DEVELOPMENT AND STANDARDISATION OF AN INSTRUMENT FOR ASSESSING PERFORMANCE OF STUDENTS IN OXY-ACETYLENE TASK OPERATIONS AT TECHNICAL COLLEGE LEVEL

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ABSTRACT

The study was aimed to develop an instrument for assessing students' performance in oxy-acetylene cutting and welding operations at technical college level. Three research questions were formulated to guide the study. Instrumentation research design was adopted for the study and the instrument used for data collection was a structured questionnaire developed by the researchers. The questionnaire was validated by 8 experienced technical teachers in terms of its face, content and construct. Similarly, the instrument has reliability coefficient of 0.87 based on Cronbach's Alpha statistical tool used to determine it. The study identified 4 basic tasks associated with Oxy-acetylene operation practices. The study identified 39 observable skills in assessing students, when performing Oxy-acetylene operation practices. To determine its validity the developed performance assessment instrument, titled; Instrument for Assessing Performance of Students in Oxy-acetylene Task Operations (IASPOTO), was rated by experts in welding and fabrication and yielded a validity index of 0.75. The instrument was further trial-tested in 6 technical colleges, using 30 NTC III students. The results obtained from the trial-test was computed using Cronbach's Alpha formula, which gave a reliability coefficient of 0.92 on the IASPOTO. The result of the study showed that the developed instrument (IASPOTO) is valid and reliable. The study therefore recommends among others that, examination bodies like; WAEC, NABTEB, NECO should adopt the use of IASPOTO in assessing students' performance, in welding and fabrication trade. It is also recommended that teachers that teach welding and fabrication trade at technical colleges should adopt the use of the IASPOTO when assessing students' performance for formative evaluation purposes.

Key Words: Instrument for Assessing Performance, Oxy-acetylene Operations.

INTRODUCTION

The place of welding and fabrication in the world of production of components cannot be over emphasized. Welding and fabrication trade encompasses the use of Oxy-acetylene in some task operations among other vast equipment and machines used in performing operations associated with the trade. Welding and fabrication trade is an integral part of technical and vocational education, taught in technical colleges. Since this trade of study represents vital process in most construction industries. Thus, it is no exaggeration to assert that welding and fabrication technology is also one of the vital trades upon which the economy of advance nations are based (Aminu, 2012). Trainees in this trade area need to be well trained and assessed during and at the end of their training at the technical college. Results obtained in this regard should be authentic such that it gives correct information about the student's level of achievement.

Magboh (as cited in Yalams, 2001) explains that assessment is one of the process used to ascertain whether or not the objectives of a programme are being achieved. In educational institutions one of the means of determining achieved educational objectives is through achievement and performance tests conducted at a stage or at the end of a programme by individual teachers or a certified examination bodies. In this regard, vocational technical education programme implemented in technical colleges needs standard way of determining the extent to which these objectives are achieved. This can successfully be done when valid test instruments are used for that purpose. Performance test can then be seen as a stage in evaluation process that is aimed at generating data for drawing conclusion during decision making.

Okwelle and Okoye (2012) observed that a lot of technical teachers have difficulties in the assessment of student's performance in the trained manipulative skills. Okwelle and Okoye further stated that teachers in technical schools assess students' performance based on the final appearance of the finished product (practical task given). This form of assessment seems to be faulty of reliability, as individual teachers have peculiar aspect that attracts them most in a given product. Thus, measurement given under this situation largely depends on individual teacher rather than using a unique method of assessment. The measurement conducted under this situation eventually leads to false conclusion and thus, yields a misleading information that could be used when decision making.

Bukar (1994) observed that there is generally lack of a well prepared assessment instrument for practical oriented subjects in technical vocational education system in Nigeria. Perhaps that is why Yalams (2001) asserted that lack of unique and standard means of assessing students' performance has been responsible for inconsistency in the assessment of practical skills by teachers of many trades in technical colleges, of which welding and fabrication trade is not an exception. These observations imply that the methods used in assessing practical performance in technical trades seem to fall short of addressing the issue of standard assessment instrument to be used in generating results that quality decision could be based on, as stated by Okoro (1991).

