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DEVELOPMENT AND VALIDATION OF FURNITURE DESIGN AND CONSTRUCTION ACHIEVEMENT TEST FOR NATIONAL TECHNICAL CERTIFICATE I STUDENTS IN SOUTH EAST NIGERIA

Chukwuma, Samuel Chinonso[1] and Ukoha Akuma Ukoha (Ph.D)[2]

1. Department of Industrial Technology Education, Michael Okpara University of Agriculture, Umudike Abia State
2. Department of Industrial Technology Education, Michael Okpara University of Agriculture, Umudike Abia State

ABSTRACT

This study developed and validated Furniture Design and Construction Achievement Test (FDCAT) for accessing National Technical Certificate (NTC1) students' achievement in Furniture Design and Construction. The study was guided by four research questions. 30 NTC1 students of Furniture Design and Construction from a Delta State Technical College were used for pilot test. The population for the study was made up of 558 Furniture Design and Construction NTC1 students of technical colleges in south-east geopolitical zone of Nigeria in 2023/2024 academic session. Due to the narrowness of the population, the entire population was utilized and sampling was absent. 545 NTC1 students were used to subject initial pool of 104 objective test items for the test try-out that yielded the data for item analysis. 80 items with psychometric properties in terms of item difficulty indices ranged from 0.30-0.70, discrimination indices of +0.30-1.00 and positive distracter indices were obtained after the item analysis. The instrument developed and validated was Furniture Design and Construction Achievement Test (FDCAT) for NTCI. The content structure and internal consistency estimate of the instrument were established. The internal consistency estimate (reliability) was found to be 0.77 based on Kudder-Richardson formula 21 (KR – 21) method of estimating reliability. The results of the study revealed that the developed FDCAT instrument has moderate Psychometric properties in terms of difficulty, discrimination and distracter indices. Based on these findings, the researcher recommended, that Government at all level should adopt the instrument for accessing the achievement of NTC1 students of technical colleges in Furniture Design and Construction. Also, since the FDCAT developed consists of items of varying degrees of difficulty, discrimination and distracter indices, it should be accepted as appropriate for future use. Having developed Furniture Design and Construction Achievement Test (FDCAT) with moderate psychometric features, this study recommends that it should be adopted by State Ministries of Education and used by teachers of Furniture Design and Construction instruction.

Keywords: Achievement test, Furniture Design and Construction, Technical College, Psychometric properties, validity, reliability, Standard tests, and Teacher-made tests.

Introduction

The development of any nation depends largely on the effectiveness of its education. Education in Nigeria, is an instrument "per excellence" for affecting national development (Federal Republic of Nigeria, FRN, 2004). Consequently, different subjects are taught and studied at different levels of institutions in Nigeria towards realising the goal of education in national development. At the Technical College level, one of the subjects taught is Furniture Design and Construction I. Furniture Design and Construction I is one of different trade subjects taught to enable students acquire vocational skills and technical competence for gainful employment. The FRN (2004) in recognition

of the fact that technical and vocational education is an integral part of technological development maintained that greater proportion of educational expenditure shall continue to be devoted to technical and vocational education at Federal and State levels.

Meanwhile, the general objectives of Technical Education for which Furniture Design and Construction is a subset are to; provide trained manpower in applied sciences, technology and business particularly at craft, advanced craft and technical levels; provide the technical knowledge and vocational skills necessary for agricultural, commercial and economic development; give training and impart the necessary skills leading to the production of craftsmen, technicians and other skilled personnel who will be enterprising and self-reliant economically (Federal Republic of Nigeria, FRN, 2013). In pursuance of the above objectives of Furniture Design and Construction in technical colleges, the teaching and learning of Furniture Design and Construction in technical colleges should be carried out by applying innovative teaching techniques, bothering on the three domains of learning and the six objectives based on the cognitive domain. This means that the trade equips students with the fundamental and technical knowledge for intellectual growth and overall technological competence in the three domains of learning; namely cognitive, affective and psychomotor domains.

However, despite the role of Furniture Design and Construction to national development, the teaching and learning of the subject in technical colleges in Nigeria is still surrounded with problems. The problems range from policies which have no leaning with our problems, curriculum that has little or no relationship with workplace and social needs, embezzlement of funds meant for education development purposes, lack of teacher motivation, inadequate facilities, to inadequate funding, brain drain, poor staff training , bribery and corruption (Okoye & Arimonu, 2016). Similarly, both students and teachers of Furniture Design and Construction encounter difficulties in the teaching and learning of the subject. On the part of teachers, most Furniture Design and Construction teachers have little or no training or did not major in the subject and so find it difficult to teach the practical components of the subject and thereby making it difficult for students to appreciate and cope with the practical application of fundamental competences in Furniture Design and Construction. On the other hand, as Eze, and Okoroafor, (2012) pointed out that TVET programs which include Furniture Design and Construction in Nigeria was initially perceived as education for the less privileged and those that cannot do well in academics; thus, many students view Furniture Design and Construction as a subject for the lower class or maybe less privileged students and thus, may not take it seriously. This problem in addition to other problems such as, wrong method of teaching and assessment, for example, use of assessment instrument overtly with little or no reliability and validity; arising from teachers' inability to design and use valid tests, could be one of the main causes of poor performance of students in Furniture Design and Construction in technical college external examinations (NABTEB Chief Examiners' Report, 2018, 2019, 2020, 2021 & 2022) (The west African Examination Council, WAEC (SC) Chief Examiners'. Reports, 2022 & 2023). There is therefore the desire to raise the academic achievement of students in the subject through improved teaching and learning.

Consequently, in order to improve the teaching and learning of Furniture Design and Construction in our technical colleges, teachers need to always bear it in mind that there is a difference between the way Furniture Design and Construction and other subjects are taught and learning outcomes are measured. Anderson and Pengilly, (2015) suggested the use of active learning pedagogies to enhance students' learning where appropriate, so as to enable students achieve maximum benefits. In view of this, one important aspect which should guide any useful and effective teaching and learning of

Furniture Design and Construction is the determination of the extent to which learning objectives are achieved. It is therefore, the need to realise how well the learners have attained the objectives of instruction, as well as to use such information for curriculum development that emphasis is laid on educational evaluation (Federal Republic of Nigeria, FRN, 2013). Furthermore, to introduce a more realistic system of evaluation the Federal Ministry of Education directed that educational assessment shall be liberalized by their being based in whole or part on continuous assessment of the progress of the individual (UNESCO- NBTE, 2001). Thus, the assessment of students' performance in technical colleges begins from the first day of resumption of school, and with the first activity of the teacher versus the students. This means that the overall achievement of a student is a percentage score of the student in the ratio of 40%: 60% for continuous assessment and that of the examination respectively.

Malcolm (2012), defined achievement tests as examinations that are prepared to determine the degree of knowledge and proficiency possessed by an individual in a specific area or set of areas. An achievement test is sometimes given as part of the acceptance process into an educational program or to qualify an individual for employment or a promotion with a current employer. According to Nwagu, (1991) as cited in Chime (2012) assessment in the form of achievement test is a systematic and purposeful quantification of learning outcomes. It involves the determination of the degree of attainment of individuals in tasks, courses or programmes to which the individuals were sufficiently exposed using varieties of test instruments. In general, achievement test serves the purposes of revealing the extent to which learners have mastered knowledge and skills, as well as contribute to effective teaching of a subject. This means that achievement test should be used as the basis for guiding the teaching process so as to ensure an enhanced learning (Chime, 2012). He went further to explain that achievement test is used to find out how much a student is able to achieve in a subject he/she has been taught. It involves the determination of the degree of attainment of individuals on tasks, courses or programmes to which the individuals were sufficiently exposed.

For instance, teachers often ask questions before, during or after their lessons to ascertain how much information, problems and skills regarding the instructional content the students have learnt. Also, tests are given by teachers on weekly, termly or even yearly to assess the students in terms of achievement in the various content areas of instruction. Thus, test result provides the teacher and the students with some feedback on the students' progress in the subject. This enables a teacher to decide whether to carry on with lessons as planned or otherwise. Achievement tests measure knowledge of facts, concepts and principles. They are primarily used in making classroom-level decisions and are designed with particular reference to the specific learning objectives of a subject (Mahajan, 2017). It indicates present, not future, proficiency. Such tests evaluate students' understanding of a particular instructional domain in order to make decisions regarding the advancement or capability of the students. Decisions made on students using achievement tests can be biased if the achievement test used is not valid and reliable and at the same time possess the requisite psychometric properties in terms of difficulty, discrimination and distracters indices. As Mehrens and Lehman (1991) as cited in Ovute (2015) stated, achievement tests accomplish two major objectives namely; to discriminate among individuals according to their degrees of achievements. This type of testing is referred to as the norm-referenced testing, and is mainly used to rank students in order of achievement from high to low so that decisions based on relative achievement can be made with greater confidence. Secondly, another objective of achievement test involves the determination of the extent to which an individual has been able to reach the set standards. According to Nworgu, (2015) this form of testing, is called criterion referenced testing. In this study, the form of test being considered is the norm-referenced

achievement test which is an instrument most commonly used by teachers in evaluating learning outcome in schools.

