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DEVELOPMENT AND VALIDATION OF INSTRUMENT FOR ASSESSING STUDENTS' PRACTICAL PERFORMANCE IN FOUNDRY CRAFT PRACTICE IN TECHNICAL COLLEGES IN NIGERIA

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ABSTRACT

Inadequate assessment instrument can either over rate or under rate a student's practical performance. An over rated student will graduate with the wrong grade and may perform below expectation when employed or in advance studies. This will certainly be embarrassing to him/herself as well to the institution that graduated him/her. An under rated student will naturally express dissatisfaction and frustration; which can lead to drop-out, deviant behavior, hooliganism, crime and all forms of negative vices that can become a great threat to security within the technical colleges and the society at large. This situation necessitated the development and validation of instrument for assessing students' practical performance in foundry craft practice in technical colleges in Nigeria. The purpose of the study is to develop and validate an instrument for students' practical performance assessment in foundry craft practice trade in technical colleges in Nigeria. Five research questions guided the study. The study adopted instrumentation design. The area of the study was south east and south west geopolitical zone of Nigeria. The population for the study was 37 comprising 17 of foundry craft practice students in final year, and 20 teachers/instructors teaching foundry craft practice in technical colleges. The sample size for the study was 23 which comprised all the 20 teachers and 3 students offering foundry craft practice at government technical college, Enugu, Enugu State. The instrument used for data collection was foundry craft practical skills assessment instrument (FCPSAI). The instrument was face validated by three experts. Content validation was also carried out using a table of specifications based on Simpson's model of psychomotor domain. Mean was used to select the specific performance objectives of the instrument. The developed instrument was tried out on the 3 students offering foundry craft practice at government technical college, Enugu, Enugu State. Findings from the study indicated that 10 practical task items, 83 practical skill items, and five performance objectives were found to be suitable for inclusion in the instrument. All the 10 practical task items and 83 practical skill items were found to be valid. The internal consistency of the instrument was found to be 0.83, indicating that the instrument was reliable. Based on the findings, it was recommended among others that National Business and Technical Board (NABTEB) should consider and adopt the use of FCPSAI in assessing students' practical performances in foundry craft practice at NTC and ANTC practical exams. Furthermore, the Nigerian educational research and development council should adopt and use the FCPSAI in the evaluation of the foundry craft practice trade curriculum in the country.

Keywords: Validation, Instrument, Assessing, Skills, foundry.

Introduction

Foundry craft practice is one of the trade taught in technical colleges. The trade is concerned with providing the students with both the theory and practical skills desirable to carry out foundry work. It also prepares the students for further studies in the field of technology either in the colleges of education (technical), universities, polytechnic, or other institutions of higher learning. According to Kehinde (2020), foundry craft practice involves the manufacturing of metal products in a single step from liquid to solid without intermediate operation of mechanical workings such as rolling, fabrication or forging. Foundry craft practice is the process of producing metal/ alloy component parts of desired shapes by pouring the molten metal / alloy into a prepared mold (of that shape) and then allowing the metal/alloy to cool and solidify (Dhairya, Gunjan, Aman and Shrikant 2015; Munkaila 2021). The solidified piece of metal/alloy is known as casting. The importance of foundry craft products in the society and in the world of today is indicated by how societies depend extensively upon metals and metal products. Practically all metal products start by first being cast in ingot (Abah, 2019). For instance, metal ingot from which other areas of metal shaping starts, must first be cast. Therefore, without the foundry technology process, there would be no metals, and if there were no metals, there would be virtually nothing and many products would be nonexistent, as metal cannot be obtained in a useable form from the earth. Major components of machine tools, power plants, industrial machinery and equipment, automobile, agricultural and textile industry and several others are produced by the foundry technology process. The development of foundry craft practice therefore, should be of strategic concern to curriculum planners in technical colleges so as to enhance the rapid industrialization of the nation (Patrick and Akintunde, 2017; Kehinde, 2020). One can therefore rightly say that the acquisition of foundry technology skill is basic to economic development. Students are therefore expected to acquire adequate skills in foundry work operations. 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 the standard activities developed to support the assessment method and used to collect the evidence of student competence (Australia Skills Quality Authority ASQA, 2020). Instruments to be used for assessment of practical skills in foundry craft practice and indeed all other subjects in technical colleges. 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 assessment is carried out at different sessions, the degree in which the outcomes relate with another is referred to as reliability.