The problem of lack of unique and standard means of assessing students' performance on practical skills specifically, in welding and fabrication at technical college level motivated this study. The study strives to come up with an instrument for assessing students' performance on welding and fabrication trade in technical colleges.

The main purpose of this study is to develop and validate an instrument for assessing students' performance on welding and fabrication skills at Technical College level. Specifically, the study sought to;

1. Identify the requisite tasks in Oxy-acetylene operations to be taught at technical college level, as are set out by the National Business and Technical Examination Board, (NABTEB, 2007).
2. Determine the requisite process skill operations that teachers should consider when scoring students' performance on Oxy-acetylene task operations at technical college level.
3. Determine the reliability of the constructed instrument for assessing performance of students in oxy-acetylene task operations at technical college level.

Research Questions

The following research questions were formulated to guide the study;

1. What are the requisite basic oxy-acetylene task operations to be taught at technical college level?
2. What are the requisite process skills operations that teachers should consider

when scoring students' performance on oxy-acetylene task operations at technical college level?

3. What is the reliability of the constructed instrument for assessing performance of students in oxy-acetylene task operations?

METHODOLOGY

This study was aimed at the development and validation of an instrument for assessing performance, thus an instrumentation research design was adopted. This is in line with Uzuogulu (2011) who opines that a study is termed an instrumentation if its primary purpose is towards producing a new modified content, idea or procedure for educational achievement.

The study was conducted in North-Eastern geopolitical region of Nigeria. This region is located within the geographical boundary of latitude 6.26^0 East and longitude 4.92^0 North East of the equator. Its total land area is $103{,}639m^2$ (Atlas, world map, 2013). The zone comprises of Adamawa, Bauchi, Borno, Gombe, Yobe, and Taraba States. The target population of the study is 1083, comprising of 44 technical teachers and 1039 NTCIII welding and fabrication students.

The population of the study was made up of all the teachers teaching welding and fabrication course (code - 050) in all the sampled technical colleges in the North-east geopolitical region of Nigeria. Furthermore, the target population of the study is 1089 in composing 44 teachers of welding and fabrication in technical colleges and 1045 students in NTC III, opting for Welding and Fabrication Trade. Purposive random sampling was used to come up with a sample size of 17 teachers and 30 NTCIII students, which was finally used in the study. The teachers were used to respond to the questions items in the instrument 'Basic Oxy-acetylene Task Operations' (BOTO) while the students were used in during trial-test of the developed instrument 'Instrument for Assessing Students' performance in Oxy-acetylene Task Operations' (IASPOTO).

The instrument used for data collection was a structured questionnaire developed by the researcher. The instrument is named 'Basic Oxy-acetylene Task Operations '(BOTO), composing of 3 sections. Section A' requested for personal data of the respondent, section B' check list of oxy-acetylene task operations extracted from NABTEB syllabus (2007) within welding and fabrication trade, with code 050. Section C' of the instrument contains process skill in oxyacetylene operations generated by the researcher. The instrument requested technical college teachers that teach welding and fabrication to state their opinions on the appropriateness or otherwise, on the listed question items generated by the researcher.

Validity of the Instrument (BOTO)

This instrument was validated by 8 experienced teachers that teach welding and fabrication in technical colleges to ascertain the content coverage and the criterion validity of the instrument. Their corrections and suggestions were fully effected and the final copy of the questionnaire was produced and sent to the respondents (welding and fabrication teachers).

Reliability of the Instrument (BOTO)

The reliability coefficient of the instrument (BOTO) was determined by administering a single pilot testing on 8 welding and fabrication teachers, grouped into two (those with less than 5 years teaching experience and those with more 5 years teaching experience in teaching welding and fabrication trade). The result was then analysed using Cronbach's alpha co-efficient (α) statistical tool which yielded a reliability coefficient of 0.87 and thus, used for this study.

METHOD OF DATA ANALYSIS

The data collected on the first instrument; Basic Oxy-acetylene Task Operation (BOTO) and that of questions items on skills operations under each BOTO

was analysed using Descriptive and Inferential statistics. Validates Mean score on each item was used. Each item was scored on 4' point rating scale; very appropriate (4), Appropriate (3). Not Appropriate (2) Highly Not Appropriate (1). The mean score for 4 point scale is given as;

4+3+2+1/ 4 = 2.5.