Consequently, considering the fact that achievement in school subjects such as Furniture Design and Construction is positively related to technique of evaluation, as measuring instrument contributes to effective teaching and learning, any meaningful attempt at the improvement of students' performance should take cognizance of the use of valid and reliable testing instrument with requisite psychometric features in terms of difficulty, discrimination and distracters indices (Yusop, Rasul, Mohamad, Hashim, & Jalaludin, (2022). As a potent factor in determining learning outcomes, the proper assessment of students' achievement becomes an important consideration in any effort towards improving students' performance in Furniture Design and Construction. In addition to this, proper assessment of achievement hinges on the availability of instruments with known and satisfactory psychometric characteristics. However, there seems to be none-existence of valid and reliable instruments which would yield dependable and authentic results of students' achievement and the directive for instructors to device methods of accurately assessing the trainees to enable them give the students their final grade at the end of the term (NBTE, 2016), (Nwankwo & Agama, 2023). To that end, Furniture Design and Construction teachers might be relying entirely on teachers' made achievement test. Such tests are known to be of doubtful psychometric features since no step might have been taken to establish their psychometric properties before adoption and use. In addition, changes in the NBTE modules curricula objectives, contents, pedagogical strategies, hence, the need for designing instrument to measure students' achievement in the subject. The NBTE (2016) realised the negative consequences on students' performance in Furniture Design and Construction and directed teachers to device methods of accurately assessing students to arrive at the authentic results of students' achievement. One of such methods could be teachers having access to and using standardised Furniture Design and Construction achievement test of known and valid psychometric qualities. The directive underscores the need to develop and validate an instrument for measuring students' achievement in Furniture design and Construction.

Providing Furniture Design and Construction teachers access to such an instrument would entail developing and validating a Furniture Design and Construction achievement test which the study sought to accomplish. The objective of this study therefore, was to develop and validate a Furniture Design and Construction Achievement Test (FDCAT) for National Technical Certificate (NTC) I students in technical colleges in South East Nigeria.

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Research Questions

The following research questions were formulated to guide the study:

1. What is the content structure (validity) of the Furniture Design and Construction Achievement Test (FDCAT) for NTC I students?
2. What is the internal consistency estimate of the FDCAT?
3. What are the psychometric properties of the developed FDCAT in terms of difficulty, discrimination and distracters indices?
4. What are the Furniture Design and Construction Achievement Test with suitable psychometric properties for NTC 1 Students?

Methodology

The stages involved in the development of achievement tests applied in this study was as listed by Nworgu (2015). It comprises of planning of the test, items construction, pilot testing, trial testing, item analysis, and assembling of the final test. Each of the stages were described below.

Planning of the test: The table of specifications or test blueprint was first constructed and used. This was to determine the number of test items to be generated from each topic. The relative weights of each topic in terms of difficulty level, coverage, time spent in teaching the topic was estimated in percentages. Similarly, the relative weightings of the cognitive levels in terms of number of questions were considered in the test blueprint and represented in percentages. The population for the test try-out comprised 558 students of Technical Colleges in the South East, accredited by the NBTE to run Furniture Design and Construction trades in the 2023/2024 academic session. The content area of the study was based on the NTC1 Furniture Design and Construction curriculum module. The test blueprint consisted of 104 items in the content area of the NTC1 Furniture Design and Construction curriculum. (See table 1).

Table 1: *Table of Specifications for Furniture Design and Construction Achievement Test (FDCAT) at Cognitive Levels(First Draft)*

S/N	Content Objectives	Remembering 24%	Understanding 17%	Applying 16%	Analysing 14%	Evaluating 19%	Creating 10%	Total 100%
1	Design Elements13%	5 (2,3,4,5,11)	4 (1,10,12,13)	0	3 (7,9,14)	0	2 (6,8)	14
2	Design Principles 6%	0	0	2 (16,17)	2 (15,18)	0	2 (19,20)	6
3	Anthropometric Principles of Apportioning Sizes 9%	1 (24)	3 (23,29,30)	2 (25,27)	1 (26)	2 (22, 28)	1 (21)	10
4	Timber Preparation 6%	0	0	0	1 (36)	3 (31, 32,33)	2 (34,35)	6
5	Marking out 10%	3 (41,42,43)	0	3 (44,45,47)	1 (40)	2 (37, 46)	2 (38,39)	11
6	Timber Growth & Structure 10%	5 (48,49,50,54, 57)	0	1 (56)	3 (51,52, 53)	1 (55)	1 (58)	11
7	Wood Surface Preparation 7%	0	1 (63)	2 (60,64)	1 (65)	3 (59, 61, 62)	0	7
8	Timber Conversion & Seasoning 11%	5 (68,69,71,72, 76)	1 (67)	0	1 (77)	5 (66, 70, 73, 74, 75)	0	12
9	Timber Defects 10%	3 (78,82,83)	3 (84,85,86)	0	1 (80)	3 (79, 81, 87)	0	10
10	Technical Terms in Furniture 8%	2 (90,91)	5 (88, 89,92,94, 95)	1 (93)	0	0	0	8
11	Adhesives used in Woodwork 10%	1 (96)	1 (97)	6 (98,99,100, 101,102,103)	0	1 (104)	0	9
	Total 100%	25	18	17	14	20	10	104

Items Construction: Different methods of the objective test was used in the construction of the FDCAT items. This was because it was to be scored objectively and versatility in content coverage was needed (Eleje, Abanobi & Obasi 2017). One hundred and four (104) items that are in line with the table of specifications were constructed using recommended text books for Furniture Design and Construction by the National Board for Technical Education (NBTE).

The first draft of the constructed items was given to two experts in Industrial Technical Education and an expert in Educational Measurement and Evaluation, for face and content validation. Their expert observations, comments and suggestions were incorporated in the modifications of the test.

Pilot testing: Pilot testing was carried out on 30 NTC1 Furniture Design and Construction students of a technical college in Delta State to ascertain grammatical error and compatibility of the FDCAT test items (Nworgu, 2015).

The test try-out: The items were administered to 545 NTC1 Furniture Design and Construction students during third term of 2023/2024 academic session. This was carried out when the NTC1 students have been sufficiently exposed to the contents of the test items by having completed the teaching and learning of the test content. The purpose of the test try-out was for the purpose of item analysis.

Item analysis: This is done to ascertain the psychometric properties of the items. It was carried-out in six (6) main steps.

i. Identify the upper (U) and lower (L) achievers.
ii. Compute test responses.
iii. Calculate item difficulty index.
iv. Calculate item discrimination index.
v. Calculate the distracter indices.
vi. Select good items.

An item was considered good for inclusion in the final output of the test if it had difficulty index range between 0.30 - 0.70, discrimination index between +0.30 to +1.00 and a positive distracter index (Nworgu, 2015). However, items with appropriate difficulty indices but with discrimination indices of less than +0.30 were not accepted as good. Also, items with appropriate discrimination index but have difficulty index of less than 0.30 or more than 0.70 were rejected (See Table 2). Finally, eighty (80) items that met the above criteria were selected as the final draft of the FDCAT.

Assembling of final test: The final version of the FDCAT (80 items) were arranged in-line with the content area on the test blueprint.

Results and Discussion

Research Question 1: What is the content structure (validity) of the Furniture Design and Construction Achievement Test (FDCAT) for NTC I?

From the comments of the three panel members who validated the instrument used for data collection, it was established that the instrument has good content structure (validity).

Research Question 2: What is the internal consistency estimate (reliability) of the FDCAT?

The internal consistency estimate (reliability) of the Furniture Design and Construction Achievement Test (FDCAT) Instrument was calculated using Kuder-Richardson formula 21 (KR-21), based on the pilot test carried out, and internal consistency estimate of 0.77 was obtained. (See appendix II)

This showed that the developed Furniture Design and Construction Achievement Test (FDCAT) Instrument developed was of good internal consistency estimate (reliability).

Research Question 3: What are the Psychometric properties of the developed FDCAT in terms of difficulty, discrimination and distracter indices?

Table 2 (a): *Difficulty and discrimination Indices of Furniture Design and Construction Achievement Test (FDCAT)*

Items	U	L	P-value	Remarks	D-value	Remarks
1	175	66	0.30	Good	0.60	Good
2	180	71	0.30	Good	0.60	Good
3	175	62	0.31	Good	0.62	Good
4	165	48	0.32	Good	0.65	Good
5	165	57	0.30	Good	0.60	Good
6	160	51	0.30	Good	0.60	Good
7	166	52	0.31	Good	0.63	Good
8	175	65	0.30	Good	0.61	Good
9	180	65	0.32	Good	0.64	Good
10	180	52	0.35	Good	0.71	Good
11	167	53	0.31	Good	0.63	Good
12	180	88	0.25	Difficult	0.51	Good
13	177	65	0.31	Good	0.62	Good
14	180	65	0.32	Good	0.64	Good
15	180	55	0.39	Good	0.77	Good
16	180	65	0.32	Good	0.64	Good
17	160	49	0.31	Good	0.61	Good
18	176	53	0.34	Good	0.68	Good
19	164	65	0.27	Difficult	0.55	Good
20	177	65	0.31	Good	0.62	Good
21	176	65	0.31	Good	0.61	Good
22	164	44	0.33	Good	0.66	Good
23	165	65	0.28	Difficult	0.55	Good
24	176	68	0.30	Good	0.60	Good
25	162	52	0.30	Good	0.61	Good
26	167	55	0.31	Good	0.62	Good
27	175	61	0.31	Good	0.63	Good
28	170	51	0.33	Good	0.66	Good
29	156	55	0.28	Difficult	0.56	Good
30	179	65	0.31	Good	0.63	Good
31	176	65	0.31	Good	0.61	Good
32	174	44	0.36	Good	0.72	Good
33	163	65	0.27	Difficult	0.54	Good
34	176	65	0.31	Good	0.61	Good
35	160	52	0.30	Good	0.60	Good
36	167	55	0.31	Good	0.62	Good
37	150	61	0.25	Difficult	0.49	Good
38	170	53	0.32	Good	0.65	Good
39	155	55	0.28	Difficult	0.55	Good
40	179	65	0.31	Good	0.63	Good
41	171	59	0.31	Good	0.63	Good
42	158	72	0.24	Difficult	0.48	Good
43	163	55	0.30	Good	0.60	Good
44	164	90	0.20	Difficult	0.41	Good
45	164	55	0.30	Good	0.60	Good
46	173	53	0.33	Good	0.66	Good
47	173	52	0.33	Good	0.67	Good
48	175	65	0.30	Good	0.61	Good
49	168	65	0.28	Difficult	0.57	Good
50	163	36	0.35	Good	0.70	Good
51	167	55	0.31	Good	0.62	Good

