JHER Vol. 21, December 2014, pp. 92-104

Workshop Based Process Skills Test in Metal Grinding for Students in Technical Colleges

Danjuma, A.O.
Department of Technical Education,
College of Education
Akwanga, Nasarawa State, Nigeria.

Abstract

The study focused on the development and validation of Workshop-Based Process Skills Tests (WBPST) for students in metal grinding trade in technical colleges. It adopted instrumentation design and was carried out in Nasarawa State. The population of the study was 25 National Technical Certificate (NTC) III students. Eighty-nine workshop-based process skill items were generated, validated and utilized to develop workshop-based process skill tests. The test was used in assessing the students in Government Technical College, Assakio. The data collected were analyzed using Cronbach Alpha, Kendall coefficient of concordance and Scheffe test. The reliability of the WBPST revealed coefficient of 0.76. It was found out that there were significant differences in the mean scores of three ability groups (high, average and low) of the students at 0.05 level of significance. The inter-rater reliability coefficient of the WBPST was 0.57. It was recommended that examination bodies, National Business and Technical Examination Board (NABTEB) and West African Examination Council (WAEC) should integrate the workshop –based process skill test items in their examination process for certification of NTC students.

Key words: Development, Validation, Process, Assessment, Skill, Metal, Grinding

Introduction

Metal grinding is one of the job areas in mechanical engineering craft programme in technical colleges in Nigeria. Students undergoing the program me are examined by the National Business and Technical Examination Board (NABTEB) for the award of National Technical Certificate(NTC). The main objective of metal grinding module is to produce competent craftsmen who will be able to produce spare parts to specifications and carry out daily maintenance of tools and equipment. The National Board for Technical Education(NBTE) (2003) curriculum specified the objectives of metal module for NTC students and emphasized that when the module is successfully completed it can be used for employment purposes. Okoro

(2012) defined grinding as a machining process which remove metal from work piece either with a revolving abrasive (grinding wheel),a moving abrasive belt, a disc or some other form. To grind means to abrade to wear away by friction or to sharpen. Metal grinding is then a module of study involving operations such as reshaping cutting tools, snagging the rough spots from castings, polishing, wheel mounting, and grinding to produce and repair valuable metal articles.

The objectives of metal grinding in NBTE (2003) is meant to achieve adequate development in skills which can make the recipient employable. To achieve this goal at the NTC level, learners need to be well assessed. Hersbatch (2010) observed that the product evaluation used by NABTEB only helps to determine students' achievement of metal grinding objectives in cognitive domain. Ogbu (2011) noted that there are negligible observable results in achievement of psychomotor objectives. Williams (2012) stated that metal grinding practical examination conducted by NABTEB and teachers are mere product rating and not process rating of students. Similarly, Bukar (2010) explained that the assessment of manipulative activities as acquired by the students in the production processes need to be ascertained through workshop-based process skill test. In Zhang and Lam (2013), workshop-based process skill test connote the presentation of step-by-step practical activities to be responded to by the learners in a typical workshop setting. In this study, workshop-based process skill test is an instrument for determining the extent to which students can demonstrate the practical competencies in metal grinding using process rating scale while the examiner observes the student perform the step by step operations involved. For effective assessment, the workshop-based process skill test should be valid and reliable.

Validity of a measuring instrument in Garba (2010) is the property that ensures that the instrument measures what it is supposed to measure. The validity of workshop based process skill test is then the extent to which the student intended practical competencies outlined in the NTC curriculum are covered by the test items. A valid test should also be reliable.

Reliability in Kaide (2013) is the ability of an instrument to measure consistently the phenomenon it is designed to measure. It is the consistency with which an instrument measure whatever it measures. The use of valid and reliable WBPST for assessing NTC Students in metal grinding will ensure that students are taught the proper way of performing tasks according to their ability level

In technical colleges in Nasarawa State, NABTEB is accorded the responsibility of assessing the performance of students in metal grinding trade. The examining body has been using product evaluation technique in the form of marking

scheme checklist. This is done at the expense of judging the production process of students through WBPST. Experience in technical colleges show that NABTEB sends her practical examination question papers to schools two weeks ahead of examination date. Students are left on their own to produce products in the workshop without their teachers' intervention. On the examination day, one examiner is sent to each college to rate finished products and marks are awarded based on mere looking and checking the end results of students' activities. Students can get assistance from outside to produce products presented for final assessment. This assessment practice is considered subjective and prone to abuse by both students and the raters. The practice of the examining body, has given room to product evaluation without students process skill development. Most metal grinding graduates lack skills and yet have good grades in their results. Ombugus (2013) observed that the objectives of metal grinding cannot be achieved with product evaluation. Evidence in the field revealed that graduates of metal grinding trade cannot practice on their own or get sustainable employment. The students' skills cannot be guarantee with the present NABTEB mode of assessment, hence the need to try out an alternative method.

