the respondents are close to one another and to the mean.

Table 3: Summary of Factorial Analysis Conducted on Joinery Tasks

S/N	Operational Tasks	No of Items Tested	No of Items Valid	Factor Loading at 0.50
1	Interpreting drawings and planning work	7	7	0.71
2	Measuring and laying out timber	11	10	0.64
3	Testing	3	3	0.88
4	Sawing timber	9	8	0.61
5	Shaping timber	10	9	0.62
6	Dressing or planning timber	11	11	0.62
7	Boring and drilling	8	7	0.67
8	Construction	5	5	0.77
9	Assembling	5	5	0.75
10	Finishing	15	15	0.65
11	Maintaining tools and equipment	7	7	0.67
12	Nailing and screwing	4	4	0.67
13	Costing of joinery items to be included	3	3	0.79
14	Adopting safe working practices	8	8	0.68
	Total	**106**	**101**	**0.70**

The 14 tasks had factor loadings that ranged from 0.61 to 0.88 and were above the factor loading of 0.50 at 10% over lapping variance with three components. All the 14 tasks and 13 skills are valid enough and were included in the JSAI.

Table 4: Reliability Estimates of the Joinery Skills Assessment Instrument

S/N	Task Clusters	r_s	Remark
1	Interpreting drawing and planning work	0.66	Reliable
2	Measuring and laying out timber	0.63	Reliable
3	Testing	0.63	Reliable
4	Sawing timber	0.68	Reliable
5	Planning timber	0.65	Reliable
6	Shaping Timber	0.66	Reliable
7	Boring and drilling	0.61	Reliable
8	Clamping and cramping	0.63	Reliable
9	Maintaining tools and equipment	0.64	Reliable
10	Driving iron mongeries, dowels, etc. into timber	0.63	Reliable
11	Removing iron mongeries, dowels, etc	0.55	Reliable
12	Installing hardware fixtures	0.68	Reliable
13	Costing of joinery items	0.68	Reliable
14	Adopting Safe working practices	0.64	Reliable
Total estimates for the 14 Clusters		**0.64**	**Reliable**

Where: r_s = Spearman Correlation Coefficient

The 14 tasks had reliability coefficients of 0.55 to 0.68 while the entire instrument had reliability coefficient of 0.64. Therefore, given the high reliability coefficients or substantial agreement for various tasks in the instrument, the items in JSAI are reliable and can be used for assessing the joinery skills of technical college students.

Findings of the Study

1. 14 tasks with 101 corresponding skill items were relevant and included in the JSAI.
2. 13 joinery skills that should be assessed in students were validated.
3. The JSAI was found to be valid for assessing students' joinery skills.
4. The instrument was found to be reliable.
5. There was no significant difference among three independent raters in their scoring of students' performance using JSAI.

Discussion of findings

14 operational tasks satisfied all the psychometric properties of a good skill items and were included in the JSAI. Garba (1993), Okoro (2003), Olaitan (2003), Bukar (2006), Mohammed (2006) and Ombugus (2013) noted that items that satisfied all psychometric properties with high mean are relevant for inclusion in an assessing instrument. Inclusion of appropriate skill items in assessment instrument assist in measuring the learning objectives adequately. Findings also revealed 13 joinery skills that should be assessed in students during practical. Similar findings by Garba (1995) and Yalams (2001) also supported selection of appropriate of tools, correct use/manipulation of tools, care of tools during and after work as vital for competency based assessment guide for technical college instructors and joinery teachers. Findings also revealed 14 tasks and 106 corresponding skill items were valid. Face validation was the first stage of the JSAI development by three experts from the Federal University of Technology, (FUT) Minna. Stemler (2004); Mohammed (2006) and Olaitan (2003).

Bukar (2006) and Bakare (2014) posited that to establish face validity or validation, experts are hired to vet, remove, reword and replace any irrelevant item(s) of the instrument with useful ones. To ascertain the content validity of JSAI, test items were generated through job/task analysis guided by table of specifications and suggestions from experts. Amuka (2002), Ombugus (2013) and Okeme (2011) also established content validity from detailed and comprehensive table of specification and comments of some experts. Garba (1993) and Odu (2000) added that job/task analysis helps in building validity in an instrument.

A second stage of validation by 36 C&J teachers used for the study found 14 tasks and 106 test items valid for the study. In addition to face and content validation, factorial validity test was conducted using factor analysis where 14 tasks and 101 operation items were found valid enough for inclusion in the JSAI. Five operation items that failed the factorial validity test were discarded. This finding agreed with Bakare (2014), Giachino and Gallington (1977) that if content has no components of non-loading items, it is assumed that the factorial validity of the tasks or content is high. Bakare (2014), Bukar (2012), Balogun and Mustapha (2014) posited that test items that have high factor loading and satisfy other psychometric properties are important for selection. Findings on reliability of JSAI revealed that 14 tasks had reliability coefficients from 0.55 to 0.68; the 101 corresponding skill items had reliability coefficient values that ranged from 0.41 to 1.00, while the entire items had reliability coefficient value of 0.64. The 101 tasks and their items were found reliable and included in JSAI. The result is in consonance with the recommendation of (Landis & Koch, 1977) that acceptable reliability of a test or agreement of raters on students' tests in education ranged from 0.41 to 1.00. Also, the findings of Ombugus (2013), Odu (2000), Yalams (2001), Zhang and Lam (2008) who obtained a reliability coefficient values of 0.71, 0.68, 0.86, and w = 0.97 respectively using Cronbach alpha statistics gave credence to the findings of this study.

Conclusion

A standard instrument for assessing students' joinery skills in technical colleges has been realized. The developed JSAI will reduce measurement errors in students' practical assessment because all the procedures for good development and validation of test instrument were followed to fill the gap created by teaching and learning of joinery skills towards achieving the overall objectives of TVET. The practice by joinery teachers of assessing students' cognitive achievement and products of their work alone is now a past because teachers can now use the developed JSAI to assess the joinery skills possessed by TC students. This will make the assessment of joinery work comprehensive and the achievement of the objectives of TVET in joinery realizable.

Recommendations

1. Examination bodies (NABTEB, NECO and WAEC) should integrate JSAI to examine students' joinery skills.
2. Teachers of joinery should be encouraged to make use of the JSAI for assessing students.
3. Workshop and seminar should be organized for teachers on how to use the JSAI to assess joinery students.

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