52	172	65	0.30	Good	0.59	Good
53	160	72	0.24	Difficult	0.49	Good
54	163	55	0.30	Good	0.60	Good
55	164	52	0.31	Good	0.62	Good
56	165	55	0.30	Good	0.65	Good
57	163	53	0.30	Good	0.61	Good
58	170	52	0.33	Good	0.65	Good
59	175	65	0.30	Good	0.61	Good
60	168	84	0.23	Difficult	0.46	Good
61	163	36	0.35	Good	0.70	Good
62	167	55	0.31	Good	0.62	Good
63	162	52	0.30	Good	0.61	Good
64	173	65	0.30	Good	0.60	Good
65	172	65	0.30	Good	0.59	Good
66	162	42	0.33	Good	0.66	Good
67	165	55	0.30	Good	0.61	Good
68	156	42	0.31	Good	0.63	Good
69	171	55	0.32	Good	0.64	Good
70	158	94	0.18	Difficult	0.35	Good
71	170	60	0.31	Good	0.61	Good
72	172	65	0.30	Good	0.59	Good
73	163	42	0.33	Good	0.67	Good
74	163	65	0.27	Difficult	0.54	Good
75	176	65	0.31	Good	0.61	Good
76	164	52	0.31	Good	0.62	Good
77	167	55	0.31	Good	0.63	Good
78	175	61	0.31	Good	0.63	Good
79	170	53	0.32	Good	0.65	Good
80	155	55	0.28	Difficult	0.55	Good
81	179	65	0.31	Good	0.63	Good
82	176	65	0.31	Good	0.61	Good
83	164	44	0.33	Good	0.66	Good
84	163	65	0.27	Difficult	0.57	Good
85	176	66	0.30	Good	0.61	Good
86	161	51	0.30	Good	0.61	Good
87	167	56	0.31	Good	0.61	Good
88	175	61	0.31	Good	0.63	Good
89	170	53	0.32	Good	0.65	Good
90	159	56	0.28	Difficult	0.57	Good
91	180	61	0.32	Good	0.64	Good
92	167	67	0.28	Difficult	0.55	Good
93	163	73	0.25	Difficult	0.50	Good
94	172	56	0.32	Good	0.64	Good
95	169	91	0.22	Good	0.43	Good
96	170	92	0.22	Difficult	0.43	Good
97	151	54	0.27	Difficult	0.54	Good
98	173	51	0.34	Good	0.67	Good
99	176	69	0.30	Good	0.59	Good
100	168	84	0.23	Difficult	0.46	Good
101	163	37	0.35	Good	0.70	Good
102	169	56	0.31	Good	0.62	Good
103	176	65	0.31	Good	0.61	Good
104	168	84	0.23	Difficult	0.46	Good

Note.
U = Upper: 1/3 of the people that got the item correctly,
L = Lower: 1/3 of the people that got the item wrongly,
P-value = Item difficulty index
D-value = item discrimination index of the items

Table 2 (a), showed the psychometric properties of the developed FDCAT in terms of item difficulty index, discrimination index and distracters index of each of the items of the developed instrument. In terms of item difficulty, all the items of the developed achievement test instrument have item difficulty between 0.30 to 0.70 except 12, 19, 23, 29, 33, 37, 39, 42, 44, 49, 53, 60, 70, 74, 80, 84, 90, 92, 93, 95, 96, 97, 100, and 104. This could be interpreted that except the under listed items, which

were either too easy or too difficult to be included in the final draft of the test, the rest of the test items were ideal items in terms of the degree of easiness or difficulty of the items. For the items' discrimination indices, all the items were found to possess discrimination indices between +0.30 to +1.00. This implies that most of the items are also ideal items in terms of item's ability to discriminate between the dull and bright students.

Table 2 (b): *Distracters Indices of Furniture Design and Construction Achievement Test (FDCAT)*

	A		B		C		C								
ITEM NO	L	U	L	U	L	U	L	U	OM	TOTAL	A	B	C	D	REMARKS
1	55	3	47	2	59	175	20	1	0	362	0.29	0.25	H	0.10	Good
2	30	0	40	0	45	1	60	180	6	362	0.17	0.22	0.24	H	Good
3	60	175	34	2	47	1	40	3	0	362	H	0.18	0.25	0.20	Good
4	48	165	30	7	43	4	51	5	9	362	H	0.13	0.22	0.25	Good
5	50	9	34	3	57	165	35	4	5	362	0.23	0.17	H	0.17	Good
6	70	5	25	5	51	160	36	10	0	362	0.36	0.11	H	0.14	Good
7	50	5	52	166	43	4	31	8	3	362	0.25	A	0.22	0.13	Good
8	21	2	50	1	41	3	60	175	9	362	0.10	0.27	0.21	A	Good
9	60	180	31	0	20	1	65	0	5	362	A	0.17	0.10	0.36	Good
10	52	180	28	0	52	0	49	1	0	362	H	0.15	0.29	0.27	Good
11	50	6	53	167	28	3	50	5	0	362	0.24	H	0.14	0.25	Good
12	64	0	59	180	46	0	12	0	1	362	0.35	H	0.25	0.07	Good
13	21	3	54	0	45	2	60	177	0	362	0.10	0.30	0.24	H	Good
14	31	0	49	0	41	0	60	180	1	362	0.17	0.27	0.23	H	Good
15	53	0	38	1	48	0	40	180	2	362	0.29	0.20	0.27	H	Good
16	60	180	42	0	36	1	43	0	0	362	H	0.23	0.19	0.24	Good
17	29	4	48	8	55	9	49	160	0	362	0.14	0.22	0.25	H	Good
18	39	2	40	1	43	2	53	176	6	362	0.20	0.22	0.23	H	Good
19	42	12	42	15	60	150	38	3	0	362	0.17	0.15	H	0.19	Good
20	40	1	48	4	38	5	60	166	0	362	0.22	0.24	0.18	H	Good
21	30	0	42	5	60	176	45	0	4	362	0.17	0.20	H	0.25	Good
22	44	164	35	10	49	19	33	8	0	362	H	0.14	0.17	0.14	Good
23	29	5	60	164	42	12	31	10	9	362	0.13	H	0.17	0.12	Good
24	31	0	52	0	38	5	60	176	0	362	0.17	0.29	0.18	H	Good
25	52	151	43	15	45	7	41	8	0	362	H	0.15	0.21	0.18	Good
26	49	8	52	5	25	11	55	157	0	362	0.23	0.26	0.08	H	Good
27	58	175	50	2	47	4	26	0	0	362	H	0.27	0.24	0.14	Good

28	51	7	49	2	51	170	31	1	0	362	0.24	0.26	H	0.17	Good
29	46	3	40	10	40	22	55	146	0	362	0.24	0.17	0.10	H	Good
30	51	2	60	179	60	0	10	0	0	362	0.27	H	0.33	0.06	Good
31	60	176	43	2	39	0	40	2	0	362	H	0.23	0.22	0.21	Good
32	50	4	47	3	47	174	37	0	0	362	0.25	0.24	H	0.20	Good
33	60	153	69	8	41	11	11	9	0	362	H	0.34	0.17	0.01	Good
34	35	5	60	176	45	0	41	0	0	362	0.17	H	0.25	0.23	Good
35	65	5	41	13	23	12	52	151	0	362	0.33	0.15	0.06	H	Good
36	55	157	40	14	41	0	45	10	0	362	H	0.14	0.23	0.19	Good
37	58	135	54	9	46	11	23	26	0	362	H	0.25	0.19	-0.02	Replace
38	40	0	53	170	52	1	36	10	0	362	0.22	H	0.28	0.14	Good
39	62	1	46	15	18	20	55	145	0	362	0.34	0.17	-0.01	H	Replace
40	60	179	36	0	46	2	39	0	0	362	H	0.20	0.24	0.22	Good
41	60	161	46	18	37	0	38	2	0	362	H	0.15	0.20	0.20	Good
42	33	14	35	9	58	148	55	10	0	362	0.10	0.14	H	0.25	Good
43	38	8	38	5	55	163	48	5	2	362	0.17	0.18	H	0.24	Good
44	52	4	59	154	29	19	41	4	0	362	0.27	H	0.06	0.20	Good
45	55	155	43	5	53	10	30	10	1	362	H	0.21	0.24	0.11	Good
46	53	173	42	4	44	4	41	0	1	362	H	0.21	0.22	0.23	Good
47	52	173	45	3	40	5	44	0	0	362	H	0.23	0.19	0.24	Good
48	35	1	60	175	46	5	40	0	0	362	0.19	H	0.23	0.22	Good
49	20	1	56	3	60	168	45	9	0	362	0.10	0.29	H	0.20	Good
50	65	0	42	163	36	3	43	10	0	362	0.36	H	0.18	0.18	Good
51	57	4	55	167	43	6	26	3	1	362	0.29	H	0.20	0.13	Good
52	51	4	45	7	25	9	60	161	0	362	0.26	0.21	0.09	H	Good
53	42	13	38	10	59	148	42	10	0	362	0.16	0.15	H	0.18	Good
54	54	2	40	6	55	163	32	10	0	362	0.29	0.19	H	0.12	Good
55	52	154	45	6	54	6	30	15	0	362	H	0.22	0.27	0.08	Good
56	53	11	35	9	38	6	55	155	0	362	0.23	0.14	0.18	H	Good
57	50	5	44	12	34	11	53	153	0	362	H	0.18	0.13	-0.55	Replace
58	45	4	50	10	34	14	52	153	0	362	0.23	0.22	0.11	H	Good
59	61	0	29	3	31	3	60	175	0	362	0.34	0.14	0.15	H	Good
60	35	4	45	3	59	168	42	6	0	362	0.17	0.23	H	0.20	Good

