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Development and Validation of Mechanical Engineering Trade Skills Assessment Instrument for Sustainable Job Security in Yobe State

ADAMU, GISHUA GARBA
GOVERNMENT SCIENCE AND TECHNICAL COLLEGE, POTISKUM

DAWHA, JOSPHINE MUSA KAMAR, TIAMIYU SALIHU
DEPARTMENT OF TECHNICAL EDUCATION, FEDERAL COLLEGE OF EDUCATION (T), GOMBE

Abstract
Mechanical Engineering Trade Skills Assessment Instrument (METSAI) is aimed at determining the extent to which students have acquired practical skills before graduation that will enable them get employment for sustainable job security in Yobe state. The study employed instrumentation research design. The populations of the study were 23 mechanical engineering trade teachers and 98 mechanical engineering trade students. The study answered two research questions and tested two hypotheses. The METSAI comprising of practical skills items or operations based on NBTE curriculum and NABTEB syllabus were developed and validated by four experts. Mechanical engineering trade teachers from technical colleges in Yobe state were used for further content-validation of the METSAI items which was tried out on 98 mechanical engineering trade students. Data collected were analyzed using statistical mean, Standard deviation, Split-half technique, t-test and ANOVA. The result of the study showed that 13 basic tasks and 72 practical skills items were found appropriate for the METSAI. The instrument was found to possess a high reliability of 0.92. Based on this result, it was recommended amongst others that teachers and examination bodies (NABTEB, WAEC and NECO) should use METSAI for assessing performance of students in mechanical engineering trade.
Key words: Practical skills; Assessment instrument; Job security.

Introduction

Technical and Vocational Education and Training (TVET) programmes are offered for the purpose of producing skilled manpower required for the nation's economic and technological development (Federal Republic of Nigeria [FRN], 2009). In the Nigerian educational system, technical colleges' curriculum has practical skills content up to 60% (National Board for Technical Education [NBTE], 2003). After graduation students are expected to acquire these practical skills to enable them create or secure sustainable jobs and use their knowledge, abilities, initiative and creativity for self-reliance. This is in line with the 2001 United Nation Educational, Scientific and Cultural Organization (UNESCO) and International Labour Organization's (ILO) General Conference on TVET. They referred to TVET as those aspects of the educational process involving, in addition to general education, the study of technologies and related sciences, and the acquisition of practical skills, attitudes, understanding and knowledge related to occupations in various sectors of the economic and social life (UNESCO & ILO, 2002). Mechanical engineering trades is one of the TVET programmes in technical colleges in which students are examined by the National Business and Technical Examination Board (NABTEB) based on the NBTE curriculum for the award of National Technical Certificate (NTC). The TVET programme mechanical engineering trade among others is aimed at training and imparting necessary skills leading to the production of craftsmen who will be self-reliant and enterprising in job areas such as metal fitting, machining, etc (NBTE, 2003).

The term 'job security' in a concept that is synonymous with the broad definition of TVET can be regarded as a means of preparing for occupational fields and effective participation in the world of work that is a lifelong learning and preparation for responsible and self-reliant citizenship with appropriate skills and experience to differentiate themselves from job seekers and unemployment. Job security is a chance of becoming unemployed due to limited opportunities and appropriate skills required for a job. It is the probability that an individual will keep his/her job. A small chance of becoming unemployed indicates a high level of job security (Clark & Fabien, 2005). High employment rate is a good indicator of high level of job security. Thus, employment is an important ingredient of human security, primarily through providing economic/income security (Dekker, 2010). The main determinant for job security at individual level is employability that is the individual's personal skills and experience. Job security can be influence by acquiring appropriate skills through education and experience which can make the recipient employable. For this reason, assessment of practical skills should be conducted in the school simulation laboratories to determine whether students have acquired such employable practical skills before graduation.