However, notwithstanding the laudable objectives of teaching foundry craft practice, several studies (Adekola, (2017); Okoye and Auta, (2020); Umanah, (2016), indicated that the current way of assessment of practical skills in technical and vocational subject related areas, including foundry craft practice 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 suggests that the students were merely handed an undeserved grade without adequate assessment instrument.

Inadequate assessment instrument can either over rate or under rate a student's practical performance. An over rated student will graduate with the wrong grade and may perform below expectation when employed or in advance studies. This will certainly be embarrassing to him/herself as well to the institution that graduated him/her. An under rated student will naturally express dissatisfaction and frustration; which can lead to drop-out, deviant behavior, hooliganism, crime and all forms of negative vices that can become a great threat to security within the technical colleges and the society at large. It is against these situations that this study is designed to develop and validate an instrument for assessing students' practical performance in foundry craft practice trade in technical colleges in Nigeria.

Research Questions

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

1. What are the specific performance objectives of the practical task contents of foundry craft practice?
2. What are the practical task contents in foundry craft practice appropriate for inclusion in the FCPSAI?
3. What are the practical skills in foundry craft practice appropriate for inclusion in the FCPSAI?
4. What is the validity of the developed FCPSAI?
5. What is the reliability of the developed FCPSAI?

Research 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 all the NBTE accredited technical colleges offering foundry craft practice in South East and South West geopolitical zone of Nigeria. The population for this study is 37, which consists 17 of foundry craft practice students in final year, 20 teachers/instructors teaching foundry craft practice in technical colleges in South East and South West geopolitical zone of Nigeria. The sample size for this study is 23. there was no sampling in the selection of teachers, therefore all the 20 teachers formed part of the sample size. However, for the students, only 3 final year foundry craft students in Government Technical College, Enugu, Enugu State were purposively selected for the study. The choice of Government Technical College, Enugu, Enugu State out of the three technical colleges offering foundry craft practice in the two zones for try-out of the instrument was based on the fact that the technical college has a foundry craft practice workshop that is well equipped with almost all the instructional facilities required for effective teaching and learning of the trade.

The instrument for data collection was Foundry craft practical skills assessment instrument. The instrument was developed by the researcher based on the NBTE curriculum for foundry craft practice. The instrument consists of two parts, structured in line with the research questions. Part A seek for information on academic qualifications for teachers Part B of the instrument addressed

foundry craft practice. The following stages which usually characterized instrumentation design for assessment of psychomotor outcomes was adopted from Okoye and Auta, (2020):

1. Isolation of objectives of assessment from the curriculum
2. Identification of psychomotor skills areas in the foundry craft practice 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 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: two from foundry and forging unit of Metalwork Department, Federal College of Education (Technical), Umuze, Anambra State while the remaining one is an expert in measurement and evaluation at Federal College of Education (Technical), Asaba, Delta State. The instrument was administered on the foundry craft teachers. At the try-out stage, the instrument was administered on 3 final year students of foundry craft practice in Government Technical College, Enugu, Enugu State under examination condition. To answer research questions 1,2, and 3, the specific objectives of the practical task contents of foundry craft practice, the identified practical tasks and practical skill items were analyzed using mean statistics. To answer Research Question 4, the content validity was determined using Simpson's (1972) taxonomy of psychomotor objectives in generating the test items. Also comments of experts in foundry craft practice and measurement and evaluation were utilized to determine the face validity of the test items. For Research Question 5, the Cronbach Alpha coefficient was used to test the degree of reliability of each task and the entire instrument.