61	36	163	45	8	52	5	48	5	0	362	H	0.20	0.26	0.24	Good
62	55	167	36	5	40	5	50	4	0	362	H	0.17	0.19	0.25	Good
63	35	9	52	152	45	10	49	10	0	362	0.14	H	0.19	0.22	Good
64	51	2	35	2	35	3	60	173	1	362	0.27	0.18	0.18	H	Good
65	50	2	34	4	37	3	60	172	0	362	0.27	0.17	0.19	H	Good
66	46	7	44	8	42	162	49	4	0	362	0.22	0.20	H	0.25	Good
67	45	4	55	165	36	8	45	4	0	362	0.23	H	0.15	0.23	Good
68	50	9	50	6	42	156	39	10	0	362	0.23	0.24	H	0.16	Good
69	51	2	45	3	30	5	55	171	0	362	0.27	0.23	0.14	H	Good
70	59	144	32	17	50	8	40	12	0	362	H	0.08	0.23	0.15	Good
71	50	5	21	7	60	164	5	50	0	362	0.25	0.08	H	-0.25	Replace
72	60	172	41	3	50	2	30	4	0	362	H	0.21	0.27	0.14	Good
73	49	6	42	163	40	10	50	2	0	362	0.24	H	0.17	0.27	Good
74	60	153	51	6	45	10	24	12	1	362	H	0.25	0.19	0.07	Good
75	52	0	40	2	30	3	59	176	0	362	0.29	0.21	0.15	H	Good
76	52	164	30	9	49	5	50	3	0	362	H	0.12	0.24	0.26	Good
77	50	6	50	7	55	157	26	10	1	362	0.24	0.24	H	0.09	Good
78	28	7	61	165	52	4	40	5	0	362	0.12	H	0.27	0.19	Good
79	53	170	38	5	48	3	42	3	0	362	A	0.18	0.25	0.22	Good
80	55	145	36	15	40	15	50	6	0	362	H	0.12	0.14	0.24	Good
81	41	0	52	0	28	1	60	179	1	362	0.23	0.29	0.15	H	Good
82	40	1	51	0	60	176	30	4	0	362	0.22	0.28	H	0.14	Good
83	44	164	37	11	50	3	50	3	0	362	H	0.14	0.26	0.26	Good
84	30	18	50	5	60	153	41	5	0	362	0.07	0.25	H	0.20	Good
85	53	0	58	176	30	3	40	2	0	362	0.29	H	0.15	0.21	Good
86	60	9	51	151	41	10	29	11	0	362	0.28	H	0.17	0.10	Good
87	55	10	40	8	30	6	56	157	0	362	0.25	0.18	0.13	H	Good
88	61	175	40	0	58	2	22	4	0	362	H	0.22	0.31	0.10	Good
89	40	2	48	7	40	2	53	170	0	362	0.21	0.23	0.21	H	Good
90	50	10	45	12	30	13	56	146	0	362	0.22	0.18	0.09	H	Good
91	60	180	50	0	50	0	21	0	1	362	H	0.28	0.28	0.12	Good
92	58	167	43	2	50	6	30	6	0	362	H	0.23	0.24	0.13	Good
93	51	8	49	11	22	9	59	153	0	362	0.24	0.21	0.07	H	Good
94	56	162	43	2	52	8	30	9	0	362	H	0.23	0.24	0.12	Good

95	36	4	60	159	61	10	24	8	0	362	0.18	H	0.28	0.09	Good
96	60	158	51	5	40	5	30	13	0	362	H	0.25	0.19	0.09	Good
97	34	20	53	13	54	136	40	12	0	362	0.08	0.22	H	0.15	Good
98	51	173	51	0	49	2	21	6	0	353	H	0.28	0.26	0.08	Good
99	44	2	36	2	41	1	60	176	0	362	0.23	0.19	0.22	H	Good
100	49	2	41	8	57	168	31	3	3	362	0.26	0.18	H	0.15	Good
101	52	4	44	8	37	163	48	6	0	362	0.27	0.20	H	0.23	Good
102	30	2	50	3	56	169	45	7	0	362	0.15	0.26	H	0.21	Good
103	60	176	59	3	41	0	20	2	1	362	H	0.31	0.23	0.10	Good
104	30	5	50	5	59	168	42	3	0	362	0.14	0.25	H	0.22	Good

Note.

A	NO OF RESPONDENTS WHO CHOOSED OPTION A
B	NO OF RESPONDENTS WHO CHOOSED OPTION B
C	NO OF RESPONDENTS WHO CHOOSED OPTION C
D	NO OF RESPONDENTS WHO CHOOSED OPTION D

U = Upper: 1/3 of the people that got the item correctly,
L = Lower: 1/3 of the people that got the item wrongly,

H	=>	Hint
OM	=>	Omitted
N	=>	181
Good	=>	Distracters ok
Replace	=>	Replace distracter

Table 2(b) showed that, all the items have positive distracters except items: 37, 39, 57 and 71 that possess negative distracters. Hence, the Furniture Design and Construction Achievement Test Instrument developed have good item difficulty, discrimination as well as distracters indices.

Research Question 4: What are the Furniture Design and Construction Achievement Test with suitable psychometric properties for NTC 1 Students?

The final version of the items of the FDCAT was selected using the outcome of the item analysis. From a pool of 104 items. Items that met the criteria to be included were added. Items with difficulty index between 0.30 - 0.70, discrimination index of +0.30 - +1.00 and without a negative distracter were considered appropriate. (See appendix III).

Discussion

The discussion of this research findings was done according to the research questions. Achievement tests are generally designed to measure the outcome of level of accomplishment in a specified programme of instruction in a subject area or occupation, which a student had undertaken in the recent past (Nworgu, 2015). The above statement could be considered as a general purpose of achievement test items. However, before a test item could be regarded as an achievement test, it must possess certain psychometric properties. These properties were discussed below:

The content structure (validity) of the FDCAT instrument was established by the actions of the three experts, who carried out the validation exercise on the instrument. Their corrections and suggestions were applied and the result was the instrument for which the data was collected. The items were also matched with the table of specification, and according to their cognitive level of objectives.

The internal consistency estimate (reliability) of the instrument was estimated with Kudder Richardson 21 (KR – 21) method. A relatively high level of reliability was obtained. The reliability of FDCAT was calculated to to be 0.77. This internal consistency is high enough to guarantee the usage of the instrument for the assessment of NTC1 student's achievement in technical colleges.

The result obtained from item analysis showed that 80 out of 104 items of the Furniture Design and Construction Achievement Test Instrument had item difficulty between 0.30 - 0.70. This showed that the items were mostly ideal items in terms of their degrees of easiness or difficulty of the items. In terms of discrimination, all of the 80 items have discrimination indices between +0.30 to +1.00. This meant that most of the items were also of good quality in terms of ability to discriminate between the bright and dull students. Finally, all the 80 items had positive distracters except for items 57 and 71, which the researcher replaced the option that distracted negatively and included it in the final test items. Therefore, the FDCAT developed had high item difficulty and discrimination indices. These findings were in line with Nworgu, (2015) which says that an ideal item must possess difficulty index of 0.50. but realistically such tests do not exist. Therefore, an allowable distance of 0.20 was given in both upper and lower side of the value. Hence, a test is said to be good if it possesses difficulty index ranging from 0.30-0.70, discrimination index of +0.30 - +1.00 and no negative distracter. This showed that the values of difficulty and discrimination indices arising from this study indicate that the developed FDCAT items were of good quality, and could be used for assessing students' achievement in Furniture Design and Construction. The calculated indices implied that the FDCAT could effectively discriminate between bright and dull students, and also between easy and difficult test items.

Recommendations

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

1. Government at all level should adopt the instrument for accessing the achievement of NTC1 students of technical colleges in Furniture Design and Construction.
2. Since the FDCAT developed consists of items of varying degrees of difficulty, discrimination and distracter indices, it is recommended that items of difficulty levels of the range 0.30 – 0.70, and discrimination indices of 0.30 – 1.00 and a positive distracter should be accepted as appropriate for future use.

3. Having developed Furniture Design and Construction Achievement Test (FDCAT) with moderate psychometric features, this study recommends that it should be adopted by State Ministries of Education and used by teachers of Furniture Design and Construction.

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APENDIX I

National Technical Certificate (NTC) Curriculum and Module Specifications for Furniture Design and Construction

ED/STV/2001/PI/12

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

Furniture Design and Construction

National Technical Certificate (NTC) and
Advanced National Technical Certificate (ANTC)

Curriculum and Module Specifications

NATIONAL BOARD FOR TECHNICAL EDUCATION
Federal Republic of Nigeria

UNESCO – Nigeria Project
2001

The NTC and ANTC programmes are run by Technical Colleges accredited by NBTE. NABTEB conducts the final National examination and awards certificates.
Trainees who successfully complete all the courses/modules specified in the curriculum table and passed the national examinations in the trade will be awarded one of the following certificates:

S/NO	LEVEL	CERTIFICATE
	Technical Programme	
1.	Craft Level	National Technical Certificate
2.	Advanced Craft Level	Advanced National Technical Certificate

Guidance Notes for Teachers Teaching the Curriculum
The number of hours stated in the curriculum table may be increased or decreased to suit individual institutions' timetable provided the entire course content is properly covered and the goals and objectives of each module are achieved at the end of the term.
The maximum duration of any module in the new scheme is 300 hours. This means that for a term of 15 weeks, the course should be offered for 20 hours a week. This can be scheduled in sessions of 4 hours in a day leaving the remaining hours for general education. However, (properly organized and if there are adequate resources), most of these courses can be offered in two sessions a day, one in the morning and the other one in the afternoon. In so doing, some of these programmes may be completed in lesser number of years than at present.
The sessions of 4 hours include the trade theory and practice. It is left to the teacher to decide when the class should be held in the workshop or in a lecture room.