The psychomotor aspect of mechanical engineering trade objectives is meant to achieve adequate development in skills which can make the recipient employable. NABTEB uses a marking scheme checklist to assess students' practical skills in NTC mechanical engineering trades examinations. The scheme does not in detail highlight the various stages of specific operational skills involved in the process of carrying out the task given. To buttress this point, Ombugus (2013) asserted that the assessment instrument used by NABTEB and technical teachers only help to determine students' achievement of mechanical engineering trade objectives in cognitive and affective domains. This was observed in Ming (2010) that there are negligible observable results in achievement of psychomotor domain in technical colleges. The practical skills assessments conducted by NABTEB and teachers are mere product rating and not skills manipulation rating of students (Williams, 2009 and Okwelle & Okeke, 2012). This method has limitation, according to Ombugus and Ogbuanya (2014), due to its inability to assess the process of carrying out tasks and operations involved. The implication of this is that the scores and grades assigned to students in practical works by the teachers may not be true representative of their performance and though the students will be given certificates but without adequate practical skills that will enable them create and/or secure sustainable job. Hence it is necessary to develop a valid and reliable performance base assessment instrument that will contain the details of the operational skills best for employment. This study is delimited to metal fitting work of mechanical engineering trade.

Fitting means preparing mating parts to touch or join each other in such a way that one will turn inside another or slide upon another or the parts will hold tightly together so that they cannot move upon each other (Okoro, 2008). Metal Fittings are tasks necessary to make metal parts fit. It involves practical skills operations in measurement, marking-out, clamping, cutting, scrapping and lapping, filing and finishing, drillings, grinding, assembling etc to repair, maintain or produce mechanical component. The practical skills acquired in metal fitting enables technical colleges' graduates to secure and sustain a job in mechanical engineering trade (Adamu, 2015).

Validity and reliability are two properties of an assessment instrument that indicate the quality and usefulness of that instrument. Validity refers to the degree to which an instrument is measuring what it is supposed to measure, while reliability is an indication of the consistency between two measures of the same instrument (Alias, 2005). Alias further stated that an instrument may be highly reliable but may not be necessarily valid, but a highly valid instrument is usually reliable. Validity of an instrument describes the extent to which the conclusions or interpretations derived from the results of any assessment are well-grounded or justifiable, that is relevant and meaningful (Cook & Beckman, 2006). It refers to the accuracy with which an instrument measures the personality traits or abilities it sets out to evaluate. In other words, validity describes how well one can legitimately trust the results of an assessment as interpreted for a specific purpose. The first step in developing a valid assessment instrument is to identify the objectives and corresponding content of the programme or search the literature for previously published assessment instruments, which might be adapted (Cook & Beckman, 2006). A well developed assessment instrument must measure what it is supposed to measure and produce dependable and repeatable information with sufficient evidence for a confident assessment decision to be made.

This study developed and validated a Mechanical Engineering Trade Skill Assessment Instrument (METSAI) for sustainable job security in Yobe State. The study, specifically: identified the practical skills tasks and operations (based on NBTE and NABTEB) appropriate for inclusion into METSAI and ascertained if there were differences between mechanical engineering trade teachers on their ratings of appropriate practical skills tasks and operations for inclusion in the METSAI.

Research Questions

The following research question was formulated to guide the study:

1. What are the practical skills tasks and operations appropriate for inclusion into METSAI?
2. What is the reliability coefficient of the developed instrument METSAI?

Hypotheses

The following null hypotheses were tested at five percent level of significance:

1. There is no significant differences between two groups of trained technical teachers (NCE and B.Tech), regarding the appropriate practical skills tasks and operations for inclusion in METSAI.
2. There are no significant differences among three technical colleges teachers (GSTCs in Geidam, Damagum and Potiskum) regarding the appropriate operations for inclusion in METSAI.

Methodology

The study employed instrumentation research design. According to Gay (1996) instrumentation design is appropriate for use when introducing new procedures, technologies or instrument for educational practices. The study was carried out in Yobe State. There were two target populations in this study. These included 23 mechanical engineering trade teachers and 98 NTC students of Mechanical Engineering Department in the three Government technical colleges (in Geidam, Damagum and Potiskum) that offer mechanical engineering trade programme in Yobe State.

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The 23 teachers were used in the study for the purpose of content-validation of the METSAI as well as to serve as team of assessors of the students during the try-out exercise. The 98 students were used for try-out of the validated METSAI for the purpose of ascertaining its reliability. The entire populations were used as sample for the study since it is relatively manageable.

The study used a multi-staged approach in the procedural development of the instrument based on the suggestions of Cluzeau (2002); Samarakkoddy, Fernando, Perera, McClure & Silva (2010) and Okwelle & Okoye (2012). The stages include:

1. Identification of tasks and operations in metal fitting
2. Development of task specifications table
3. Writing out items for the draft METSAI
4. Development of rating scale
5. Preliminary face and content validation of items of the draft METSAI by experts
6. Pilot test METSAI
7. Administer METSAI for content validation by teachers
8. Final METSAI assembly
9. Try-out final METSAI assembly.