Purpose of the study

The major purpose of the study was to develop and validate workshop-based process skill test items in metal grinding for assessing students in technical colleges in Nasarawa State. Specifically the study:

1. Identified Workshop Based Process Skill Test items in metal grinding at NTC III level.
2. Validated Workshop Based Process Skill Test items in metal grinding at the NTC III level.
3. Established the reliability of the developed Workshop Based Process Skill Test in metal grinding at NTC III level.

Hypothesis H_0**:** There is no significant difference in the mean ratings of students on the workshop-based process skill test in metal grinding based on their ability levels (High, Average and Low).

Methodology

***Design of the study*:** The study utilized instrumentation research design, which deals with the process of developing an instrument for assessing the performance of students or obtaining data for making decisions.

***Area of the study*:** This study was carried out in Nasarawa state and covered the four technical colleges in the state.

***Population for the study*:** The population for the study was 25 NTC III students in government technical college Assakio, comprised of three ability groups (High, Average, and Low). The population consisted of 21 males and 4 females within the age range of 11 and 18years. There was no sampling because the population was manageable.

***Instrument for the study*:** The workshop based process skill test that consisted of 12 tasks and 89 process skill items was developed as the instrument for the study. The following steps were involved in the development of the instrument: Identification of the tasks in the metal grinding curriculum, Identification of parameters that were used to develop the workshop based process skill test, Preparation of table of specification and Construction of workshop based process skill test items. The tasks and skill items developed are shown in Tables 1 – 3.

***Validation of Instrument*:** To determine important process skills for inclusion into the final test instrument, the following validations were carried out – Factor analysis using 0.40 as factor loading at 10% over lapping variance Ashley, Boyale and Haile, (2010). In the results, 89 skill items with factor loading of 0.40 and above were selected for the study. A table of specification was developed based on the curriculum content given due consideration to the six levels of Simpson's (1972) level of psychomotor domain. This helped in ensuring that the 89 process skill items were adequately distributed across the levels of the domain.

The table of specification, the draft workshop-based process skill test and the curriculum of mechanical engineering craft at NTC level were validated by three experts in the department of Vocational Teacher Education (VTE) and two in Measurement and Evaluation unit, department of Science Education, all in University of Nigeria, Nsukka. The experts reviewed the appropriateness of the face validity of items in measuring students' process skills. Their corrections and suggestions were utilized in improving the test.

***Reliability of Instrument*:** The internal consistency of the metal grinding process skills items were determined using Cronbach alpha method to analyze test scores of the 25 NTC III students who were used for the field testing of the test. The result revealed reliability coefficient of 0.71. Based on the suggestion of Balogun and Mustapha (2012), every fifth out of the 25 students were systematically selected and rated by five teachers. Their rating scores were analyzed using Kendall coefficient of Concordance (Tau). The results revealed that the Kendall correlation coefficient between raters one and two is 0.71; two and three is 0.81; three and four is 0.60 and four and five is 0.80. Each of these scores represents the degree of relationship or association between the ratings of the 4- paired raters on level of performance among the 25 students of metal grinding trade. Sensiter (1996) in Okeme (2011) stated that tests with reliability coefficient of 0.70 and above are considered sufficiently reliable to be of practical use. This means that the WBPST in metal grinding is reliable.

***Data Collection and Analysis*:** The workshop-based process skill test was trial-tested in government technical college, Assakio. Data were collected during students practical activities.

Cronbach alpha method was utilized to establish the internal consistency of the questionnaire items. The result revealed reliability coefficient of 0.71.

***Development of WBPST*:** The findings revealed that teachers and technicians of metal grinding trade were used to develop WBPST for the study. The developed WBPST was built on a five-point scale namely: Very Low (VL); Low (L); Moderately High (MH); High (H) and Very High (VH). These levels of responses were weighted as 1, 2, 3, 4, and 5 respectively.

***Assessment of students*:** The workshop-based process skill test was administered on the students of metal grinding using raters to determine the extent of skills they possessed. Factorial analysis was used to determine WBPST items. Simpson (1972) psychomotor domain levels and experts' comments were utilized to establish validity of WBPST. Reliability of WBPST was established using Cronbach alpha coefficient, while ANOVA was employed to test the hypothesis at 0.05 level of probability.