INTEGRATED APPROACH IN THE TEACHER OF TRADE
Theory, Trade Science and Trade Calculation
The traditional approach of teaching trade science and trade calculation as separate and distinct subjects in technical college programmes is not relevant to the new programme as it will amount to a duplication of the teaching of mathematics and physical science subjects in the course. The basic concepts and principles in mathematics and physical science are the same as in the trade calculation and trade science. In the new scheme therefore, qualified persons in these fields will teach mathematics and physical science and the instructors will apply the principles and concepts in solving trade science and calculation problems in the trade theory classes. To this end, efforts have been made to ensure that mathematics and science modules required to be able to solve technical problems were taken as pre-requisite to the trade module.

Evaluation of Programme/Module
For the programme to achieve its objectives, any course started at the beginning of a term must terminate at the end of the term.

Instructors should therefore device methods of accurately assessing the trainees to enable them give the student's final grades at the end of the term. All students who have successfully completed their modules will take a national examination. The final award will be based on the aggregate of the scores attained in the course work and the national examination.

Curriculum Table (NTC)
CURRICULUM TABLE AND COURSE HOURS/WEEK
COURSE: NATIONAL TECHNICAL CERTIFICATE PROGRAMME: FURNITURE DESIGN &
CONSTRUCTION

			YEAR 1						YEAR 2						YEAR 3						
S/No	Subject Code	Module	Term 1		Term 2		Term 3		Term 1		Term 2		Term 3		Term 1		Term 2		Term 3		Total Hours
			T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	216
1	CMA 1215	Mathematics	2	-	2	-	2	-	2	-	2	-	2	-	2	-	2	-	2	-	288
2	CEN 1117	English	2	-	2	-	2	-	3	-	3	-	3	-	3	-	3	-	3	-	288
3	CPH 1012	Physics	2	-	2	-	2	-	2	1	2	1	2	1	2	1	2	1	2	1	288
4	CCH 1112	Chemistry	2	-	2	-	2	-	2	1	2	1	2	1	2	1	2	1	2	1	288
5	CEC 1113	Economics	2	-	2	-	2	-	2	-	2	-	2	-	2	-	-	-	-	-	216
6	CBM 11	Entrepreneurship	-	-	-	-	-	-	2	-	2	-	2	-	-	-	-	-	-	-	72
7	CTD 1113	T/Drawing	-	3	-	3	-	3	-	3	-	3	-	3	-	2	-	2	-	2	288
8	ICT 1115	Computer Studies	-	-	-	-	-	-	1	2	1	2	1	2	1	2	1	2	-	-	180
9	CME 11	General Metal Work I	2	5	2	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	168
10	CME 12	General Metal Work II	-	-	-	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	60
11	CMW 11	Machine Woodworking, I	2	8	2	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	240
12	CMW 12	Machine Woodwork II	-	-	-	-	-	-	3	17	-	-	-	-			-	-	-	-	240
13	CPD 12	Wood & Metal Finishing	-	-	-	-	-	-	-	-	-	-	-	-	3	17	-	-	-	-	240
14	CFC 11	Furniture Design & Construction. I	-	-	-	-	3	12	-	-			-	-	-	-	-	-	-	-	180

Furniture Design and Construction, I

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN FURNITURE DESIGN AND CONSTRUCTION
MODULE: FURNITURE DESIGN AND CONSTRUCTION I MODULE CODE: CFC II
GOAL: This module is designed to provide the trainee with the basic knowledge and skill to enable him understand simple furniture and Construction
General Objectives: On completion of this module, the trainee should be able to: 1. Understand design elements. 2. Appropriate design principles to design elements. 3. Understand the anthropometrics principles of apportioning sizes to products. 4. Know the principles of timber preparation. 5. Know the principles of marking out and be able to mark out given stock accurately. 6. Know the nature of timber and timber growth. 7. Know the principles of surface preparation. 8. Understand the principles and purpose of timber conversion and seasoning. 9. Know the various timber defects and how to prevent them. 10. Know the various technical terms associated with the furniture trade. 11. Know the various adhesives used in woodwork and be able to apply them on a given job.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN FURNITURE DESIGN AND CONSTRUCTION			
Module: FURNITURE DESIGN AND CONSTRUCTION I		**Module Code CFC - 11**	**Contact Hours:**
Module Specification: Theoretical Content.			
	General Objective: 1.0 Understand design elements and design principles.		
Week	**Specific Learning Outcome:**	**Teacher Activities**	**Resources**
1	1.1 Explain the meaning of design 1.2 State the basic design elements, i.e. space, line, shape, form, colour, value and texture. 1.3 Explain how these elements affect the quality of a design. 1.4 State how these elements affect the quality of a design in two and three dimensions.	• Explain to students, design elements with regards to types of lines, shapes and forms applied in drawing and how they affect dimensions.	• Chalk board. • Drawing instruments. • Lesson notes.
	General Objective 2:0 Understand Design Principles		
Week	**Specific Learning Outcome:**	**Teacher Activities**	**Resources**
2	2.1 Know the various design principles i.e. balance, movement, repetition, emphasis, contrast and unity. 2.2 Explain their effects in application to the design elements. 2.3 Describe how the design principles apply to the various design elements in nature.	• Explanation of types of lines e.g. Zig zag dotted line, thick line, thin line etc. • State the functions of these lines in drawings.	• Chalk board. • Drawing instruments. • Lesson notes.
	General Objective 3.0: Know Anthropometrics Principles		
Week	**Specific Learning Outcome:**	**Teacher Activities**	**Resources**
3	3.1 Explain the principles of human proportions and dimensions, e.g. relationship of distance between one part of the body and another. 3.2 Use anthropometrics principles to determine various sizes of different types of furniture, e.g. chairs, stools, tables, etc.	• Draw the three-dimensional views of a chosen object showing the front, side, and plan views. • Draw the pictorial view of a chosen furniture item.	• Chalk board working using drawing instruments.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN FURNITURE DESIGN AND CONSTRUCTION

Module: FURNITURE DESIGN AND CONSTRUCTION I		**Module Code CFC - 11**	**Contact Hours:**
Module Specification: Theoretical Content.			
	General Objective 4.0: Know the Principles of Timber Preparation		
Week	**Specific Learning Outcome:**	**Teacher Activities**	**Resources**
4	4.1 Explain the principles of cutting wood to size using handsaws and machine.	• List the tools used for timber preparation and explain their functions.	• Chalk board • Woodwork tools • Materials (wood)
	General Objective 5.0 Marking Out		
Week	**Specific Learning Outcome:**	**Teacher Activities**	**Resources**
5	5.1 Interpret simple working drawing of wood projects. 5.2 Identify conventional representation for timber fastenings on a drawer. 5.3 Define conversion and state its purposes. 5.4 Describe with annotated sketches how a log is converted to timber by the following methods. a. Through and through sawing b. Quarter sawing 5.5 State the merits and demerits of each type of conversion method.	• Teach students to make orthographic drawing of simple objects. • Give drawing assignment	• Drawing Equipment• Marking out tools. • Text books • Chalk board. • Lesson notes.
	General Objective 6.0 Know the nature of Timber Growth And Structure		
Week	**Specific Learning Outcome:**	**Teacher Activities**	**Resources**
6	6.1 Describe the growth of a tree from which timber is obtained, how it is fell; and cut into logs for sawmills. 6.2 Classify timber into two groups: - hardwoods and softwood and explain the difference between the two classification. 6.3 State the main characteristics of hardwoods and softwoods.	• Explain timber growth and Structure • Explain the nature of trees from which timber is obtained. • Classify timber into hard and soft wood. Show samples of these.	• Text Books • Chalk board. • Samples of woods. • Lesson notes.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN FURNITURE DESIGN AND CONSTRUCTION			
Module: FURNITURE DESIGN AND CONSTRUCTION I		**Module Code CFC - 11**	**Contact Hours:**
Module Specification: Theoretical Content.			
	General Objective 7.0 Know the methods of Wood Surface Preparation for Finishing		
Week	**Specific Learning Outcome:**	**Teacher Activities**	**Resources**
7	7.1 State the purpose of finishing e.g. decoration, preservation. 7.2 Explain the working principles of air compressors and air line dryers. 7.3 Explain the importance of fan extractors. 7.4 Recognise and remove surface defects. 7.5 Outline the process of staining and filling 7.6 Apply stains, e.g. matching stain using appropriate safety equipment.	• State the purpose of surface preparation and finishing e.g. for aesthetics, preservation, hygiene. • Name the types of finishing materials e.g. abrasive paper, stain, transparent and opaque finishes paint, polish, etc.	• Chalk board. • Samples of wood finishing materials. • Lesson note
	General Objective 8.0 Know the Principles of Timber Conversion And Seasoning		

Week	Specific Learning Outcome:	Teacher Activities	Resources
8	8.1 Explain the two types of conversion: a) through and through method, (b) back sawing or quarter sawing method. List the merits and demerits of each method. 8.2 Explain the difference between kiln seasoning and natural or air seasoning. 8.3 State the merits and demerits of each type of seasoning. 8.3 Describe the effect of proper staking of boards on the seasoning of the timber.	• Explain conversion of timber. • Explain the various methods of conversion. • Explain seasoning and state the importance of seasoning wood. Explain the two main classes of wood seasoning.	• Chalk board. • Samples of timber from different conversion methods. • Lesson note • Pictures of defects infested woods.

PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN FURNITURE DESIGN AND CONSTRUCTION			
Module: FURNITURE DESIGN AND CONSTRUCTION I		**Module Code CFC - 11**	**Contact Hours:**
Module Specification: Theoretical Content.			
	General Objective 9.0 Timber Defects		
Week	**Specific Learning Outcome:**	**Teacher Activities**	**Resources**
9	9.1 Classify timber defects into two main groups namely natural and artificial defects. 9.2 Explain the causes of the following timber defects; splits, warp, twist, casehardening, collapse, etc., 9.3 Explain the possible causes of the following timber defects; dry rot, wet rot,, woodborers and how they can be prevented. 9.4 Explain the possible causes of timber defects 9.5 Explain the methods of preventing natural and artificial defects in timber.	• Identify the various types of defects in timber - natural and artificial. • State the merits and demerits of the various methods of wood conversion. • Mention the natural and artificial defects in timber and explain their effects.	• Chalk board. • Samples of defects infested woods. • Lesson note • Pictures of defects infested woods.
	General Objective 10.0 Know Technical Terms In Furniture Work.		
Week	**Specific Learning Outcome:**	**Teacher Activities**	**Resources**
10	10.1 Make a list of Technical Terms used in furniture making e.g. Pot life, blooming, bleaching, staining, padding, tacking etc. 10.2 Define technical terms used in Furniture Making. 10.3 Identify the following Nigerian timbers - mahogany obeche, (cedar), afara, abura, etc and their uses.	• Define the related glossaries in furniture making.	• Chalk board. • Lesson notes.
PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN FURNITURE DESIGN AND CONSTRUCTION			
Module: FURNITURE DESIGN AND CONSTRUCTION I		**Module Code CFC - 11**	**Contact Hours:**
Module Specification: Theoretical Content.			
	General Objective 11.0: Know the Adhesives used in Woodwork		
Week	**Specific Learning Outcome:**	**Teacher Activities**	**Resources**
11-12	11.1 Explain the principles of adhesion 11.2 Classify adhesives into interior and exterior types: Interior: - animal, Vegetable and thermo-plastic glues; Exterior:- Phenol formaldehyde (cascamite) 11.3 State the composition of the adhesive listed above. 11.4 Prepare and apply adhesives. 11.5 Cure glue lines by normal temperature and artificial heating methods.	• Define and explain the types of adhesives and glues used in woodworking and their application. • Show samples of different adhesives to students.	• Chalk board • Lesson note • Samples of adhesive materials.
13	**Examination: Practical: - 70%: Theory - 30%**		

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APENDIX II
STUDENTS' SCORE OF THE PILOT TEST OF FURNITURE DESIGN AND CONSTRUCTION ACHIEVEMENT TEST (FDCAT)

NO	1	2	3	4	5	6	7	8	9	10	11	12	13
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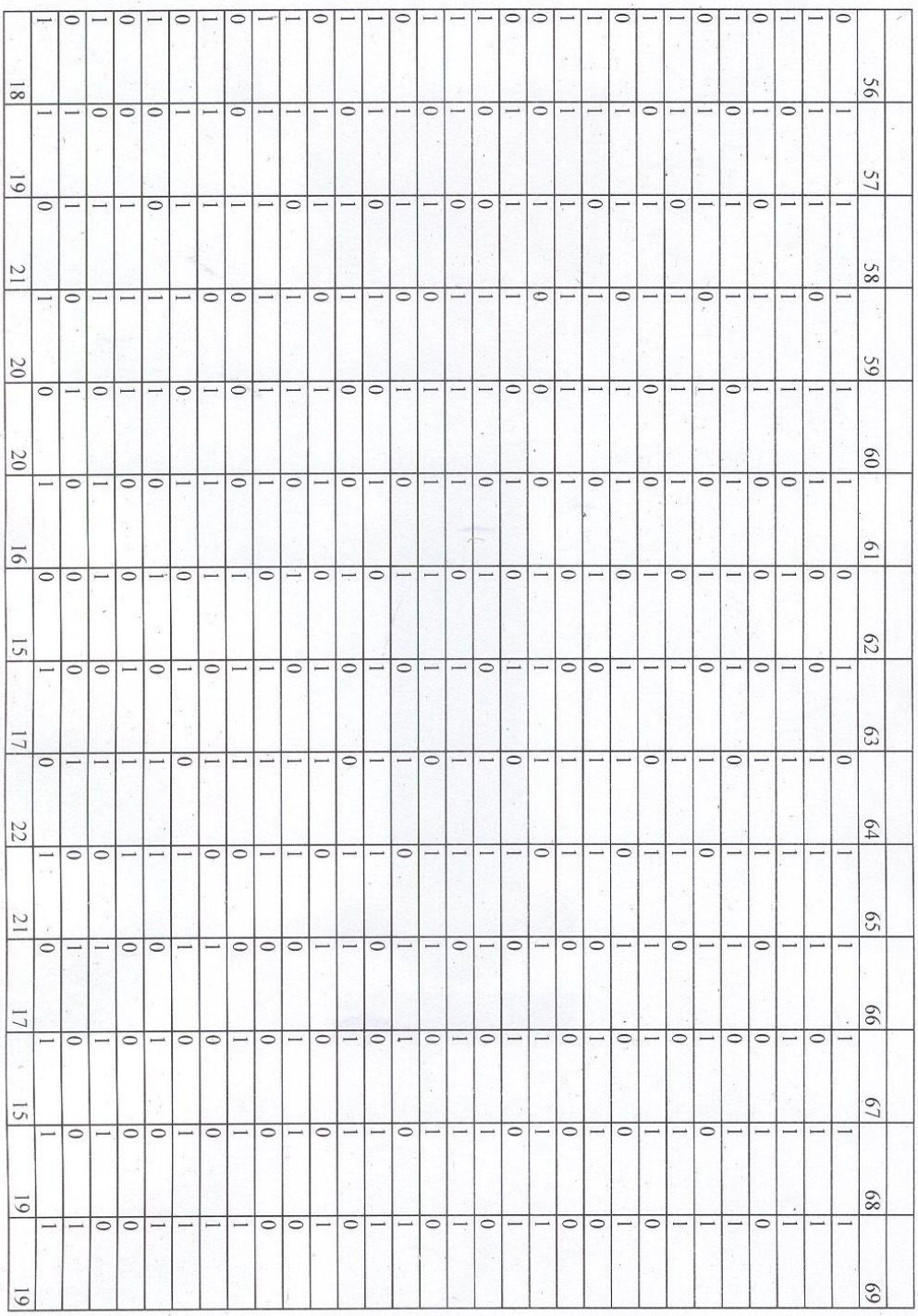

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1	0	1	1	0	0	1	1	0	1	0	1	0	0
0	1	1	0	1	1	0	0	1	1	1	0	1	1
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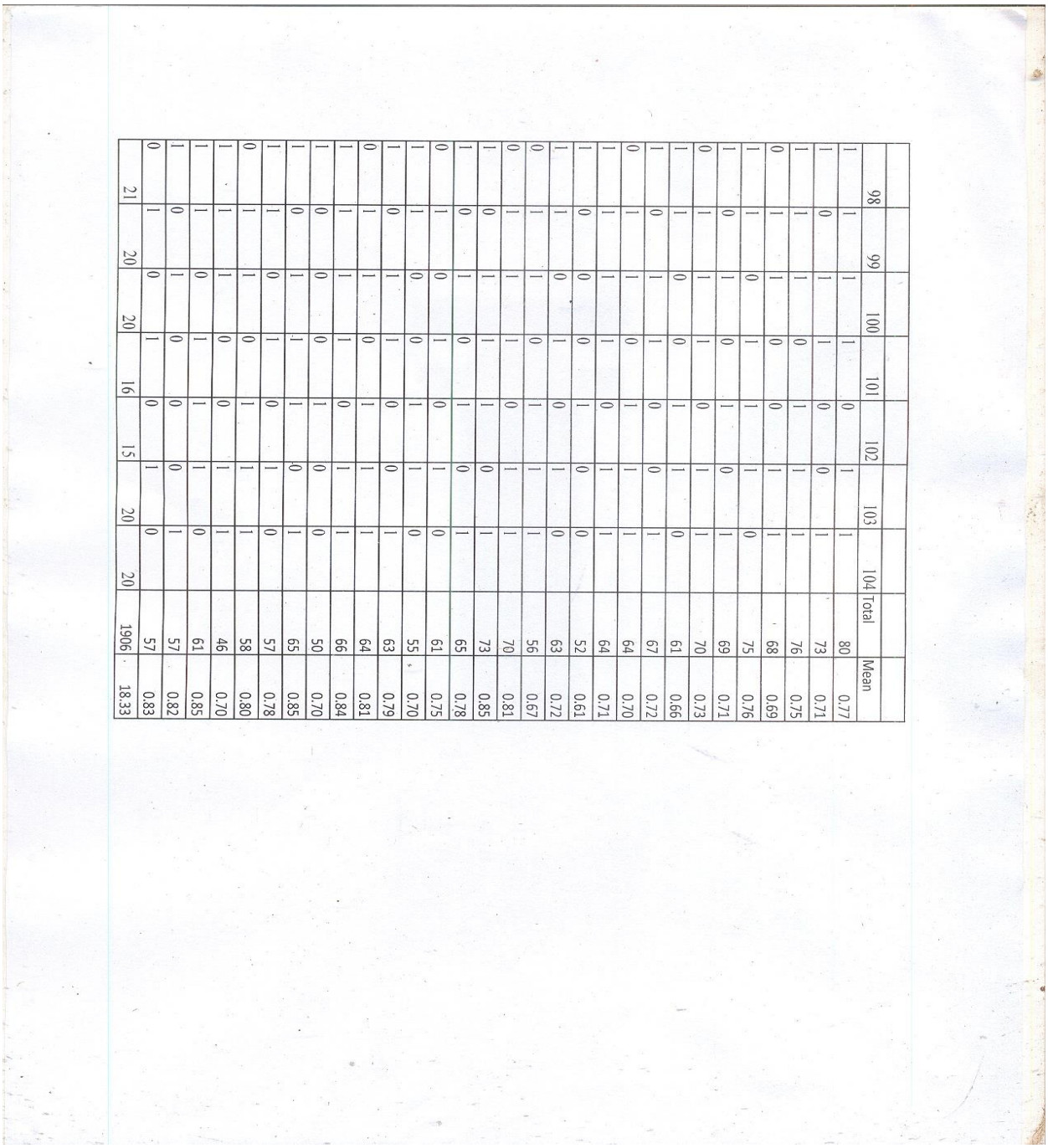
1	0	1	0	1	1	0	1	1	0	1	1	0	1
1	0	1	1	0	1	0	1	0	1	0	0	1	1
18	15	20	16	20	21	16	19	15	19	19	18	18	19



