Development and Validation of Instrument for Assessing Students Practical Skills in Building Super-Structure Operations in Nigerian Secondary Schools

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Abstract: The aim of the study is to develop and validate an instrument for assessing students' practical skills in building super-structure operations in Nigerian secondary schools. Five research questions guided the study. The study adopted instrumentation design. The area of the study was Taraba State. The population for the study was 107 comprising 82 final year senior secondary school building construction students, 18 building construction teachers and seven professional builders. The sample size for the study was 47 which comprised all the 22 students offering building construction subject at Government Technical Training School, Jalingo, All the 18 teachers and the seven professional builders. The instrument used for data collection was Building Super-structure Practical Skills Assessment Instrument (BSPSAI). The instrument was face validated by three experts. Content validation was carried out using a table of specifications based on Simpson's model of psychomotor domain. Factor Analysis was used to determine the construct validity of the instrument and a benchmark of 0.35 was pegged as an index for acceptance of an item. Mean was used to select the specific performance objectives of the instrument. The developed instrument was tried out on the 22 students offering building construction subject at Government technical Training School, Jalingo. Findings from the study indicated that 6 practical task items, 88 practical skill items, and five performance objectives were found to be appropriate for inclusion in the instrument. All the 6 practical task items and the 88 practical skill items were found to be valid. The internal consistency of the instrument was found to be 0.81 while the interrater reliability coefficient of the developed instrument was 0.80, indicating that there was a high degree of agreement among all the four raters used in the study. Based on the findings, it was recommended among others that the major examination bodies should ensure that practical task and skill items of all the major operations found in building construction curriculum are included in their instrument for the conduct of terminal examinations. NERDC should ensure that appropriate and comprehensive guidelines on methods of assessing building construction subject are embedded in the curriculum for proper guidelines.

Keywords: Validation, Instrument, Assessing, Skills, Building, Super-Structure

1. Introduction

Building construction is one of the technology subjects taught in senior secondary schools or its equivalent such as science and technical colleges. The subject is concerned with equipping the students with both the theory and practical skills needed to undertake simple building construction work. It also prepares the students for further studies in the field of technology either in the polytechnic, universities or other institutions of higher learning. Building super-structure is one of the major operations taught in building construction subject (NERDC, 2012). Building super-structure operations is concerned with the tasks carried out above the structural ground level of a building. These include wall construction, ceiling construction, suspended upper floor, roof trusses construction among others. It is therefore a critical

component that made up the building structures. Students are therefore expected to acquire adequate skills in executing this operation. In order to determine the level of skills acquired by the students in the course of their studies, there is a need for the students to be assessed using an assessment instrument.

Assessment instrument is a scheme used to determine the level at which the learner exhibits a behavior or the quality of that behavior particularly while is being observed by an assessor or a team of assessors. Instruments to be used for assessment of practical skills in building construction subject in Nigerian secondary schools and indeed all other subjects according to Uzoagulu (2011) must possess the following two key attributes for it to be useful in the assessment processes- validity and reliability. Validity of an instrument refers to the degree to which an instrument measures what it is supposed to measure. Reliability on the other hand refers to the degree to which an assessment tool produces stable and consistent results (Ombugus, 2014). When a test is carried out at different sessions or under the assessment of different raters, the degree in which the results obtained relate with another is referred to as reliability.

Despite the laudable objectives of teaching building super structure operations component of senior secondary school building construction, several studies (Olaitan, 2014; Ombugus, 2014 & Umanah, 2016) indicated that the current way of assessment of practical skills in technical and vocational subject related areas, including building super-structure component of building construction subject in Nigerian secondary schools is marred by the inability of most of the teachers to develop good assessment instrument. This is evident in the fact that the researcher observed that most of the students graduate with good grades, but they can't perform the tasks and exhibit competencies expected of them in the field of work. This is an indication that the students were merely handed an undeserved grade. There is therefore a convincing reason to develop and validate instrument for assessing practical skills in building super-structure in Nigerian secondary schools.

2. Research Questions

The findings of the study provided answers to the following research questions:

1. What are the practical task contents appropriate for inclusion in the instrument?
2. What are the practical skills appropriate for inclusion in the instrument?
3. What are the specific performance objectives of the practical task contents of building super-structure operations?
4. What is the validity of the developed instrument?
5. What is the reliability of the developed instrument?