The decision rule used was that; any item with mean score 2.5 and above was considered appropriate for inclusion in the final basic oxy-acetylene task operation (BOTO), and should then be covered during the development of the performance assessment instrument. On the other hand, any skill operation item with mean rating less than 2.5 was considered inappropriate for inclusion in the (BOTO), and not necessarily be covered during the development of the (IASPOTO). Each of these operations have further been assumed to consist of some manipulative skills for performing it. The assumed skills operations for each of the BOTO was scored by the respondents to rate its level of appropriateness to be included within the process skill operations to be considered when assessing students' performance on oxy-acetylene task operations. See Table 2 for detailed result.

RESULTS AND DISCUSSION

The results of the study is discussed under the results, presented in their respective Tables of data below:

1. Research Question 1: What are the requisite basic tasks in Oxy-acetylene Operations to be taught at technical college level?

Table 1: Results showing the Mean Scores of generated Basic Oxy-acetylene Tasks Operations (BOTO)

S/N	Oxyacetylene task operation	Mean score	Remarks
1.	Setting up of oxyacetylene equipment	3.48	Appropriate
2.	Setting up of flame	2.03	Not Appropriate
3.	Oxy-acetylene welding process	4.00	Appropriate
4.	Oxyacetylene cutting process	3.79	Appropriate
5.	Soldering operation	1.42	Not Appropriate
6.	Brazing process	3.58	Appropriate
7.	Bend test of weld	2.04	Not Appropriate

Table 1 above reveals that operations items 1, 3, 4 and 6 are appropriate to be included in the basic oxy-acetylene operations to be taught at technical college level having mean scores of 3.48, 4.00, 3.79 and 3.58 respectively. The results in the table also shows that operations items 2,5 and 7 have mean scores of 2.03, 1.42 and 2.03 respectively thus, are considered not appropriate for inclusion in the in the instrument to be developed.

The result in table 1 therefore shows that 4 basic oxyacetylene operations should be considered in the training of oxy-acetylene operations at technical college level. These include;

i) Setting up of oxyacetylene equipment
ii) Oxy-acetylene welding process
iii) Oxyacetylene cutting process
iv) Brazing process

These operations are specified in NABTEB (2007) syllabus as areas that welding and fabrication students should have practical training at technical college level. In this study therefore, the developed instrument (IASPOTO) composes the 4 identified basic oxyacetylene operations as are to be taught and considered when assessing performance of students in oxyacetylene operations.

Research Question 2: What are the requisite process skills operations that teachers should consider when scoring students' performance on oxy-acetylene task operations at technical college level?

Table 2: Results showing the Mean Scores of generated Skill Operations to be Considered When Scoring Students in Oxyacetylene Operations Tasks at Technical College Level