	98	99	100	101	102	103	104	Total	Mean
1	1	1	1	0	1	1	1	80	0.77
1	0	1	1	0	0	1	1	73	0.71
1	1	1	0	0	1	1	1	76	0.75
0	1	1	0	0	1	1	0	68	0.69
1	1	1	0	0	1	0	1	75	0.76
1	0	1	0	1	0	1	1	69	0.71
0	1	1	0	0	1	1	1	70	0.73
1	1	0	1	0	1	0	1	61	0.66
1	1	0	1	0	1	1	1	67	0.72
0	1	1	0	1	0	1	1	64	0.70
1	1	1	0	1	0	1	1	64	0.71
1	0	0	1	1	0	0	1	52	0.61
1	1	0	1	0	1	0	1	63	0.72
0	1	1	0	0	1	1	0	56	0.67
0	1	1	0	0	1	1	0	70	0.81
1	1	0	1	0	1	1	1	73	0.85
1	0	1	0	1	0	1	1	65	0.78
0	1	1	0	0	1	1	0	61	0.75
0	1	1	0	0	1	0	1	55	0.70
1	1	0	1	0	1	1	1	63	0.79
0	1	1	0	0	1	1	0	64	0.81
1	0	1	0	1	0	1	1	66	0.84
1	1	0	1	0	1	0	1	50	0.70
1	1	0	1	0	1	1	1	65	0.85
1	1	1	0	0	1	1	1	57	0.78
0	1	1	0	0	1	1	0	58	0.80
1	1	1	0	0	1	1	1	46	0.70
1	1	1	0	0	1	1	1	61	0.85
1	0	1	0	1	0	1	1	57	0.82
1	1	0	1	0	1	1	1	57	0.83
0	1	1	0	0	1	1	0	1906	18.33
	21	20	20	16	15	20	20		

Using Kuder-Richardson Formula 21 (K-R_{21}) = $\frac{n}{n-1} \times \left[1 - \left(\frac{\bar{X}(n-\bar{X})}{n \times \sigma^2}\right)\right]$

Where

n = number of items in the test = 104

$\bar{X}$ = the mean of the test score =18.33
σ^2 = variance of the test score = 62.95

$$R = \frac{104}{104-1} \times \left[1 - \left(\frac{18.33(104-18.33}{104 \times 62.95}\right)\right] = 1.01 \times \left[1 - \left(\frac{18.33 \times 85.67}{104 \times 62.95}\right)\right]$$

$$= 1.01 \times \left[1 - \left(\frac{1570.3311}{6546.8}\right)\right] = 1.01 \times 1 - [0.24] = 1.01 \times 0.76 = 0.77$$

R = 0.77

APENDIX III

Table 1: *Table of Specifications for Furniture Design and Construction Achievement Test (FDCAT) at Cognitive Levels (After Item Analysis)*

S/N	Content Objectives	Remembering 23.75%	Understanding 16.25%	Applying 16.25%	Analysing 15%	Evaluating 18.75%	Creating 10%	Total 100%
1	Design Elements16.25%	5 (2,3,4,5,11)	3 (1,10,12)	0	3 (7,9,13)	0	2 (6,8)	13
2	Design Principles 6.25%	0	0	2 (15,16)	2 (14,17)	0	1 (18)	5
3	Anthropometric Principles of Apportioning Sizes 10%	1 (21)	1 (26)	2 (22,24)	1 (23)	2 (20, 25)	1 (19)	8
4	Timber Preparation 6.25%	0	0	0	1 (31)	2 (27, 28)	2 (29,30)	5
5	Marking out 8.75%	2 (34,35)	0	2 (36,38)	1 (33)	1 (37)	1 (32)	7
6	Timber Growth & Structure 11.25%	2 (39,43)	2 (40,46)	1 (45)	2 (41,42)	1 (44)	1 (47)	9
7	Wood Surface Preparation 7.50%	0	1 (51)	1 (52)	1 (53)	3 (48, 49, 50)	0	6
8	Timber Conversion & Seasoning 12.5%	5 (56,57,58,59, 62)	1 (55)	0	1 (63)	3 (54, 60, 61)	0	10
9	Timber Defects 10%	3 (64,67,68)	2 (69, 70)	0	0	3 (65, 66, 71)	0	8
10	Technical Terms in Furniture 5.0%	1 (74)	3 (72,73,75)	0	0	0	0	4
11	Adhesives used in Woodwork 6.25%	0	0	5 (76,77,78, 79,80)	0	0	0	5
	Total 100%	19	13	13	12	15	8	80

Furniture Design and Construction Achievement Test (FDCAT) for NTC I

Instruction: Attempt all questions Time allowed - 1 hour

Answer each question by underlining the letter containing the option that best suits your answer.

Example: Which of the following is not an output device in computer?

(a). monitor (b). Printer (c). Speaker <u>(d)</u> keyboard

The correct answer is(d) and letter (d) is therefore underlined.

Now do the following:

Design Elements

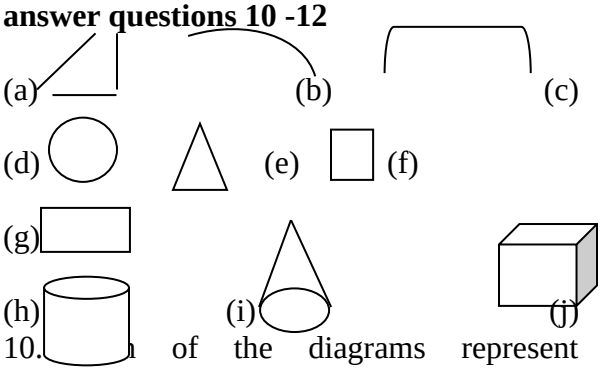
1. The word 'design' can be used in the following ways except;

(a) the material with which an article is made, (b) the article itself, (c) the estimated cost of the article when finished, (d) a patented name. [Understanding]

2. Which of the following is not a characteristic of a new design? (a) should address a problem, (b) be original (c) have a purpose (d) None of the above [Remembering]
3. Sources of information that aids a designer include the following except (a) solving practical problem (b)Existing similar article (c)professional colleagues, (d) furniture catalogues. [Remembering]

4. Which of the following is not a reason for designing a wood article? (a) technical reports (b) refining design Ideas (c) solving practical problems (d) standardization. [Remembering]
5. Those identifiable single patterns that make up or define a design are known as: (a) Line (b) Mass (c) Elements of design (d) shape. [Remembering]
6. Which of the following described by the number and type of lines that enclose a space?
   (a) Lines (b) Mass (c) Shape (d) Texture. [Creating]

Use the diagrams in the figure below to answer questions 10 -12



10. n of the diagrams represent geometrical mass objects? (a) HIJ, (b) GHI(c) FIJ,(d)BCD. [Understanding]
7. In geometry, the part traced by moving point is called: (a) Tones and Texture (b) line (c) Shape (d) mass. [Analysing]
8. The bulk of the design which is the shape combined with its substance is called_____
   (a) Colour (b) Tones (c) Lines (d)Mass. [Creating]
9. Tones is related to and refers to the harmony between the light and dark shades in a material, while the touch of roughness, smoothness or oiliness of a piece of wood refers to _____. (a) Texture (b) Tones (c)Colour (d) Appearance. [Analysing]
11. The common forms of line in the above diagrams are____ (a) DHI(b) ABC (c)HIJ(d) CEF. [Remembering]
12. Which of the above combinations comprised both geometrical shapes and mass? (a) DEFG(b) BCD (c) HIJ(d) GHIJ [Understanding]
13. Which of the following is not an element of design? (a) texture (b) line (c) shape (d) quality. [Analysing]

Principles of Design

14. The principles of design include all of the following except; (a) function, (b) utility and fitness for purpose (c) appearance (d) colour. [Analysing]
15. To ensure efficiency or function in a design, in addition to using suitable materials, the designer must also ___ (a) use suitable methods of construction (b) apply glue when necessary (c) use of informal balance (d)use practical experience. [Applying]
16. In selecting the materials for a design, the designer should consider (a) Availability, (b) cost, (c) characteristics (d) all of the above. [Applying]
17. The quality of furniture article to appear to be stable or at equilibrium is referred to as (a) proportion (b) form (c) scale (d) balance. [Analysing]
18. When a furniture article is of the right size, shape, and suits its surrounding and human use, it is considered _____ (a) balanced (b) proportional (c) efficient, (d) fit for purpose. [Creating]