3. Method

The study adopted instrumentation design. This type of design is aimed at developing and authenticating the capability of an instrument for the purpose of measurement of a given behaviour. The area of the study is Taraba State. The state is located in the north-eastern part of Nigeria and consists of 16 local government and two development areas. The population for this study is 107, which consist of 82 building construction students in the final year of senior secondary school, 18 teachers teaching building construction subject in the 8 senior secondary schools offering building construction subject in Taraba State, and the seven professional builders employed by the Taraba state ministry of works.

The sample size for this study is 47. There was no sampling in the selection of teachers and professional builders, therefore, all the 18 teachers and the seven professional builders formed part of the sample size. However, for the students, only the 22 final year senior secondary school student offering building construction subject in Government Technical Training School, Jalingo were purposively selected for the try out on the developed instrument. In order to determine the adequacy of the sample size and the suitability of the data for Factor Analysis, a Kaiser-Mayer-Olkin (KMO) Test was administered; and a value of 0.72 was obtained which according to Keiser as reported by IBM Knowledge Center (2019) is adequate for the exercise.

The instrument used for data collection was building super-structure practical skills assessment instrument (BSPSAI). The instrument was developed by the researcher based on the NERDC curriculum for building construction subject. The instrument is divided into two parts. Part one sought for the status of the respondent, while the part two which has three sections contained items that elicit for data to answer the research questions. A five point scale of Very High (VH), High (H), Moderately High (MH), Low (L) and Very Low (VL) were written against each statement to enable the teachers and the professional builders identify the level of appropriateness of each item for inclusion in the instrument. The following stages which usually characterized instrumentation design for assessment of psychomotor outcomes was adopted:

1. Isolation of objectives of assessment from the curriculum
2. Identification of psychomotor skills areas in the building construction curriculum
3. Development of table of specifications
4. Generation of practical tasks, skills, and corresponding performance objective items
5. Content validation of the draft assessment instrument
6. Development of rating scale for the practical skills assessment instrument
7. Field testing of instrument to determine validity and reliability
8. Final selection of practical skill items
9. Final Assembly of the selected items
10. Development of guidelines on how to use the instrument.

A table of specifications was developed based on the curriculum content and in line with the six out of the seven levels of Simpson's model of psychomotor domain. This is to ensure that the practical skill items are effectively distributed across the six levels of the domain. The draft practical skills assessment instrument was submitted for validation to three experts: one of the experts who specialized in building construction is a teacher at Government Science and Technical College, Potiskum; one expert is a professional builder in the employment of Taraba State University, Jalingo, while the remaining one is an expert in measurement and evaluation at Nnamdi Azikiwe University, Awka. The instrument was administered on the building construction teachers and the professional builders by the researcher and his assistants in their respective establishments. At the try-out stage, the instrument was administered on 22 SS 3 building construction students in Government Technical Training School, Jalingo, Taraba State under examination condition.

To answer research questions 1 and 2, the identified practical tasks and practical skill items the data obtained was subjected to factor analysis using 0.35 factor loading as a benchmark for acceptance (Abonyi,

2003). Mean was used to analyze data to answer research question 3 which seeks to determine the specific performance objectives of the practical task contents of building construction subject, any item with a mean rating ≥3.50 which is the lower limit of "High" on a five-point Likert type scale was considered as appropriate for inclusion. In answering research question 4, table of specifications was used to ensure the content validity of the instrument in line with Simpson's taxonomy of the psychomotor domain. This is in addition to the valuable comments of experts in building construction, and measurement and evaluation. Data for research question 5 was analyzed using Cronbach alpha and Spearman Rank Order Correlation.

3. Results

Research Question 1

What are the practical task contents appropriate for inclusion in the building super-structure practical skills assessment instrument?

Table 1: Practical task contents appropriate for inclusion in the building super-structure practical skills assessment instrument

S/N	Operations/Practical Tasks	Factor Loading	Remarks
	Building Sub-Structure Operations		
1	Blocks making	0.70	Appropriate
2	Wall Construction	0.51	Appropriate
3	Suspended Upper floor Construction	0.81	Appropriate
4	Roof Trusses Construction	0.61	Appropriate
5	Roof Covering	0.63	Appropriate
6	Ceiling Construction	0.93	Appropriate

In Table 1, data revealed that the six practical tasks presented had their factor loading > 0.35. Based on this, it can be concluded that the six practical tasks were found to be appropriate for inclusion in the building super-structure practical skills assessment instrument.