Following a detailed review of NBTE curriculum and NABTEB syllabus in NTC mechanical engineering trade, metal fitting was identified as one major practical skills area for assessment. Tasks and performance objectives relating to this major practical skills job area (metal fitting) were isolated from the curriculum. Based on the critical review of relevant literature, these objectives were transformed into thirteen (13) basic task statements. A table of specifications of two-way grids was developed: the horizontal axis lists the 13 basic tasks statements and the vertical axis lists the seven levels of psychomotor domain of Simpson (1972) (i.e. perception, set, guided response, mechanism, complex overt response, adaption and organization) which are spread into behaviuors or skills to be observed as indicated in table 1. This is to ensure that all the 13 basic tasks areas and various levels of behavioral objectives were adequately covered.

Table 1: Task Specification Table for Metal Fitting for NTC in Mechanical Engineering Trade

Observable skills	Promptness to starting a given task.	Identification of right work-pieces/materials.	Appropriate selection of tools/equipment.	Right connection/setting of tolls/equipment.	Correct use and manipulation of tools/equipment.	Correct reading position.	Use of packing when clamping.	Ability to select and install saw blade in a frame.	Ability to cut metal to specification.	Ability to file flat surface.	Ability to file curved surface.	Ability to use chisel on metals.	Ability to scrap flat surface.	Ability to scarp curved surface.	Ability to select correct lapping speed.	Ability to set and lap surfaces accurately.	Ability to install drill/drilling accessories.	Ability to select appropriate speed and feed.	Ability to carry out appropriate seating operation.
S/N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
TASK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1. MEASUREMENT	v	x	v	v	v	v	x	x	x	x	x	x	x	x	x	x	x	x	x
2. MARKING OUT	v	x	v	v	v	x	x	x	x	x	x	x	x	x	x	x	x	x	x
3. CLAMPING	v	x	v	x	v	x	v	x	x	x	x	x	x	x	x	x	x	x	x
4. CUTTING	v	x	v	x	v	x	x	v	v	x	x	x	x	x	x	x	x	x	x
5. FILING AND FINISHING	v	x	v	x	v	x	x	x	x	v	v	v	x	x	x	x	x	x	x
6. SCRAPPING AND LAPPING	v	v	v	x	v	x	x	x	x	x	x	x	v	v	v	v	x	x	x
7. DRILLING, BORING & REAMING	v	x	v	x	v	x	x	x	x	x	x	x	x	x	x	x	v	v	v
8. METAL HEAT TREATMENT	v	v	v	x	v	x	x	x	x	x	x	x	x	x	x	x	x	x	x
9. SOLDERING…	v	v	v	x	v	x	x	x	x	x	x	x	x	x	x	x	x	x	x
10. GRINDING…	v	x	v	x	v	x	x	x	x	x	x	x	x	x	x	x	x	x	x
11. TESTING METALS…	v	v	v	x	v	x	x	x	x	x	x	x	x	x	x	x	x	x	x
12. ALIGNMENT…	v	x	v	x	v	x	x	x	x	x	x	x	x	x	x	x	x	x	x
13. ASSEMBLING…	v	x	v	x	v	x	x	x	x	x	x	x	x	x	x	x	x	x	x
TOTAL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Observable skills	Selection of appropriate heat treatment process.	Ability to select/apply quenching medium.	Selection of appropriate soldering operation.	Ability to apply appropriate heat.	Testing soldered joint for rigidity and leakage.	Ability to select a grinding wheel for a job given.	Ability to grind a stock to specification.	Ability to hold and grind a stock at correct angle.	Ability to follow procedures of a metal testing.	Ability to read and interpret working drawing.	Testing the efficiency of the assembled device.	Correct interpretation of the drawing.	Kinesthetic posture on the job.	Timeliness in completing a given task.	Care of tools/equipment during and after work.	Observation of safety precautions.	Finishes of the work surface.	Quality and neatness of the job.	Total number of skills per major task.	Operations per main task.
S/N	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	-	-
TASK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1. MEASUREMENT	x	x	x	x	x	x	x	x	x	x	x	x	x	v	v	v	x	x	8	7
2. MARKING OUT	x	x	x	x	x	x	x	x	x	x	x	x	x	v	v	v	x	x	7	5
3. CLAMPING	x	x	x	x	x	x	x	x	x	x	x	x	x	v	v	v	x	x	7	4
4. CUTTING	x	x	x	x	x	x	x	x	x	x	x	x	v	v	v	v	x	x	9	6
5. FILING AND FINISHING	x	x	x	x	x	x	x	x	x	x	x	x	v	v	v	v	x	v	11	5
6. SCRAPPING AND LAPPING	x	x	x	x	x	x	x	x	x	x	x	x	v	v	v	v	x	x	12	5
7. DRILLING, BORING & REAMING	x	x	x	x	x	x	x	x	x	x	x	x	v	v	v	v	v	x	11	8
8. METAL HEAT TREATMENT	v	v	x	x	x	x	x	x	x	x	x	x	x	v	v	v	x	x	9	4
9. SOLDERING…	x	x	v	v	v	x	x	x	x	x	x	x	x	v	v	v	x	v	11	3
10. GRINDING…	x	x	x	x	x	v	v	v	x	x	x	x	v	v	v	v	v	x	11	5
11. TESTING METALS…	x	x	x	x	x	x	x	x	v	x	x	x	v	v	v	v	x	x	9	5
12. ALIGNMENT…	x	x	x	x	x	x	x	x	x	x	x	x	x	v	v	v	x	x	6	10
13. ASSEMBLING…	x	x	x	x	x	x	x	x	x	v	v	v	x	v	v	v	x	v	10	5
TOTAL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	72