S/N	Skill operation	Mean score	Remarks
1.	**1: Setting up of oxyacetylene equipment**		
	i) Identification of Oxygen gas cylinder and Acetylene gas cylinder	3.56	Scorable
	ii) Assembling of gas cylinders on trolley	3.21	Scorable
	iii) Fixing of pressure gauges on appropriate gas cylinders	3.47	Scorable
	iv) Fixing of Gas hoses on appropriate gas cylinders	3.25	Scorable
	v) Fixing of Gas hoses on blow pipe appropriately	2.78	Scorable
	vi) Fixing of selected nozzle	2.57	Scorable
	vii) Observing safety precautions on assembly of gas equipment	2.52	Scorable
	2: Oxy-acetylene welding process:		
	viii) Using hand file to bevel out edge of parent metal	1.89	Not scorable
	ix) Using electric hand filing machine to bevel out edge of parent metal	3.57	Scorable Scorable
	x) Using pedestal grinding machine to prepare edges of parent metal	2.87	Not scorable
	xi) Cleaning of metal surfaces to be welded	2.42	Not Scorable
2.	xii) Allowing flange thickness on bevelled parent metal for root penetration	3.60	Scorable
	xiii) Setting of gas discharge rate on acetylene cylinder gauge	2.89	Scorable
	xiv) Setting of working pressure rate on acetylene cylinder	2.95	Scorable
	xv) Setting of discharge rate on oxygen cylinder	2.95	Scorable
	xvi) Setting of working pressure rate on oxygen cylinder	3.56	Scorable
	xvii) Selection of correct nozzle size on given metal thickness	2.52	Scorable
	xviii) Using spark lighter to light-on cutting torch	2.58	Scorable
	xix) Tacking of parent metal	3.04	Scorable
	xx) Determining penetration gap	3.20	Scorable
	xxi) Angle of blow pipe held during welding operation	2.42	Not Scorable
	xxii) Angle of filler rod held during welding operation	2.56	Scorable
	xxiii) Welding speed	3.44	Scorable
	xxiv) Manipulation of filler rod and welding torch during welding operation	2.98	Scorable
	xxv) Observing safety precautions during and after welding	2.86	Scorable
	3.Oxyacetylene Cutting Process :		
	xxvi) Setting of gas discharge rate on acetylene cylinder gauge	3.44	Scorable
	xxvii) Setting of working pressure rate on acetylene cylinder	3.56	Scorable
	xxviii) Setting of discharge rate on oxygen cylinder	3.54	Scorable

	xxix) Setting of working pressure rate on oxygen cylinder	3.54	Scorable
	xxx) Selection of correct nozzle size on given metal thickness	2.57	Scorable
	xxxi) Using spark lighter to light-on cutting torch	2.53	Scorable
	xxxii) Setting neutral flame for pre-heating purpose on cutting	3.00	Scorable
	xxxiii) Pre-heating operation before cutting Correct speed of cutting nozzle	3.23	Scorable
	xxxiv) Observing safety precautions on oxy-acetylene cutting operation	3.56	Scorable
	2. Brazing Process :		
	xxxv) Preparation and cleaning of metal edges to be brazed	2.55	Scorable
	xxxvi) Lighting the welding torch	2.57	Scorable
	xxxvii) Setting flame to 'oxidising flame' for brazing purpose	1.20	Not scorable
	xxxviii) Applying brazing flux on brazing rod	3.41	Scorable
	xxxix) Pre-heating of parent metals	2.65	Scorable
	xl) Applying brazing rod on joint	2.67	Scorable
	xli) Manipulation of brazing rod on joint	3.44	Scorable
	xlii) Observing safety precautions during and after brazing	3.54	Scorable

Table 2 above revealed that, under BOTO 1 (setting up of oxy-acetylene equipment), all the 7 generated skill operation processes are rated as scorable when assessing students' performance. The question items have mean scores ranging between 2.52 to 3.56. the Table also shows that under BOTO 2 (oxy-acetylene welding process), 15 skill operation process have mean scores ranging between 2.56 to 3.60 thus, regarded as appropriate to be scored when assessing students while 3 skill items have a mean score ranging from1.89 to 2.42. Also, the Table disclosed that BOTO 3 (oxy-acetylene cutting process) has all the 10 generated skill items rated as scorable when assessing students. The skill items have mean scores ranging between 2.53 to 3.56. Finally, the further shows that BOTO 4 (Brazing process) has 7 scorable skill items with mean score ranging between 2.57 to 3.54 while, 1 skill item has a mean score of 1.20.

Research Question 3: What is the reliability of the constructed instrument for assessing performance of students in oxy-acetylene task operations?

Table 3: below shows students' scores as assessed by 2 observers during the trial-test.