Presentation of Results

Research Question 1: *What are the specific performance objectives of the practical task contents of foundry craft practice?*

Table 1: Mean ratings of Specific Performance Objectives for the Practical Task Content of Foundry Craft Practice

S/No	Performance Objectives	Mean	Remark
1	Ability to read designs plan of the work	5.00	Suitable
2	Ability to identify suitable tools for the task execution	2.60	Unsuitable
3	Ability to use right tools	4.90	Suitable
4	Ability to management materials	4.60	Suitable
gy5	Ability to execute task independently	4.55	Suitable
6	Ability to know overall quality of completed task	4.05	Suitable
7	Ability to observe safety rule and regulations in foundry work	4.75	Suitable

In Table 1, the respondents rated the specific performance objectives of the practical task contents of Foundry Craft Practice. The mean rating ranges from 2.60 to 5.00. Items 2 had mean rating of 2.60 which is less than 3.50. The other six items had their mean ratings greater than 3.50. Based on this, it can be concluded that six specific performance objectives were considered by the respondents as suitable for inclusion in assessing students' practical task in Foundry Craft Practice.

Research Question 2: *What are the practical task contents in foundry craft practice appropriate for inclusion in the FCPSAI?*

Table 2: Mean Ratings of Practical Tasks Contents Suitable for Inclusion in the Foundry Craft Practical Skills Assessment Instrument

S/No	Practical tasks	Mean	Remarks
8	Pattern layout	4.60	Suitable
9	Pattern construction	4.55	Suitable
10	Preparation of core sand	4.60	Suitable
11	Core forming	4.50	Suitable
12	Core baking	4.45	Suitable
13	Core finishing	4.65	Suitable
14	Molding	4.80	Suitable
15	Melting	4.80	Suitable
16	Casting	4.80	Suitable
17	Finishing	4.75	Suitable

The Mean rating of the practical task contents ranged from 4.45 to 4.80 as could be seen in the analysis presented in Table 2. The least Mean was noted on task 5 which is core baking. The highest Mean of 4.80 was obtained by task items no 14, 15 and 16. All the tasks had mean greater than the cutoff point of 3.50 and were considered suitable.

Research Question 3: *What are the practical skills in foundry craft practice appropriate for inclusion in the FCPSAI?*

Table 3: Mean Ratings of Practical Skill Contents on Pattern Layout

	Task 1: Pattern layout	Mean	Remarks
18	Read blue-print of drawings	4.45	Suitable
19	Design patterns from blue-print of drawing	4.10	Suitable
20	Make two view of the drawing on a sheet using shrink rule	4.30	Suitable
21	Add machine allowance to the design	4.25	Suitable
22	Provide draft allowance to the design	4.25	Suitable

Analysis in Table 3 indicated that the mean ratings of Practical skill contents on pattern layout ranged from 4.10 to 4.45. Based on this premise, all the items were considered acceptable, appropriate and suitable for inclusion into the Foundry Craft Practical Skills Assessment Instrument (FCPSAI) For Technical Colleges

Table 4: Mean Ratings of Practical Skill Contents on Pattern Construction

	Task 2: Pattern construction	Mean	Remark
23	Establish the number of parts that pattern will be made	4.45	Suitable
24	Identify pattern making materials	4.55	Suitable
25	Measure patterns material accurately	4.25	Suitable
26	Use a marking out gauge to see if board is at right thickness.	4.15	Suitable
27	Secure the board flat on the bench.	4.20	Suitable
28	Mark out pattern correctly	4.25	Suitable
29	Plane the two pieces of board to be joined to required length, thickness and width	4.15	Suitable
30	Fasten board properly on bench and with plane,	4.15	Suitable
31	Assemble the two pieces of board with glue and strengthen it with nails or screws.	4.10	Suitable
32	Chisel off part of a wood to make a mortise and tenon joint.	4.10	Suitable
33	Set out position for mortise and tenon joint.	4.25	Suitable
34	Construct butt joint with dowels.	4.30	Suitable
35	Fastening each half of a split pattern to the opposite sides on one plate	4.35	Suitable
36	Build fillets in a pattern without destroying the pattern.	4.35	Suitable
37	Fill wax in all fillets in order to remove sharp corners	4.30	Suitable
38	Give a shellac coating to pattern	4.35	Suitable
39	Colors the pattern for identification purpose	4.40	Suitable
40	Construct pattern to a given specification	4.55	Suitable

Table 4 shows the respondents mean ratings for the test items for assessing practical performance on pattern construction. The mean ratings ranged from 4.10 to 4.55. As could be seen, all the test items had mean ratings that qualified them as appropriate and acceptable/suitable for the instrument. Therefore, all the test items were found suitable for inclusion into the instrument having been rated above 3.50 which is the cut-off point.