Research Question 2

What are the practical skills appropriate for inclusion in the building super-structure practical skills assessment instrument?

Table 2: Practical skills appropriate for inclusion in the building super-structure practical skills assessment instrument

S/N	Practical Skills	Factor Loading	Remarks
	A student should be able to:		
	Task 1: Blocks Making		
1	Select suitable materials	0.98	Appropriate
2	Batch the materials to correct specification	0.73	Appropriate
3	Mix the material	0.65	Appropriate
4	Apply the right quantity of water	0.92	Appropriate
5	Lubricate the mould	0.85	Appropriate
6	Fill the mortar into the mould	0.62	Appropriate
7	Tamp the mortar to close voids	0.83	Appropriate
8	Demould the finished product	0.65	Appropriate
9	Cure the blocks	0.84	Appropriate
10	Stack the blocks	0.87	Appropriate
	Task 2: Wall Construction		
11	Select suitable materials	0.34	Inappropriate
12	Check the sand to ensure that it is hard, durable and clean	0.89	Appropriate
13	Check the cement for the presence of any visible lump	0.78	Appropriate
14	Batch the materials to correct specification	0.63	Appropriate
15	Mix the material	0.95	Appropriate
16	Use water of right quantity and quality	0.78	Appropriate
17	Form the blocks in its rightful position	0.90	Appropriate
18	Get the angles as per the design	0.95	Appropriate
19	Select the right type of bonding method	0.67	Appropriate
20	Spread the mortar evenly “course by course”	0.67	Appropriate
21	Get the horizontal level	0.84	Appropriate
22	Get the vertical uprightness	0.86	Appropriate
23	Transfer the vertical level to other partitions	0.90	Appropriate
24	Consolidate the joints mortar	0.84	Appropriate
	Task 3: Suspended Upper Floor Construction		
25	Determine the positions of column and beams from the blueprint	0.95	Appropriate
26	Determine the size and shape of beams	0.56	Appropriate
27	Determine the size of reinforcement	0.92	Appropriate
28	Measure and mark out the formwork	0.63	Appropriate
29	Saw the formwork as per the measurement	0.85	Appropriate
30	Install the formwork appropriately	0.56	Appropriate
31	Measure and mark out the stirrup as per the design	0.97	Appropriate
32	Cut the stirrup to size	0.78	Appropriate

33	Bending the stirrup to shape	0.76	Appropriate
34	Measure and mark out the main bars as per the design	0.76	Appropriate
35	Cut the main bars to size	0.44	Appropriate
36	Bend the main bars to shape	0.54	Appropriate
37	Measure and mark out the runners as per the design	0.52	Appropriate
38	Cut the runners to size	0.67	Appropriate
39	Bend the runners to shape	0.87	Appropriate
40	Link the stirrup, main bars and the runners appropriately	0.78	Appropriate
41	Produce the spacers	0.84	Appropriate
42	Measure the cover	0.62	Appropriate
43	Determine the thickness of the slab	0.57	Appropriate
44	Select concrete materials	0.84	Appropriate
45	Batch the material as per the design	0.63	Appropriate
46	Mix the materials	0.85	Appropriate
47	Use the right water/cement ratio	0.52	Appropriate
48	Transport the concrete to its place of placement	0.97	Appropriate
49	Place the concrete at a reasonable height	0.65	Appropriate
50	Compact the concrete to close voids	0.63	Appropriate
51	Finish the concrete surface	0.95	Appropriate
52	Cure the concrete	0.95	Appropriate
	Task 4: Roof Trusses Construction		
53	Select the right material	0.67	Appropriate
54	Prepare material estimates	0.89	Appropriate
55	Measure and mark out the position of members	0.45	Appropriate
56	Cut material to size	0.56	Appropriate
57	Determine the roof layout	0.87	Appropriate
58	Place the wall plate in position	0.73	Appropriate
59	Place the tie beam in position	0.87	Appropriate
60	Determine the height of the kingpost	0.93	Appropriate
61	Position and fasten the kingpost	0.74	Appropriate
62	Fasten the rafters	0.72	Appropriate
63	Link the rafters and the tie beam with struts	0.62	Appropriate
64	Determine the spacing of the purlin	0.83	Appropriate
65	Fasten the purlin	0.88	Appropriate
66	Determine the position of facia board on the eaves	0.90	Appropriate
67	Cut the eaves “tail”	0.73	Appropriate
68	Fasten the facia board to the eave’s “tail”	0.82	Appropriate
	Task 5: Roof Covering		
69	Select the right material	0.68	Appropriate
70	Determine the gauge of the roofing sheet	0.67	Appropriate
71	Fix washers and gaskets on the roofing nails	0.89	Appropriate