School/Student	Scores by rater A /195	Scores by rater B/195	Total Mean Score /195	Total score of student /100
Group A: GSTC Bauchi				
1.	126	146	136.0	69.7
2.	156	145	150.5	77.2
3.	97	105	101.0	51.8
4.	133	158	145.5	74.4
5.	157	120	138.5	71.0
Group B: GSTC Tafawa Balewa				
1.				
2.	187	177	182.0	91.9
3.	145	134	139.5	71.2
4.	123	110	116.5	59.7
5	178	167	172.5	88.5
Group C :GSTC Gombe	98	69	83.5	42.8
1.				
2.	135	120	127.5	65.4
3.	145	149	147.0	75.4
4.	167	157	162.0	83.0
5	89	91	90.0	46.2
Group D: GSTC Jalingo	123	112	117.5	60.3
1.				
2.	178	125	151.5	77.7
3.	167	138	152.5	78.2
4.	145	149	147.0	75.4
5	148	134	141.0	72.3
Group E: GSTC Tula	91	78	84.5	43.3
1.				
2.	167	172	169.5	86.9
3.	145	131	137.5	70.5
4.	187	175	181.0	92.3
5	143	132	137.5	70.5
Group F: GSTC Numan	102	108	105.0	53.8
1.				
2.	178	165	171.5	87.9
3.	176	175	175.5	90.0
4.	156	161	158.5	8101
5	100	119	109.5	56.2
	105	127	116.0	59.5

Table above shows details of students' scores as rated by 2 separate observers when the instrument (IASPOTO) was subjected to trial –test. The scores obtained was computed using Cronbach's alpha statistical tool, with the use of special package on statistical soft wire (SPSS). See 'Reliability of instrument IASPOTO'.

Reliability Test of the Instrument (IASPOTO)

To establish the internal consistency of the IASPOTO, the draft instrument was subjected on 30 NTCIII students, randomly selected in each of the selected technical colleges. The data obtained in the experiment was computed and Cronbach's alpha statistical tool was used to establish reliability coefficient. The result showed that the instrument possess a reliability coefficient of 0.92.

SUMMARY OF RESULTS

From the result obtained in this study, it is observed that there are 4 basic oxy-acetylene task operations to be taught at technical college level, 7

skill operation processes when performing setting up of oxy-acetylene equipment. It is also identified that there 15 skills operation processes in performing oxy-acetylene welding process and 10 operation skills processes in oxy-acetylene cutting process. Similarly, the result revealed that brazing process has 7 skills operation processes. These identified skill operation processes are further used as scorable skill items in the developed performance assessment instrument (IASPOTO). The draft instrument (IASPOTO) was later subjected to trial-test on 30 randomly selected NTCIII students. The result was computed using Cronbach's alpha statistical tool and yielded a reliability coefficient of 0.92. This shows that the instrument is reliable to be used for the assessment purpose. Thus, the draft instrument was adopted as a final developed assessment instrument.

Instrument for Assessing Performance of Students in Oxyacetylene Task Operations (IAPSOTO)

STUDENT'S NAME..... **REG. NO**.....

DATE OF EXAM.....

Task operation	Skill operation process	Maximum Score
BOTO 1: (Setting up of Oxyacetylene Equipment)	i) Identification of Oxygen gas cylinder and Acetylene gas cylinder	1 2 3 4 5
	ii) Assembling of gas cylinders on trolley	1 2 3 4 5
	iii) Fixing of pressure gauges on appropriate gas cylinders	1 2 3 4 5
	iv) Fixing of Gas hoses on appropriate gas cylinders	1 2 3 4 5
	v) Fixing of Gas hoses on welding blow pipe appropriate	1 2 3 4 5
	vi) Fixing of selected welding nozzle	1 2 3 4 5
	vii) Observing safety precautions on assembly of gas equipment	1 2 3 4 5

Total Scores in this task Operation: .....

Task operation	Skill operation process	Maximum Score
BOTO 2: (Oxyacetylene welding Process)	xiii) Using electric hand filing machine to bevel out edge of parent metal	1 2 3 4 5
	xiv) Using pedestal grinding machine to prepare edges of parent metal	1 2 3 4 5
	x) Allowing flange thickness on bevelled parent metal for root penetration	1 2 3 4 5
	xi) Setting of gas discharge rate on acetylene cylinder gauge	1 2 3 4 5
	xii) Setting of working pressure rate on acetylene cylinder	1 2 3 4 5
	xiii) Setting of discharge rate on oxygen cylinder	1 2 3 4 5
	xiv) Setting of working pressure rate on oxygen cylinder	1 2 3 4 5

	xv) Selection of correct nozzle size on given metal thickness	1 2 3 4 5
	xvi) Using spark lighter to light blowpipe	1 2 3 4 5
	xvii) Tacking of parent metal	1 2 3 4 5
	xviii) Determining penetration gap	1 2 3 4 5
	xix) Angle of filler rod held during welding operation	1 2 3 4 5
	xx) Manipulation of welding torch	1 2 3 4 5
	xxi) Welding speed	1 2 3 4 5
	xxii) Observing safety precaution	1 2 3 4 5

Total Scores in This Task Operation: .....