Table 5: Mean Ratings of Practical Skill Contents on Preparation of Core Sand

	Task 3: Preparation of core sand	Mean	Remark
41	Select suitable materials	4.65	Suitable
42	Choose correct sand type	4.65	Suitable
43	Carryout sand testing	4.55	Suitable
44	Assemble the materials to correct specification	4.60	Suitable
45	Mix the material	4.75	Suitable
46	Apply the right quantity of water	4.80	Suitable

Analysis result in Table 5 gave mean ratings of Practical skill contents on preparation of core sand items in a range of 4.55 to 4.80. Going by those mean ratings, the whole six items were suitable for inclusion into the instrument. The items were therefore, retained because they had mean ratings greater than the cut-off mark of 3.50 already set for selecting the test items.

Table 6: Mean Ratings of Practical Skill Contents on Core Forming

	Task 4: Core Forming	Mean	Remark
47	Set the core box on a work bench	4.20	Suitable
48	Fill the core box	4.35	Suitable
49	Rammed the prepared sand into core box	4.30	Suitable
50	Remove the extra sand from the core box	4.20	Suitable
51	Reinforced the core to ensure coherence and stability	4.20	Suitable
52	Invert the core box over the core plate	4.40	Suitable
53	Provide vent holes to allow gases to escape	4.40	Suitable

Result of Table 6 shows that the mean ratings of the respondents on the seven practical skill items ranged from 4.20 to 4.40. The least mean ratings were obtained from test items 47, 50 and 51 which were on ability to set the core box on a work bench, Remove the extra sand from the core box and ability to reinforce the core to ensure coherence and stability. Test items 52 and 53 had the highest mean ratings. However, all the test items (7 in number) had mean ratings greater than 3.50 and were therefore considered suitable for the task.

Table 7: Mean Ratings of Practical Skill Contents on Core Baking

S/No	Task 5: Core Baking	Mean	Remarks
54	Determine the right furnace for the job	4.55	Suitable
55	Set the furnace to the accurate baking temperature of 100 degree Celsius	4.40	Suitable
56	Choose the baking time/hours	4.25	Suitable
57	Observes the baking time/ hours determined	4.25	Suitable

Table 7 analysis showed that mean ratings of the respondents on the four practical skill items ranged from 4.25 to 4.55. All the items had mean ratings greater than 3.50 and were considered appropriate and suitable for inclusion into the instrument

Table 8: Mean Ratings of Practical Skill Contents on Core Finishing

S/No	**Task 6: Core finishing**	**Mean**	**Remarks**
58	Carryout felting operation on the core i.e. trimming, brushing, coating etc.	4.50	Suitable
59	Check and correct the various dimensions by inserting fixture	4.25	Suitable
60	Perform pasting of the core	4.40	Suitable

The analysis result in Table 8 showed that mean ratings of the respondents on the three practical skill items ranged from 4.25 to 4.50. All the items had mean ratings greater than 3.50 and were considered appropriate and suitable for inclusion into the instrument

Table 9: **Mean Ratings of Practical Skill Contents on Molding**

	Task 7: Molding	**Mean**	**Remarks**
61	Select suitable materials	4.40	Suitable
62	Batch the materials to correct specification	4.40	Suitable
63	Mix the material	4.45	Suitable
64	Apply the right quantity of water	4.45	Suitable
65	Set the drag flask on the board	4.60	Suitable
66	Sprinkle dry facing sand on the board	4.50	Suitable
67	Rammed the prepared sand into mold box	4.30	Suitable
68	Removal of the excess sand with a strike rod.	4.30	Suitable
69	Construct vent holes to allow gases to escape	4.20	Suitable
70	Position wire in mold sections to reinforce molds, using hand tools and glue	4.10	Suitable
71	Clean and smooth the mold	4.20	Suitable
72	Sprinkle parting agents onto patterns and mold sections to facilitate removal of Patterns from molds.	4.40	Suitable
73	Position patterns inside mold sections	4.45	Suitable
74	Remove the pattern from the mold sections	4.30	Suitable
75	Cut spouts, runner holes, and sprue holes into molds	4.25	Suitable
76	Position cores into lower sections of molds,	4.25	Suitable
77	Reassemble molds for pouring	4.50	Suitable