72	Fasten the roofing sheet on the purlin as per specification	0.73	Appropriate
73	Overlap one corrugation for water tightness	0.97	Appropriate
74	Trim the eaves of the roofing sheet where necessary	0.78	Appropriate
75	Fix the ridge cap	0.89	Appropriate
76	Fix the eave flash	0.93	Appropriate
77	Inspect the installation to seal all identified “holes”	0.78	Appropriate
	Task 6: Ceiling Construction		
78	Determine the height of the headroom	0.67	Appropriate
70	Mark out the height vertically on the wall surface	0.74	Appropriate
80	Take level across the length and the breath of the wall enclosure	0.86	Appropriate
81	Cut the 2“x2” noggin materials to size	0.89	Appropriate
82	Fix the noggin on the wall surface as marked out	0.73	Appropriate
83	Establish the spacing between the noggins	0.96	Appropriate
84	“Brace” the noggin and link it with the tie beam	0.99	Appropriate
85	Fix the noggin as marked out	0.52	Appropriate
86	Fix the ceiling board as per the noggin arrangement	0.68	Appropriate
87	Measure the length of the noggin	0.59	Appropriate
88	Cut the batten to size	0.86	Appropriate
89	Fasten the batten as per the noggin arrangement	0.73	Appropriate

Data presented in Table 2 indicated that 88 out of the 89 practical skill items presented had their factor loading > 0.35. Only item 11 factor loaded < 0.35. Based on this, it can be concluded that 88 practical skill items were found to be appropriate for inclusion in the building super-structure practical skill assessment instrument.

Research Question 3

What are the specific performance objectives of the practical task contents of building super-structure?

Table 3: Specific performance objectives of the practical task contents of building super-structure

S/N	Performance Objectives	Mean	Remarks
1	Identify appropriate tools for the task accomplishment	4.42	Appropriate
2	Use working tools appropriately	4.37	Appropriate
3	Read and interpreted blueprints	3.22	Inappropriate
4	Conserve materials and supplies	3.48	Inappropriate
5	Consider safety measures	3.90	Appropriate
6	Execute task Independently	4.24	Appropriate
7	Ensure quality of the completed task	3.83	Appropriate

In Table 3, the respondents rated the specific performance objectives of the practical task contents of building super-structure. The mean rating ranges from 3.22 to 4.42. Items 3 and 4 had mean rating of 3.22 and 3.48 respectively which is < 3.50. The other five items had their mean ratings > 3.50. Based on this, it can be concluded that five specific performance objectives were considered by the respondents as appropriate for inclusion in assessing students' practical task in building super-structure.

Research Question 4

What is the validity of the developed instrument for assessing practical skills in building super-structure in Nigerian Secondary Schools?

Table 4: Validated practical tasks and skill items for assessing practical skills in building super-structure in Nigerian secondary schools

S/N	Operations	No. of Skills Items	Remarks
1	Blocks making	10	Valid
2	Wall Construction	13	Valid
3	Suspended Upper floor Construction	28	Valid
4	Roof Trusses Construction	16	Valid
5	Roof Covering	9	Valid
6	Ceiling Construction	12	Valid
	Total	88	Valid

The data in Table 4 revealed that 6 practical tasks and 88 out of the 89 practical skill items were found to be valid thereby appropriate for inclusion in the building super-structure practical skills assessment instrument. For the face validity, comments of three experts (Building Construction Teacher in a Secondary School, Registered Builder who practiced in the field, and an Expert in Measurement and evaluation who is a Lecturer in a Nigerian University) who examined the instrument for proper wording, consistency, and representativeness were utilized to improve the instrument. For the construct validity, Factor Analysis was used and a factor loading of 0.35 and above was considered as an index for acceptance.

Research Question 5

What is the Reliability of the developed instrument for assessing practical skills in building super-structure in Nigerian Secondary Schools?