Task operation	Skill operation process	Maximum Score
BOTO 3: (Oxyacetylene Cutting Process)	xxiii) Setting of gas discharge rate on acetylene cylinder gauge	1 2 3 4 5
	xxiv) Setting of working pressure rate on acetylene cylinder	1 2 3 4 5
	xxv) Setting of discharge rate on oxygen cylinder	1 2 3 4 5
	xxvi) Setting of working pressure rate on oxygen cylinder	1 2 3 4 5
	xxvii) Selection of correct nozzle size on given metal thickness	1 2 3 4 5
	xxviii) Using spark lighter to light-on cutting torch	1 2 3 4 5
	xxix) Setting neutral flame for pre-heating purpose on cutting	1 2 3 4 5
	xxx) Pre-heating operation before cutting	1 2 3 4 5
	xxxi) Correct speed of cutting nozzle	1 2 3 4 5
	xxxii) Observing safety precautions on oxy-acetylene cutting operation	1 2 3 4 5

Total Scores in this task Operation: .....

Task operation	Skill operation process	Maximum Score
BOTO 4: (Brazing Process)	xxxiii) Preparation and cleaning of metal edges to be brazed	1 2 3 4 5
	xxxiv) Setting flame to 'oxidising flame' for brazing purpose	1 2 3 4 5
	xxxv) Applying brazing flux on brazing rod	1 2 3 4 5
	xxxvi) Pre-heating of parent metals	1 2 3 4 5
	xxxvii) Applying brazing rod on joint	1 2 3 4 5
	xxxviii) Manipulation of brazing rod on joint	1 2 3 4 5
	xxxix) Observing safety precautions during and after brazing	1 2 3 4 5

Total Scores in this task Operation.....

Sum of Total Scores in All Operations.....

EXAMINER'S SIGNATURE .....DATE.....

NAME OF EXAMINER.....

MAJOR FINDINGS OF THE STUDY

The major findings of the study are;

1. Careful analysis of the NABTEB syllabus (2007) by experts in welding and fabrication shows that there are 4 basic task operations in oxy-acetylene processes to be taught at technical college level.
2. The study also revealed that there are 39 process skills operations to be scored when assessing performance of students in oxy-acetylene operations.
3. Analysis of the data obtained during trial testing of the instrument (IASPOTO) shows that it has a reliability coefficient of 0.92. Thus, the results that it will generate when used for the purpose it is meant will be reliable.

CONCLUSION

The result of this study revealed that the developed IASPOTO has 4 basic operations, 39 observable manipulative skills in oxy-acetylene task operations at technical college level. The developed instrument has a reliability coefficient of 0.92. This shows that the instrument (IASPOTO) has the capability to assess students' performance with little or no error of measurement.

Each assessment sheet of the instrument carries one identified basic operation and the scorable requisite process skills in performing the operation. Similarly, scoring scale is assigned to each corresponding skill process.

RECOMMENDATIONS

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

1. Teachers of welding and fabrication should adopt the use of IASPOTO in assessing their students' performance in oxyacetylene operations at technical college.
2. Examination bodies like; WAEC, NABTEB, NECO should adopt and influence its examiners to always use IASPOTO when conducting their practical examinations on welding and fabrication at technical college level. This will make the results obtained to be valid and reliable as a unified way of assessment is used.
3. Teachers of welding and fabrication should use the instrument IASPOTO in measuring the strength and weaknesses of their students in practical lessons.
4. During teacher made test, teachers should use the IASPOTO using applicable operations as per level covered content area, and adjust grading to suit purpose.
5. Teachers teaching welding and fabrication should as well use the IASPOTO during conducting student's continuous assessment (CA) so as to work on reliable result from the beginning of the assessment procedure.

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