***Results of the study*:** The results of the study are presented according to headings that correspond to the purposes of the study and the hypothesis tested:

1. Workshop-based process skill test items for assessing students' skills in metal grinding at NTC level

Twelve tasks with their 89 corresponding process skill items were found suitable for inclusion in the workshop-based process skill test. See tables 1 – 3.

Table 1: Factor analysis result on process skill items in Mounting grinding wheel on machine spindle, Grinding metal object with surface grinder, Sharpening a cutting tool with a grinding wheel and Dressing and truing grinding wheel.

S/N	WBPST Items	Factor loading	Remark
1	Testing wheel for damage/crack	.687	Important
2	Selecting washers or blotters	.806	"
3	Checking lead bush for burrs and fit	.643	"
4	Pushing wheel on spindle	.472	"
5	Tightening flange nut	.806	"
6	Test-running wheel without load	.744	"
7	Test-running with load *	.341	Not Important
8	Cleaning work-piece	.512	Important
9	Wiping magnetic chuck with clean cloth	.759	"
10	Greasing magnetic chuck *	.285	Not Important
11	Centering work piece on the chuck	.560	Important
12	Adjusting the table reverse dogs	.633	"
13	Turning on the coolant valve	.486	"
14	Adjusting the rate of table feed	.686	"

15	Turning on the power	.449	"
16	Hand feeding the table in until work piece is under grinding wheel	.693	"
17	Adjusting grinding wheel down until it is near the work piece	.679	"
18	Turning on the power table feed	.433	"
19	Turning the cross-feed out one fourth the width of the grinding	.542	"
20	Wheel Grinding the entire work piece surface	.696	"
21	Checking the condition of the tool	.605	"
22	Hand-running the grinding wheel	**.529**	**Important**
23	Removing burrs or dirt from work piece	.434	"
24	Turning on power	.773	"
25	Holding the tool and pressing against wheel at correct angle	.722	"
26	Dipping the tool in water regularly	.582	"
27	Grinding to required angle	.605	"
28	Checking the condition of the wheel	.743	"
29	Rising with oil *	.285	Not Important
30	Selecting wheel dresser	.636	Important
31	Wearing safety goggles	.892	"
32	Turning on power	.647	"
33	Holding dresser on tool rest	.734	"
34	Feeding the dresser across the wheel until it is true	.778	"

The data in Table 1 revealed that three skill items could not load and were not important.

Table 2: Factor analysis result on process skill items in maintaining grinding machine, hand polishing a metal article, sharpening centre punch on bench grinder and sharpening in screw driver in bench grinder.

S/N	WBPST Items	Factor loading	Remark
1	Checking the condition of the machine	.427	"
2	Taking measurement *	.331	Not Important
3	Cleaning oil, chips and other dirts	.598	Important
4	Toping oil level	.631	"
5	Greasing mating parts	.648	"
6	Adjusting slides	.835	"
7	Cutting a strip of abrasive cloth from a roll or sheet	.696	"
8	Wrapping it round a stick or file	.670	"
9	Applying a few drops of oil to the metal surface	.717	"
10	Rubbing the cloth back and as if you were sanding. Do not rock the tool, keep it flat.	.458	"
11	Removing all scratches to make abrasive grains	.757	"

	float in oil on the surface		
12	Reversing the cloth, exposing the back. Rubbing back and forth to get a high polish.	.572	"
13	Checking the condition of the punch	.614	"
14	Test running the grinding wheel with hand	.688	"
15	Turning on power	.555	"
16	Holding punch to the wheel at the correct angle	.863	"
17	Pressing the punch against the grinding wheel	.654	"
18	Swinging the punch from side to side by pivoting it over the tool rest	.421	"
19	Ensuring correct angle of the punch	.849	"
20	Dipping the punch in water regularly	.769	"
21	Checking the correct point angle of the punch	.633	"
22	Checking the condition of the screw driver	.611	Important
23	Test running the grinding wheel with hand	.471	"
24	Filing either side of the point to remove dirts	.486	"
25	Turning power of the grinding machine	.509	"
26	Grinding each side of the point a little a time	.691	"
27	Grinding the tip square	.516	"
28	Dipping the tool in water often to keep it cool	.797	"

In Table 2, the result shows that one skill item has less than 0.40 factor loading and as such was not important.