Data presented in Table 9 indicated that all the seventeen practical skill items presented had their mean rating greater than 3.50. Based on this, it was concluded that the seventeen practical skill items were found to be appropriate for inclusion in the foundry craft practical skills assessment instrument.

Table 10: Mean Ratings of Practical Skill Contents on Melting

	Task 8- Melting	**Mean**	**Remarks**
78	operate melting furnaces	4.30	Suitable
79	Carry out tapping operations	4.20	Suitable
80	Carryout furnace linings,	4.10	Suitable
81	Determine molten metal temperature	4.30	Suitable
82	Operate thermocouples, optical and pyrometers	4.40	Suitable
83	Carryout fluidity testing	4.45	Suitable
84	Measure casting temperature	4.40	Suitable

As shown in Table 10, respondents rated all the 7 practical skill items suitable for use in the final instrument with mean ratings ranging from 4.10 to 4.45. The 7 practical skill items were adjudged acceptable to be included in the instrument, since all the items had mean ratings greater than 3.50.

Table 11: Mean Ratings of Practical Skill Contents on Casting

S/No	**Task 9- Casting**	**Mean**	**Remarks**
85	Carryout slag and dross removal	4.35	Suitable
86	selecting ladle	4.25	Suitable
87	checking ladle	4.25	Suitable
88	preparing ladle for pouring	4.25	Suitable
89	transferring metal to ladle	4.10	Suitable
90	carrying molten metal treatment	4.55	Suitable
91	Selecting molten metal	2.05	Unsuitable
92	sampling and testing molten metal	4.30	Suitable
93	pouring molten metal into molds	3.90	Suitable

Data presented in Table 11 indicated that 8 out of the 9 practical skill items presented had their mean rating greater than 3.50. Only item 89 mean rating was less than 3.50. Based on this, it was concluded that 8 practical skill items were found to be appropriate for inclusion in the foundry craft practical skills assessment instrument.

Table 12: Mean Ratings of Practical Skill Contents on Finishing

S/No	**Task 10- Finishing**	Mean	Remarks
94	conveying completed castings from one section to another	4.25	Suitable
95	Remove gates, feeders, risers, and fins from castings	4.25	Suitable
96	file to smoothen cast with hand files	4.25	Suitable
97	Sandpapering operation	2.05	Unsuitable
98	Carryout heat treatment on cast	4.40	Suitable
99	Carryout inspection of finished products	4.25	Suitable
100	Salvage defective castings if required	4.35	Suitable
101	Carryout dust and noise control	4.20	Suitable
102	Carryout destructive testing of castings	4.40	Suitable

Analysis in Table 12 indicated that the mean ratings of practical skill items ranged from 2.05 to 4.40. Based on this premise, all the test items were considered acceptable, appropriate and suitable for inclusion in the foundry craft practical skills assessment instrument except items 95 with mean rating of 2.05.

In general, 83 items out of the 85 practical skill items under consideration had mean ratings above 3.50 and were found to be appropriate for inclusion in the foundry craft practical skills assessment instrument. The remaining two practical skill items that had mean ratings less than

3.50 were considered unsuitable for inclusion in the instrument and were subsequently dropped.