KEY
v=applicable
x=non-applicable

SOURCE: NBTE CURRICULUM (2003) AND NABTEB SYLLABUS (2007).

The 13 basic task statements were further analysed to generate 75 operations or practical skills items which were matched with appropriate tasks on the table of specifications. The practical skills items were further written by expressing the extent of appropriateness of performing each of the 75 practical skills items or operations by using the four point rating scale format with response options (in the order of Can do without help, Can do with little help, Cannot do without help and Cannot do with help) with assigned values of 4, 3, 2 and 1 respectively to form the initial copy of the METSAI.

In order to ensure the validation of the initial copy of the METSAI was subjected to preliminary content and face validation by four experts. The experts were made up of two lecturers from the Department of Technology Education, Modibbo Adama University of Technology Yola, and two lecturers from the Department Vocational and Technology Education, Abubakar Tafawa Balewa University, Bauchi. The experts were requested to read through and assessed the instrument for any area of ambiguity or improper wording, disarrangement of the entire structure noticed and inconsistency. This is also to verify that METSAI practical skill items and metal fitting job are substantially similar in terms of ability requirements. Following the comments of the experts, all the 13 basic tasks and 72 practical skill items were considered appropriate for inclusion into METSAI. Their observations, corrections and suggestions were used in improving the quality of the instrument.

A pilot study of the draft METSAI was carried out on 10 NTC III students of mechanical engineering trade, GSTC Gombe which was not part of the study area. The pilot study was carried out after validation exercise for the purpose of estimating the initial reliability of the METSAI. The internal consistency of METSAI was determined using technique fashioned along Uzoagulu's (2011) Split-half and Spearman-Brown which estimated the whole initial reliability of 0.93. This value exceeded Nunnally's criterion of 0.70 accepted for statistical consideration (Nunnally, 1978). The choice of Split-half technique in determining the reliability coefficient of METSAI was informed by the fact that it excludes some sources of error arising from psychological disposition, fatigue, health etc (Uzoagulu, 2011).

Based on the results of the pilot study, the draft copies of the preliminary validated METSAI was revised in wordings to produce the questionnaire Expected Tasks and Operations in Metal Fitting (ETOMF) for further content validation by the practicing mechanical engineering trade teachers. In order to determine the basic tasks and practical skills items or operations appropriate for inclusion in the final METSAI, ETOMF was administered to the 23 teachers in mechanical engineering department of the 3 technical colleges that run NBTE and NABTEB programme in Yobe State. The instrument ETOMF was arranged in two parts: I and II. Part I sought personal data such as location of the school and educational qualification while part II had 13 tasks which comprise 72 items dealing with practical skills in metal fitting. A five point scale of Highly Expected (HE), Expected (E), Moderately Expected (ME), Not-Expected (NE), Highly Not-Expected (HNE), were written against each of the practical skill statements with a corresponding assigned values of 5, 4, 3, 2, and 1 respectively. Mechanical engineering trade teachers were requested to indicate the level at which each item or practical skills operation is expected to be performed by NTC mechanical engineering trade students.