Table 3: Factor analysis result on process skill items in sharpening cold chisel on pedestal grinder, sharpening a twist drill on pedestal grinder, polishing metal article with compound wheel and polishing a metal article with coated abrasive.

S/N	WBPST Items	Factor loading	Remark
1	Selecting the chisel *	.293	Not Important
2	Checking the condition of the chisel	.491	Important
3	Hand running the grinding wheel	.663	"
4	Removing burrs from cutting edge with file	.508	"
5	Switching on the grinding machine	.422	"
6	Controlling chisel movement	.821	"
7	Holding one side of cutting edge against the face of the wheel and moving it back and forth in an arc	.697	"
8	Grinding the second side to form a sharp edge	.694	"
9	Cooling the chisel at interval of grinding	.426	"
10	Checking the condition of the twist drill	.496	"
11	Switching on the grinding machine	.599	"
12	Grasping the drill near the point in your right hand, with your left hand holding the shank	.824	"

13	Holding the lip of the drill at an angle of 59 degree to the grinding wheel	.864	"
14	Turning the drill in a clockwise direction, at the same swinging the shank down in an arc of 12-15 degrees	.699	"
15	Grinding a little off each cutting edge	.773	"
16	Dipping the drill coolant at intervals	.604	"
17	Checking with a drill-grinding gauge for current cutting edges length and angles	.457	"
18	Listing out materials for polishing	.497	"
19	Selecting the type of article to be polished	.411	Important
20	Attaching a clean, soft cloth wheel to the head of the polishing machine	.518	"
21	Selecting a stick of greaseless polishing compound	.623	"
22	Turning on the machine	.639	"
23	Holding the abrasive stick against the turning wheel until the face is coated	.890	"
24	Holding the work piece firmly in your hands,	.642	"
25	Moving it back and forth across the wheel until the scratches have been removed	.792	"
26	Selecting the type of article	.788	"
27	Stating the conditions of the metal article	.747	"
28	Fixing the abrasive belt around two or three pulleys	.511	"
29	Turning on power	.643	"
30	Holding the work against the belt in the areas between the pulleys	.483	"
31	Moving the work piece back and forth	.570	"
32	Applying even pressure for a good polish	.441	"

The data in Table 3 reveals that one skill item could not load and was not important.

From the results above, it was found out that the twelve tasks with their 89 corresponding skill items were important in assessing students' skills in metal grinding operation in technical colleges.

ll. Validity of the developed workshop-based process skill tests for assessing students' skills in metal grinding at NTC level

The validity of an instrument in Odu (2012) is the degree to which a test measures what it is designed to measure. An instrument with high validity will measure accurately the particular qualities it is supposed to measure. The validity of WBPST is then, the extent to which the students

intended practical competencies outlined in the curriculum are covered by test. In this study, the table of specification constructed based on Simpson (1972) levels of psychomotor domain showed that 6 levels were adequately covered and satisfactory comments were made by experts on the test. On the whole as shown in Tables 1-3 above, there were 12 tasks with their 89 corresponding process skill items in metal grinding in the study.

III. Reliability of the developed workshop-based process skill tests for assessing students' skills in metal grinding at NTC level

The result of the internal consistency of the workshop-based process skill test items are given in Table 4 below.

Table 4: Reliability estimate (Cronbach alpha) for items in metal grinding operation of WBPST

S/N	Task	Cronbach alpha	No. of items	Remark
1	Mounting wheel in machine spindle	0.66	6	Very high
2	Grinding metal object with surface grinder	0.74	12	"
3	Sharpening a cutting tool with a grinding wheel	0.76	7	"
4	Dressing and truing grinding wheel	0.65	6	"
5	Maintaining grinding machine	0.76	6	"
6	Hand polishing of a metal article	0.82	6	"
7	Sharpening centre punch on the bench grinder	0.81	8	"
8	Sharpening a screw driver on bench grinder	0.74	7	"
9	Sharpening cold chisel on pedestal grinder	0.63	7	"
10	Sharpening a twist drill on pedestal grinder	0.71	8	"
11	Polishing metal article with compound wheel	0.74	6	"
12	Polishing a metal article with coated abrasive	0.74	6	"

Table 4 reveals that each of the 12 grinding tasks had a high reliability coefficient ranging from 0.63 to 0.82. Also the reliability coefficient of the entire test was computed to be 0.71 which indicated that the assessment instrument was a refined test in consonance with the recommendation of Uzoagulu (2011) who stated that acceptable reliability of test use in education is generally in the range of 0.50 – 0.95. Therefore given the reliability coefficients of the various grinding tasks would be in the affirmative. Thus, the items in WBPST were reliable and considered for assessing metal grinding students' skills in technical colleges.