Table 5: Internal consistency of practical tasks and skill items for assessing practical skills in building super-structure in Nigerian secondary schools

S/N	Practical Tasks	No. of Skill Items	Internal Consistency	Remarks
1	Blocks making	10	0.82	Highly Reliable
2	Wall Construction	13	0.84	Highly Reliable
3	Suspended Upper floor Construction	28	0.80	Highly Reliable
4	Roof Trusses Construction	16	0.79	Highly Reliable
5	Roof Covering	9	0.81	Highly Reliable
6	Ceiling Construction	12	0.77	Highly Reliable
	Reliability Coefficient	88	0.81	Highly Reliable

Table 6: Summary of inter rater reliability of building construction practical skills assessment instrument

S/N	Raters	Reliability Coefficient	Remarks
1	Rater 1 & Rater 2	0.80	Highly Reliable
2	Rater 1 & Rater 3	0.82	Highly Reliable
3	Rater 1 & Rater 4	0.79	Highly Reliable
4	Rater 2 & Rater 3	0.74	Highly Reliable
5	Rater 2 & Rater 4	0.81	Highly Reliable
6	Rater 3 & Rater 4	0.85	Highly Reliable
	Reliability coefficient	0.80	Highly Reliable

The data presented in Table 5 indicated that, the reliability coefficient with regards to the internal consistency of all the 88 practical skill items across the 6 task clusters ranges from 0.77 to 0.84 with the overall reliability coefficient of the instrument at 0.81. The summary of the inter-rater reliability is presented in Table 6, the reliability coefficient of the four raters ranges from 0.74 to 0.85 with the overall reliability coefficient for the four raters was found to be 0.80. Based on this, it can be concluded that, the instrument is highly reliable for assessing students' practical skills in building super-structure in Nigerian Secondary Schools.

4. Discussion of Findings

The finding on research question 1 shows that, six practical tasks were found to be appropriate for inclusion in the building construction practical skills assessment instrument. This finding is in agreement with the works of Ibrahim (2012), and Okeme (2011) who opined that only items that satisfied all psychometric properties in addition to possessing high factor loading should be considered as appropriate for inclusion in practical skills assessment instrument.

Findings from research question 2 revealed that 88 practical skill items were found to be appropriate for inclusion in the building construction practical skills assessment instrument. This finding is in disagreement with the study of Effiong (2006) who carried out a study on development and validation of alternative to practical test for measuring skills in electronics device and circuit in technical colleges.

According to the instrument developed by Effiong, students must not necessarily to go to the shop to conduct practical for the practical skills in their possession can be measured, instead, an instrument with alternative to shop practice items can be develop to measure same construct. However, the findings is in agreement with Yalams (2001) and Garba (1993) who emphasized that only items that satisfied all the relevant psychometric properties should be considered as appropriate for inclusion in a practical skill assessment instrument.

For research question 3, findings revealed that five specific performance objectives were found to be appropriate for inclusion in assessing students' practical task in building construction subject. This finding is supported by Enya (1995) who conducted a study on development and preliminary validation of an electricity achievement test for technical colleges. According to Enya, an instrument must be developed to measure the specific objectives of the instructional contents under consideration so that whatever the outcome of the assessment may be, it will not be far from what the examiner set to achieve. The finding is also consistent with Achusi (1997) in assessing practical skills, performance objectives must be clearly identified and be stated in a measurable term so that the assessor can be properly guided on areas to observe while the examinee execute the assigned task.

The findings for research question 4 shows that 4 practical tasks and 40 practical skills were found to be valid and appropriate for inclusion in the building construction practical skills assessment instrument. This finding is in line with Umanah (2016) who opined that validity of an instrument for assessing practical skills is a basic requirement for the instrument to fulfill its obligation. According to the author, the instrument must be subjected to face, contents, and construct validation, when that is done, the instrument will naturally appear to possess the ability to fulfill the predictive validity requirements.

Findings from research question 5 indicated that the developed instrument having attained an internal consistency of 0.81 and inter-rater reliability of 0.80 of the six practical tasks and 88 practical skill items was found to be reliable for assessing students' practical skills in Building construction in Nigeria secondary Schools. This finding is in disagreement with the study conducted by Olaitan (2014) on development and validation of test for assessing technical college students on motor vehicle mechanic works. While the internal consistency of the instrument developed by Olaitan ranges from 0.84 to 0.96, the internal consistency of this instrument ranges from 0.70 to 0.87. With respect to inter-rater reliability, the study conducted by Olaitan had its inter-rater reliability coefficient ranging from 0.55 to 0.84 which is an indication of the level of variation existing between the two findings.