All the 23 copies of the ETOMF administered and returned were found to be valid and therefore used in the study. None of the 13 basic tasks and 72 operations was dropped as they were rated above "Moderately Expected". The result of this exercise was used to assembly the final form of METSAI with the initial rating options of Can do without help, Can do with little help, Cannot do without help and Cannot do with help, with assigned values of 4, 3, 2 and 1 respectively. This final version of METSAI was tried out on 98 mechanical engineering trade students from the three technical colleges in Yobe State. The internal consistency reliability of the instrument was ascertained using the Split-half and Spearman-Brown technique to obtain the overall reliability coefficient of 0.92.

Data for answering the research questions were analyzed using mean, standard deviation, t-test and analysis of variance (ANOVA). In order to select the appropriate tasks and practical skills items for inclusion in the METSAI, a mean cut-off of 3.00, which is moderately expected was chosen. Therefore, any practical skill with a mean score of 3.00 and above was appropriate, while a practical skill with a mean score below 3.00 was inappropriate. For testing null hypotheses, if calculated t-value/f-value was greater than or equal to t-critical/f-critical value at five percent level of significance, then reject null hypothesis but if otherwise, accept the null hypothesis. All statistical analysis was performed with Statistical Package for Social Sciences (SPSS) statistical soft ware.

Results

Research Question 1

What are the metal fitting practical skills tasks and operations appropriate for inclusion into METSAI?

Table 2: Teachers' Mean Ratings of metal Fitting Tasks and Operations expected of Mechanical Engineering Craft Practice Students at Technical Colleges

Tasks and Operations	X	SD	Remark
Task 1: Measurement			
1. Measuring a surface with a rule	4.26	0.689	expected
2. Measuring a surface with inside/outside calipers	3.57	0.728	expected
3. Measuring with a micrometer	3.83	0.491	expected
4. Measuring a depth with a micrometer depth gauge	3.30	0.573	expected
5. Measuring with a vernier caliper	3.65	0.573	expected
6. Measuring angles with a protractor	3.83	0.576	expected
7. Measuring with gauges	3.35	0.647	expected
Task 2: Marking Out			
8. Marking out parallel lines using a combination set	3.26	0.619	expected
9. Marking out lines at right angles to an angle	3.04	0.475	expected
10. Marking out angles using an adjustable square	3.69	0.703	expected
11. Marking out angles using a protractor	3.96	0.706	expected
12. Locating center of a stock using an odd-leg caliper	4.26	0.541	expected
Task 3: Clamping			
13. Clamping a stock with a hand vice	3.22	0.518	expected
14. Clamping a stock with a bench vice	4.39	0.499	expected
15. Clamping a stock with a leg vice	3.22	0.518	expected
16. Clamping an irregular stock with a vee-block	4.09	0.596	expected
Task 4: Cutting			
17. Cutting-off a stock with a hacksaw	4.26	0.541	expected
18. Cutting-off a stock with a power saw	3.70	0.470	expected
19. Cutting-off a stock with a snip/hand shear	4.26	0.689	expected

Table 2: Teachers' Mean Ratings of Metal Fitting Tasks and Operations expected of Mechanical Engineering Craft Practice Students at Technical Colleges

Tasks and Operations	X	SD	Remark
20. Cutting-off a stock with a bench shear	3.83	0.650	expected
21. Cutting-off a stock with a power shear	3.61	0.583	expected
22. Cutting-off a stock with a cold-chisel	4.74	0.449	expected
Task 5: Filing and Finishing			
23. Filing-off a stock with a flat file	4.09	0.288	expected
24. Filing-off a stock with a curved file	4.04	0.209	expected
25. Filing-off a stock using a coarse file	3.96	0.367	expected
26. Finishing-up a stock with a fine-grade file	3.96	0.367	expected
27. Using a cold-chisel on metals	3.43	0.788	expected