H_0: The summary result of analyzed data for the hypothesis is presented in Table 5.

Table 5: Summary of Analysis of variance on the mean ratings of students on workshop-based process skill test on grinding operation based on their ability levels.

	Sum of Squares	DF	Mean of Squares	F	Sig. (P-Value)
Between groups	1.4502	2	0.70744	1.05098	0.4982
Within groups	15.43938	22	0.70176		
Total	16.8544	24			

P – Critical = 0.05.

Table 5 reveals the mean ratings of teachers on students' performance on skill items in metal grinding. The analysis indicated that there was significant difference in the mean scores of the three groups of students at 0.05 level of significance, df 2 and 22. In all the 89 skill items (except items 051 and 052), the P – value calculated were significant at 0.20 which is greater than 0.05 probability level. This means that the null hypothesis of no significant difference was accepted in all the WBPST items but rejected for items 051 and 052.

Discussion of the Findings

The findings that 43 items with high factor loading were found suitable for inclusion in the workshop-based process skill test was supported by the conclusions of Jimoh(2010), Williams (2011) and Ugbalu(2012). In their various studies, the authors concluded that test items that have high factor loading and satisfy other psycho-metric properties are important for selection. In this study, item 31 in task 4 had the highest factor loading of 0.892 probably because of the importance of safety in metal working. Miller (2011) and Ombugus(2013) observed that safety is a vital skill in metal industries. The authors added that metal grinders skillful in safety precautions produce accurate and better articles. Three out of 46 process skill items had factor loading below 0.40 and so needed exclusion. Eighty nine process skill items had factor loading ranging from 0.411 to 0.892 portraying them with their corresponding 12 tasks as suitable and were used to develop the WBPST.

The content validity of the workshop-based process skill test was ascertained by critical analysis of each item by specialists in industrial technical section of vocational and teacher education, and measurement and evaluation unit, University of Nigeria, Nsukka. As pointed out by Okeme(2011) and Zhang & Lam(2013) that the content validity of psychomotor learning activities could be pursued by submitting the list of skill items drawn up for use to experts for review so as to yield compromise or consensual agreement on the importance of the items and such was

the case in this study. The draft test was further content validated for representativeness by building a detailed and comprehensive table of specification based on six levels of Simpson's(1972) model of psychomotor domain. This result was in agreement with the assertion by Odu(2010), Ogbu(2011) and Okoro(2012) that the fairer the degree of distribution of test items ,the better representation of the behavioral domain and the higher the content validity of the test.

Eighty nine skill items in metal grinding had reliability coefficient of 0.71. This indicated that all the items were reliable in the six levels of Simpson's taxonomy tested. These results are in agreement with the findings of Cohen, Manion and Morrison (2011) in a study on development and validation of metalwork process evaluation scheme, where it was found out that the instrument had good reliability with Cronbach alpha coefficient of 0.83. The findings also agree with the findings of Ashley, Boyale & Haile (2010) in a study on development and validation of Racquet Ball Skills Test for Adult Beginners in Cleveland where the test had a high reliability of Cronbach coefficient of 0.68. The findings of this study on reliability is in consonance with the findings of Jimoh(2010) in a study on development and validation of objective test items in physics for class nine in Rawalpindi city, Pakistan, where it was found out that the test had a reliability coefficient of 0.75.

The study further found out that there were significant differences in the mean performances of the three groups of students (high, average and low) on the workshop-based process skill test in metal grinding. Hence, the null hypothesis of no significant difference was rejected. This finding of the study is in agreement with the findings of Bukar (2012) in his study on development of an Instrument for evaluating practical projects in electronics in Kaduna polytechnics, Nigeria. The study found out that there were significant differences in the mean scores of high and low abilities but no significant difference in the mean scores of high and average abilities. The findings of the above authors gave credence to the findings of this study.

Conclusion

The developed workshop-based process skill test has provided a readily available process assessment instrument of high quality for the realization of skill development in students of metal grinding in technical colleges. Test developers, NABTEB, teachers and students would benefit from the study in terms of test preparations, certification processes, teaching and learning of metal grinding at the NTC level. The implementation of the developed test would no doubt remove the inconsistencies associated with assessment of skills in metal grinding. If the WBPST is implemented, there will be assurance of skill acquisition

which would enhance the possibility of employment after graduation.