5. Conclusion

The study identified the practical tasks, practical skills contents, and the specific performance objectives appropriate for inclusion in the building super-structure practical skills assessment instrument. It is expected that when the instrument is effectively put into use in assessing secondary school students in building super structure operations component of building construction subject, it will bring to the fore the amount of skills the students acquired in the course of their studies. This will assist greatly in passing a valid judgment about the level of competence the students might have attained in handling practical task component of the subject which will form the basis for their certification.

6. Recommendations

Based on the findings of this study, it is recommended that:

1. The two major examination bodies (WAEC & NECO) should ensure that practical tasks and skill items of all the major operations found in building construction curriculum are included in in their instrument for the conduct of terminal examinations.
2. Building construction teachers in Nigerian secondary schools should ensure that only valid and reliable instruments are used in their formative and summative evaluation of students in building construction practical classes.
3. Government and private school owners offering building construction and being examined by WAEC and NECO should organized workshops to building construction teachers on methods of assessing practical skills in the subject.

References

Abonyi O. S. (2003). *Instrumentation in behavioural research: A practical approach.* Enugu-Nigeria: Fulladu Publishing Company.

Achusi, M. M. (1997). Development and validation of instrument for the assessment of practical work in block laying and concreting in government technical colleges. *Unpublished M. Ed Thesis,* University of Nigeria, Nsukka.

Dallal, G. E. (2012). *The little handbook of statistical practice.* Retrieved from http://www.jerrydallal.com/LHSP/pval.html

Effiong, E. J. (2006). Development and validation of alternative to practical tests for measuring skills in electronic devices and circuits in technical colleges. *Unpublished Ph.D Thesis* University of Nigerian, Nsukka.

Enya, D. E. (1995). Development and preliminary validation of electricity achievement test (ELAT) for Nigerian technical colleges. *Unpublished M.Ed Thesis* University of Nigeria, Nsukka.

Federal Republic of Nigeria (2013). National policy on education. Abuja: NERDC Press.

Garba. L. N. (1993). Development of an instrument for evaluating practical projects in woodwork. *Unpublished PhD Thesis,* University of Nigeria, Nsukka.

IBM Knowledge Center (2019). *KMO and Berltlett's test.* Online access http://www.ibm.com/support/knowledgecenter/SSLVMB_23.0.0/spss/tutorials/fac_telco_kmo_01.html

Ibrahim, D. (2012). Development and validation of an instrument for assessing students' manipulative skills in bricklaying and blocklaying practice at technical colleges in Niger state, Nigeria. *Journal of Science, Technology & Education,* 1(1), 35-43

Nigerian Educational research and Development Council (NERDC) (2012). *Building construction for SS1-3.* Abuja: NERDC Press

Okeme, I. (2011). Development and validation of psycho-productive skills multiple choice items for students in agricultural science in secondary schools. *Unpublished PhD Thesis,* Department of Vocational Teacher Education. University of Nigeria, Nsukka.

Okwelle, P.C., & Okoye, K.R.E (2012). Development and validation of instrument for assessing practical skills in building electronics systems in Nigerian technical colleges. *Journal of Emerging Trends in Engineering and Applied Sciences. JETEAS 3*(5) 779-785.

Olaitan, O. O. (2014). Development and validation of tests for assessing students' skills in motor vehicle mechanic works for technical colleges. *Unpublished PhD Thesis,* University of Nigeria, Nsukka.

Ombugus, D. A (2014). Development and validation of workshop-based process skill test in metal grinding for assessing students in technical colleges for work. *Journal of Education and Practice,* 5(25), 108-116.

Umanah, R. A. (2016). Development and validation of an instrument for assessing basic electronics process skills in senior secondary schools in Lagos Nigeria. *Unpublished PhD Thesis,* University of Nigeria, Nsukka.

Uzoagulu, A. E. (2011). *Writing research project reports in tertiary institutions*. Enugu: John Jacob's Classic Publishers Ltd

Yalams, S. M. (2001). *Development and validation of metalwork process evaluation scheme. Unpublished PhD Thesis,* University of Nigeria, Nsukka.