Research Question 4: *What is the validity of the developed FCPSAI?*

Table 13: Validated Practical Tasks and Skill Items for Assessing Practical Skills in the Foundry Craft Practice in Technical Colleges in Nigeria

S/No	Tasks	No of skill items	Remarks
1	Pattern layout	5	Valid
2	Pattern construction	18	Valid
3	Preparation of core sand	6	Valid
4	Core forming	7	Valid
5	Core baking	4	Valid
6	Core finishing	3	Valid
7	Molding	17	Valid
8	Melting	7	Valid
9	Casting	8	Valid
10	Finishing	8	Valid
	Total	83	Valid

To answer this research question, the Table of specifications constructed based on the Simpson's (1972) model of psychomotor domain revealed that out of the 83 practical skills, 9.41% comprising 8 items were assessing the Perception level; 8.24% comprising 7 items were assessing Set level; 26.51% comprising 23 items were assessing Guided Response level; 25.30% comprising 22 items were assessing Mechanism level; 23.53% comprising 20 items were assessing Complete Overt Response level and 5.88% comprising 5 items were assessing Adaptation level. The Origination level of Simpson's Model was not involved in the study because it was not covered by NTC curriculum. These results showed that 6 levels of the domain were adequately covered in the assessment method. This means that all the 83 practical skill items were valid for inclusion in the instrument.

In addition, the instrument was submitted to three experts; two experts in foundry craft practice who practiced in field and an expert in Measurement and evaluation who reviewed the appropriateness of the face validity of the items in measuring students' practical performance in foundry craft practice. The experts reviewed, reworded and re-structured the test items and made satisfactory comments about the entire tests. On the whole as shown in table 13 above, there were 10 practical tasks and 83 out of the 85 practical skill items were found to be valid thereby suitable for inclusion in the foundry craft practical skills assessment instrument.

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Research Question 5: *What is the reliability of the developed FCPSAI?*

Table 14: Reliability Coefficients of the 10 Practical Task Content of Foundry Craft Practice for Assessing Students‟ Practical Work Performance.

S/No	Practical Tasks	No of skill items	Reliability coefficient	Remarks
1	Pattern layout	5	0.84	Highly reliable
2	Pattern construction	18	0.94	Highly reliable
3	Preparation of core sand	6	0.82	Highly reliable
4	Core forming	7	0.85	Highly reliable
5	Core baking	4	0.79	Highly reliable
6	Core finishing	3	0.83	Highly reliable
7	Molding	17	0.76	Highly reliable
8	Melting	7	0.72	Highly reliable
9	Casting	8	0.74	Highly reliable
10	Finishing	8	0.98	Highly reliable
	Overall reliability coefficient		**0.83**	**Highly reliable**

The data presented in Table 14 indicated that, the reliability coefficient with regards to the Cronbach's alpha of all the 83 practical skill items across the 10 task clusters ranges from 0.72 to 0.98 with the overall reliability coefficient of the instrument at 0.83. Based on this, it can be concluded that, the instrument is highly reliable for assessing students' practical skills in foundry craft practice in technical colleges in Nigeria

Discussion of Findings

The finding on research question 1 revealed that six specific performance objectives were found to be suitable for inclusion in assessing students' practical task in foundry craft practice trade. This finding is supported by Kalkbrenner (2021) in one of his work titled "A Practical Guide to Instrument Development and Score Validation in the Social Sciences: The MEASURE Approach". According to Kalkbrenner, an instrument must be developed to measure the specific objectives of the instructional contents under consideration because it provides the teachers with a clear and structured understanding of what they need to achieve. The finding is also consistent with Achusi in Okoye and Auta (2021) who posited that, 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.

Finding on research question 2 shows that, ten practical tasks were found to be appropriate for inclusion in the foundry craft practical skills assessment instrument (FCPSAI). These task clusters identified agreed with Hassan (2019) who opined that practical task operations are group in different clusters. Students are expected to perform the tasks in foundry craft practice trade during practical exercises. Similarly, suggestions by UNESCO (2019) and Aminu (2015) hold similar views that, the first thing in developing an instrument is to specify the purpose, develop table of specification and select relevant task clusters.

Findings from research question 3 revealed that 83 practical skill items were found to be suitable for inclusion in the foundry craft practical skills assessment instrument. This finding is in

agreement with the works of Ramli, Talib, Hassan, and Manaf (2020), Okoye and Auta (2021) and Tsado (2013). Emphases in their works revealed that practical skill items that satisfied all psychometric properties are enough and adequate for inclusion in assessment instrument. However, 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 workshop to conduct practical for the practical skills in their possession can be measured, instead, an instrument with alternative to workshop practice items can be develop to measure same construct. Test item 46 in Table 5 received a highest mean of 4.80 to show how important the application of the right quantity of water to sand (green sand) in foundry work is. Anaele and Ogundu (2020) emphasized that the correct application of water to sand in core pattern and mould making operation in foundry craft work is key and when it is practically and strictly adhered to. It allows gases to escape the mould thereby reducing defect that is associated with the high temperatures of molten metals and alloys involved in casting.