Task 6: Metal Scraping and Lapping			
28. Scrapping-off a stock with a flat scrapper	4.09	0.515	expected
29. Scrapping-off a stock with a half-round scrapper	3.26	0.619	expected
30. Scrapping-off a stock with a three-square scrapper	3.26	0.619	expected
31. Lapping a stock using a honing machine	3.30	0.559	expected
32. Lapping a stock with a lapping machine	3.30	0.559	expected
Task 7: Drilling Operations			
33. Drilling a stock with a hand drilling machine	3.26	0.619	expected
34. Drilling a stock with a sensitive/bench drilling machine	4.30	0.559	expected
35. Drilling a stock with a pillar drilling machine	4.04	0.562	expected
36. Boring a hole with a boring tool	4.22	0.671	expected
37. Counter-boring operation	4.13	0.626	expected
38. Counter-sinking operation	4.00	0.674	expected
39. Reaming a hole with a hand reamer	3.09	0.515	expected
40. Reaming a hole with a reaming tool	4.17	0.491	expected
Task 8: Metal Heat Treatment			
41. Annealing	3.43	0.662	expected
42. Hardening	3.61	0.499	expected
43. Normalizing	3.48	0.593	expected
44. Tempering	3.39	0.722	expected
Task 9: Soft and Hard Soldering			
45. Soldering a stock using a blow lamp	3.43	0.507	expected

Table 2: Teachers' Mean Ratings of Metal Fitting Tasks and Operations expected of Mechanical Engineering Craft Practice Students at Technical Colleges

Tasks and Operations	X	SD	Remark
46. Soldering a stock using an electric soldering bit	3.70	0.470	expected
47. Brazing a stock using oxy-acetylene gas	4.39	0.583	expected
Task 10: Metal Grinding			
48. Grinding a stock with a hand grinder	3.04	0.208	expected
49. Grinding a stock with a pedestal grinder	3.74	0.541	expected
50. Grinding a stock with a bench grinder	4.09	0.515	expected
51. Grinding a stock with a universal cylindrical grinder	3.65	0.573	expected
52. Grinding a stock on off-hand grinder	3.09	0.289	expected
Task 11: Testing Metal Properties			
53. Testing a stock for hardness	3.83	0.491	expected
54. Testing a stock for toughness	4.26	0.689	expected
55. Testing a stock for ductility	4.22	0.600	expected
56. Testing a stock for malleability	4.22	0.599	expected
57. Testing a stock for shear strength	3.65	0.647	expected

Task 12: Alignment of Components			
58. Checking alignment of lathe centers	4.52	0.511	expected
59. Aligning a stock with a steel test bar	3.87	0.344	expected
60. Aligning a stock with a dial-indicator	4.74	0.449	expected
61. Aligning shaft	3.48	0.593	expected
62. Aligning pulley	3.35	0.647	expected
63. Aligning couplings	3.39	0.583	expected
64. Aligning belts	3.39	0.583	expected
65. Aligning chains	3.35	0.573	expected
66. Aligning sprocket	3.35	0.573	expected
67. Aligning horizontal, vertical, or angular planes	3.39	0.583	expected
Task 13: Assembling Simple Mechanical Devices			
68. Reading machine blue-print	3.57	0.591	expected
69. Reading working drawing	3.70	0.703	expected
70. Identification of mechanical components	4.30	0.559	expected
71. Mantling/assembling components	4.30	0.559	expected
72. Testing for efficiency of the assembled machine	3.52	0.593	expected

Table 2 indicates that the mean (X) ratings of the items ranged from 3.04 to 4.74. All the operations in each of the 13 tasks had their mean scores above the cut-off point of 3.00, which qualifies all the 72 operations or practical skills items appropriate for inclusion in the METSAI. The standard deviation (SD) of the items ranged from 0.208 to 0.788. This implies that mechanical craft practice teachers were very close in their ratings.

Research Question 2

What is the reliability coefficient of the developed instrument METSAI?

Table 3: Distribution of Reliability Coefficient of the METSAI

Task	No. of items	Mean Item Discrimination index	Reliability Coefficient
1	7	0.57	0.98
2	5	0.87	0.94
3	4	0.75	0.93
4	6	0.67	0.97
5	5	0.89	0.85
6	5	0.89	0.94
7	8	0.75	0.89
8	4	0.78	0.94
9	3	0.67	0.95
10	5	0.50	0.94
11	5	1.00	0.85
12	10	0.80	0.91
13	5	0.85	0.89
Grand mean item discrimination index			0.77
Full length reliability coefficient			0.92

Table 3 shows that the 13 tasks in the METSAI have reliability coefficient from 0.85 to 0.98. The full length reliability coefficient of METSAI is 0.92. The table also indicated that METSAI has distributed the scores of the students fairly with the discrimination indices ranging from 0.50 to 1.00.