Recommendations

In view of the findings and discussions, the following recommendations were made:

- The external examination bodies(NABTEB and WAEC) should integrate WBPST items in their examination for certification of the students.
- Seminars and workshops should be organized for teachers on process skill assessment.
- Evaluators in technical education should use WBPST to study their curricular, structure their contents into relevant tasks and develop similar tests in their respective subject areas.

References

Manion, K.O. (2011). Students' ability level and their competency in problem-solving task in physics. Retrieved on 5th January, 2012 from http://www.soeagra.com/ijert/vol.2/7.pdf.

Miller,R.(2011) Development and Standardization of performance based tests in Agricultural science for secondary schools in Ondo State. International Journal of Educational Research, Faculty of Education, university of Nigeria, Nsukka. 11(1),85-89.

Ashler, Boyale and Haile (2010). Adaptation decision and use intensity of soil and water conservative measures by small holders subsistence farmers in Dodo District, Western Ethiopia. Hand degradation and Development, vol. 18: 289 – 302.

Balogun, K.O.& Mustapha, A.O. (2011). Development Validation of Psycho-Productive Test in Sheet Metalwork for assessing Students in Technical Colleges in Bauchi, State. *Journal of Nigerian Association of Teachers of Technology(NATT)13(1),*136-143..

Bukar, J., (2012). Development of an Instrument for Evaluating Practical Project in Electronics. in Kaduna Polytechnic. *Nigerian Vocational Association Journal(NVAJ). 17(2),*36-43.

Crowder,V.L.(2010).Assessment of Pre-Service and In-Service. Retrieved on 3rd February 2013 from Fao.Org/sd/Exdirect/Exanoo1.htm.

Garba,N. L.(2010).Evaluating Students' Practical Projects in Technology Education. *Spectrum Journal*,(2) 2, 164-173.

Hersbatch, D.R.(2010). Deriving Instructional Content Through Task Analysis. U.S.A. *Journal of Industrial Teacher Education(13)3*, 63-71.

Jimoh,J,A. (2010).Management skills Required by Motor Vehicle Mechnics Work Students Establishing Small and Medium Scale Enterprises in a Global Market Economy. Nigeria Association of Teachers of Technology(NATT).15(2),211-221.

Kaide,A.L.(2013).An Assessment of Teaching Effectiveness of Pre-Vocational Subjects Teachers in Ogun State, Nigeria. Retrieved on 5th March,2014 from htt://www.academic journal.org/JJVTE.

National Board for Technical Education (2003). *National Technical Certificate and Advance National Technical Certificate Programmes, Currilum and Module Specifications in Mechanical Engineering Craft.*

Odu,O.K.(2012).Development and Validation of an Instrument forAssessing Studeents Psychno-performance in Block laying and concreting. Nigerian Vocational Association Journal.17(1)123-132.

Ogbu, E. J. (2011). Development and Factorial Validation of Basic Electricity Interest Inventory. *Nigeria Vocational Association Journal, 14(1)*1-12.

Okoro, E.N (2012). Improving Students' Skill Acquisition through Industrial Technical Education in Tertiary Institution in Anambra. *Nigeria Vocational Association Journal(17)1,*17-22.

Okeme, I. (2011). Development and Validity of Psycho-Productive Skills Multiple Choice Items for Students in Agricultural Science in secondary schools. (Unpublished Ph. D Thesis) submitted to the Department of Vocational Teacher Education, University of Nigeria, Nsukka.

Ombugus,D.A.(2013). Development and Validation of Workshop-based Process Skill Test in Mechanical Engineering Craft for Assessing Students skills in Technical Colleges in Nasarawa State, Nigeria.(Unpublished Ph.D Thesis) submitted to the Department of Vocational Teacher Education, University of Nigeria, Nsukka.

Simpson, E., (1972). The Classification of Educational Objectives in the Psychomotor Domain. *The Psychomotor Domain*, (3) Washington, DC: Gryphon House.

Ugbalu,N.M.(2012).Development and Validation of Metal work Process Evaluation Scheme for NCE(Tech,) Students. International Institute for Science, Technology and Education. *Journal of Education and Practice5(1),*63-72.

Williams, P.S. (2012). Skill Acquisition: A Tool for Youth Development and Empowerment, Nigerian Association of Teachers of Technology (NATT) 22nd Annual National Conference, p. 184 – 188.

Zhang, J.J. & Lam E.T.C(2013). Development and Validation of a Racquetball Skill Test Battery Young Beginners. Retrieved on 3rd February from Fao.Org/sd/Exanool1.htm