The findings for research question 4 shows that 10 practical tasks and 83 practical skills were found to be valid and appropriate for inclusion in the foundry craft practical skills assessment instrument. The validation was carried out using content validation. 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 achieve its purpose. In similar studies, Ombugus (2014) ascertained the validity of WBPST by constructing a table of specifications based on the six levels of the psychomotor domain of Simpson (1972). Thereafter, teachers and technicians of mechanical engineering and experts in the industrial technical section of vocational teacher education and measurement and evaluation, from the University of Nigeria Nsukka, were given the instrument to indicate how important the items are for assessing students' skills performance.

Additionally, Sanusi, Ahmad and Bishir (2022) established the content validity of IACJSPS by identifying a major practical area for assessment from the NBTE curriculum, isolation of tasks. A table of specifications was developed based on the seven levels of the psychomotor domain of Simpson (1972), which spread into behaviours or skills to be observed. The IACJSPS was submitted to three subject experts for content validation. one expert in Woodwork Technology from the Department of Industrial and Technology Education, Federal University of Technology Minna; one expert in Curriculum from the Department of Educational Foundations, Bayero University Kano; and one expert in Testing and Measurement from the Department of Educational Foundations, Yusuf Maitama Sule University Kano. Their observations, corrections, and suggestions were used to improve the quality of the instrument. The findings of the above authors gave credibility to the findings of this study.

Findings from research question 5 indicated that the developed instrument having attained a reliability coefficient of 0.83 was found to be reliable for assessing students' practical skills in foundry craft practice in technical colleges in Nigeria. This finding is in agreement 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 reliability coefficient of the instrument developed by Olaitan ranges from 0.84 to 0.96, the reliability coefficient of this instrument ranges from 0.72 to 0.98. However, inconsistent with this finding, Sanusi, Ahmad and Bishir (2022) found the reliability coefficient of IACJSPS between 0.86 and 0.88 with an overall coefficient of 87 which is an indication of the level of variation existing between the two findings. Also, Hassan, Musa and Usman (2020) found the reliability overall coefficient of the process skill rating scale test of 81. Both Hassan et al and Sanusi, et al pointed out that the reliability of their developed instruments had high reliability and the instruments considered reliable. To this end, FCPSAI was considered reliable and could be used for assessing foundry craft practice students' practical skills in technical colleges in Nigeria.

Conclusion

The study identified the specific performance objectives, practical tasks, and practical skills contents suitable for inclusion in the FCPSAI. Moreover, the findings of this study have resulted in a developed and validated foundry craft practical skills assessment instrument (FCPSAI). that contains 6 specific performance objectives, 10 practical tasks, and 83 practical skills contents with a 5-point rating scale of Excellent, Very Good, Good, Fair, and Poor. The instrument (FCPSAI) has a reliability coefficient of 0.83. This shows that the instrument (FCPSAI) is proficient in effectively assessing foundry craft practice students' practical performance in technical colleges in Nigeria. It is expected that when the instrument is effectively put into use in assessing students in foundry craft practice, 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 ability the students might have attained in handling practical task component of the trade which will form the basis for their certification.

Recommendations

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

1. Foundry craft practice trade teachers should adopt and use the FCPSAI in assessing students' practical skills in foundry craft practice in technical colleges in Nigeria.
2. National Business and Technical Board (NABTEB) should consider and adopt the use of FCPSAI in assessing student's practical performances in foundry craft practice at NTC and ANTC practical exams.
3. The Nigerian Educational Research and Development Council should adopt and use the FCPSAI in the evaluation of the foundry craft practice trade curriculum in the country.
4. Government at all level should organize workshops, conferences and seminars to train foundry craft practice teachers on the use of FCPSAI

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