Hypothesis 1

There is no significant differences between two groups of trained technical teachers (NCE and B.Tech), regarding the appropriate operations for inclusion in GFSAI.

Table 4: t-test analysis of mean response of NCE technical teachers and B.Tech teachers regarding the appropriate operations for inclusion in METSAI

Group of teachers	X	SD	df	Std Error	t-cal.	t-table	Remark
NCE	3.717	0.294					
			21	0.139	-0.856	1.721	Accepted
B.Tech	3.836	0.168					

$N_{NCE}=18$, $N_{B.Tech}=5$, $P>0.05$ ($P=0.402$).

Table 4 showed that at 21 degree of freedom (df), the t-calculated value of -0.856 is lower than t-tabulated value of 1.721, indicating that there is no significant difference between NCE technical teachers and B.Tech teachers on appropriate operations for inclusion in METSAI. The first null hypothesis was accepted.

Hypothesis 2

There are no significant differences among three technical colleges' teachers (GSTCs in Geidam, Damagum and Potiskum) regarding the appropriate operations for inclusion in METSAI.

Table 5: ANOVA of three technical colleges teachers' responses regarding appropriate operations for inclusion in METSAI

Source of variation	Sum of square	df	Mean square	f-cal	f-table	Remark
Between groups	0.003	2	0.002			
				0.019	3.49	Accepted
Within groups	1.637	20	0.082			
Total	1.640	22				

$N_{Geidam}=4$, $N_{Damagum}=12$, $N_{Potiskum}=7$, $P>0.05$ ($P=0.981$).

Table 5 showed that there are no significant differences in the mean responses across the three technical colleges' teachers regarding the appropriateness of operations for inclusion in METSAI. This is evident from the table since the f-calculated value of 0.019 is less than the f-tabulated value of 3.49 at five percent level of significance. The second null hypothesis was also accepted.

Discussion

The main contribution of this study is the successful development of a valid and reliable instrument to assess students' employable metal fitting practical skills for sustainable job security. The findings of the study related to research question 1 indicated that 13 tasks and 72 practical skill items or operations presented in table 2 were considered suitable for inclusion in the instrument METSAI. This signifies that the teachers of mechanical engineering trade in technical colleges considered the 13 tasks and 72 practical skill items or operations as appropriate for use in assessing students' performance in practical areas of metal fitting. This finding is consistent with Iji (2007) and Okwelle and Okoye (2012) regarding the fact that all the items of the assessment instruments they developed were considered by the respondents as appropriate for use in assessing students' performance.

The non-significance differences between the two groups of mechanical engineering trade teachers that participated in the instrument validation are further evidence of the instrument's validity. The analysis of data relating to the null hypothesis 1 revealed that there were no significant differences between the two groups of practicing teachers (NCE and B.Sc./B.Tech.) regarding the practical skills items or operations for inclusion in METSAI. This entails that qualification was not a significant factor in deciding which practical skill item should be selected for the METSAI instrument. This result suggests similar ratings in appropriateness of practical skills by all the teachers of different educational qualifications in the findings of Okwelle and Okeke (2012).

The analysis of data relating to the null hypothesis 2 revealed that there were no significant differences among the three technical colleges' teachers (GSTCs in Geidam, Damagum and Potiskum) regarding the appropriate operations for inclusion in METSAI. This entails that differences in operational location of the schools was not a significant factor in deciding which practical skills operations should be selected for the METSAI.

Conclusion

To produce a skilled manpower that can secure and sustain their jobs, it requires a reform of assessment processes in our educational system. METSAI provided a detailed valid and reliable assessment instruments which will take account of the process of practical activities leading to the completion of the final practical products.

Recommendations

1. Mechanical engineering trade teachers in technical colleges and similar skills acquisition institutions should be made to be aware and use METSAI for assessing students' practical skills on the programme.
2. NABTEB and similar examination bodies could consider using METSAI in assessing students' practical skills at NTC level.

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