Anthropometric Principles of Apportioning Sizes

19. Which of the following factors is not considered in determining an acceptable furniture sizes? (a)accessibility to room (b) working surface area required (c)cost of material (d)size and shape of room. [Creating]
20. Which type of furniture style is used to save space in a room? (a)contemporary furniture (b)traditional furniture (c)all of the above (d)none of the above. [Evaluating]
21. One of the following is not an anthropometric data in furniture making: (a) hip breadth, (b) sitting shoulder height, (c) popliteal height (d) abdominal width. [Remembering]
22. What is the suitable way to determine the height of a simple office chair? (a) average popliteal height of the intended user, (b) by assumption, (c) hip breadth of the intended user, and (d) measurement of the whole body. [Applying]
23. Anthropometry deals with body dimensions such as shape, size strength etc. while _____ is to ensure comfortability, physical health, safety, and convenience in a furniture design. (a) anthropometric investigation, (b) physical dimension, (c) Aesthetics, and (d) ergonomics. [Analysing]
24. The felling of the tree is usually carried out in ___ (a) winter (b) summer (c) rainy season (d) spring. [Applying]
25. In large forests, trees are felled using _____ (a) Hammer and chisel (b) chain saw (c) tractor (d) Axe. [Evaluating]
26. Which of the following is not a material for manufacture of particle board? (a) shavings (b) fibres (c) ribbons (d) flakes.[Understanding]

Timber Preparation

27. Debarking is done, so as to: _____ (a) safeguard saws (b) improve seasoning (c) Expose surface of wood (d) reduce weight. [Evaluating]
28. In the production of plywood, _____ has to be carried out before peeling? (a) conditioning (b) seasoning (c) debarking (d) sorting. [Evaluating]
29. Hatching is necessary during marking-out in order to: (a) beautify the area marked (b) prevent mistakes and remove only the hatched area ((c) cut the timber to appropriate sizes (d) add allowance for shrinkage. [Creating]
30. Cutting list record the components required for a given furniture task; all of the following are components of a cutting list except: (a) width (b) thickness and length, (c) comment, (d) cutting tools. [Creating]
31. The first step in marking-out a furniture item is: (a) select the face and edge of all the piece, (b) mark out a pattern first from a rod, (c) lay the piece out around

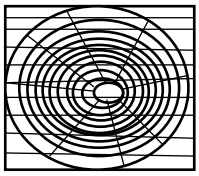
the rod and write out the back, (d) marking out the pattern. [Analysing]

Marking Out

32. Hatching is necessary during marking-out in order to: (a) beautify the area marked (b) prevent mistakes and remove only the hatched area ((c) cut the timber to appropriate sizes (d) add allowance for shrinkage. [Creating]
33. The first step in marking-out a furniture item is: (a) select the face and edge of all the piece, (b) mark out a pattern first from a rod, (c) lay the piece out around the rod and write out the back, (d) marking out the pattern. [Analysing]
34. Indicate a marking out tool made of a stock and blade fixed at right angles to each other from the options below: (a) try square, (b) sliding bevel, (c) metre square and (d) compass. [Remembering]
35. The metre square is used for setting out and checking angles at ____ (a) 30^0 and 60^0, (b) 45^0 and 135^0, (c) 90^0 and 180^0 (d) none of the above. [Remembering]
36. How can a cut line be made more visible? (a) pencil over the cut line, (b) saw over the cut line, (c) light marking, and (d) non of the above [Applying]
37. Why must the stock be kept firmly against the edge of the wood on marking gauge? (a) Otherwise the pin may be guided by the grain and not the user, (b) to produce visible line, (c) to make the mark straight, and (d) non of the above. [Evaluating]
38. A wood stock to be worked on is placed on ___ so as to be steady. (a) vice, (b) jack plane, (c) try square, and (d) all of the above. [Applying]

Timber Growth and Structure

39. What is the name of the inner bark of a tree? __ (a) Bark (b) Bast (c) Bist (d) Pith. [Remembering]
40. Softwood comes from the evergreen tree that are called __ (a) decidius (b) conifer (c) pine (d) fir. [Understanding]
41. What is the sequence from inside to out? Bark, Bast(a) Medullary Rays,(b) Cambium (c) Annual Rings (d) Sapwood. [Analysing]
42. The part of the tree that transports food from the heartwood to the cambium and store food in the winter mouths is __ (a) Annual rings (b) pith (c) summer growth (d) medullary rays. [Analysing]
43. What is the colour of a good quality timber? (a) light (b) gradient (c) dark (d) brown. [Remembering]
44. The strongest timbers are timbers with __ annular rings. (a) Narrow (b) Wide (c) Distinct (d) indistinct. [Evaluating]
45. What conversion method is best used when the tree trunk is rotted in the centre (pith)? (a) Tangential (b) Through and through (plain sawn) (c) quarter sawn (rift sawn) (d) Box heart. [Applying]
46. What method of conversion is this?



(a) Through and through (b) box heart (c) quarter sawn (d) tangential. [Understanding]

47. The method of timber conversion that is costly but can look nice on some hardwoods is __ (a) Tangential (b) Through and through (c) Box heart (d) Quarter sawn. [Creating]

Wood Surface Preparation

48. Which of the following is not applied to a timber with natural finish? ____ (A) finishing (b) sanding (c) distress (d) stain. [Evaluating]
49. A good timber preservative is known to be __ (a) poisonous (b) unaffected by heat and pressure (c) have pleasant smell (d) white in colour. [Evaluating]
50. What is the suitable method of applying preservatives to moist timber? (a)

pressure application (b) brushing and spraying (c) soaking (d) hot and cold tank treatment. [Evaluating]

51. Sanding is a term applied to ____ (a) addition to the adhesive to be used in bonding furniture articles, (b) the use of all types of coated abrasives, (c) the use of sand to apply texture on a finished stock, and (d) none of the above. [Understanding]
52. Uses of sanders include all of the following except ____ (a) smoothing surface, (b) shaping and finishing surface, (c) smoothing ends and mitre, and (d) cutting tenons [Applying]
53. Identify the odd one in option: (a) Buzzer, (b) jointer, (c) surface planner and edger, and (d) circular saw. [Analysing]

Timber Conversion and Seasoning

54. Wood contains water in three forms; vapour bound, hygroscopic and (a) contact water (b) capillary water (c) true water (d) bulk water. [Evaluating]
55. Breaking down is a process of __(a) (c) defect in timber (d) reducing weightfelling of a tree (b) conversion of logs. [Understanding]
56. The types of rough sawing we have are: (a) 4 (b) 5 (c) 2 (d) 3. [Remembering]
57. A freshly cut wood or wood that has not been seasoned is also called ____ (a) sap wood (b) fresh wood (c) heart wood (d) green wood. [Remembering]
58. The process of removing water from timber is __ (a) burning timber (b) adding preservation (c) seasoning (d) adding glaze. [Remembering]
59. The standard cross-sectional width of timber in Nigeria is_____(a)300mm, (b)225mm, (c)150mm, (d)100mm. [Remembering]
60. Which of the changes below do not occur after seasoning? (a) increased durability (b) decreased stiffness (c) workable timber (d) reduction in weight. [Evaluating]
61. Which of the following is a disadvantage of air seasoning? (a) power requirement (b) skilled supervision (c) elaborate equipment (d) uniformity of seasoning. [Evaluating]
62. The seasoning method that leaves the timber brittle after seasoning is __(a) water seasoning (b) klin seasoning (c) electric seasoning (d) boiling. [Remembering]
63. The most rapid and effective method of seasoning is __ (a) natural seasoning (b) klin seasoning (c) electric seasoning (d) chemical seasoning. [Analysing]

Timber Defects

64. Which of the following is not an insect which is responsible for decay of timber? (a) marine borers (b) snake (c) termites (d) wood boring beetles. [Remembering]
65. Two main natural forces responsible for defects in timer are abnormal growth and __ (a) rupture of tissues (b) insects (c) frost (d) rain. [Evaluating]
66. What is the life time of a moderately durable timber? (a) 10 – 20yrs (b) 1 – 5yrs (c) 10 - 15yrs (d) 5 – 10yrs. [Evaluating]
67. Which of the following is an example of soft wood? (A) sal (b) oak (c) Deodar (d) Mahogany. [Remembering]
68. Which of the following is a property of soft wood? (a) medullary rays are less distinct (a) Annual rings are less distinct (c) Dark in colour (d) close grained structure. [Remembering]
69. The timber defect that is indicated by red or yellow tingle in wood is __ (a) Froxiness (b) Druxiness (c) callus (d) burls. [Understanding]
70. A crack which separates wood fibres is called __ (a) warp (b) check (c) collapse (d) split. [Understanding]
71. Dry rot in timber is caused by __ (a) Bacteria (b) Beetle (c) white ants (d) fungus. [Evaluating]

Technical Terms

72. When a cut is made from edge to face on a wood piece it is called __ (a) bevel (b) chamfer (c) taper (d) mitre. [Understanding]
73. A 90^0 cut made on a wood piece it is called __ (a) miter (b) angle (c) lap (d) square. [Understanding]
74. A 45^0 cut made between an edge and end of a timber piece is known as _____ (a) chamfered corner, (b) arris edge, (c) beveled edge, and (d) rounded edge. [Remembering]
75. Which of the following represents a carcase? (a) shelves and drawers, (b) tops of chair seats, (c) bottoms of drawers, and (d) plinths. [Understanding]

Adhesives Used in Woodwork

76. The glue that can bond a metal to wood is __ (a) contact cement (b) super glue. (c) PVC cement (d) Gorilla glue. [Applying]
77. Which of the following glue can be made plastic again by re-heating? (a) Thermo-setting (b) Rubber glue (c) Animal protein glue (d) Thermo-plastic. [Applying]
78. Which of the following is used to join light metals? (a) metal glue (b) cycle weld (c) araldite glue (d) special glue. [Applying]
79. Which of the following is used to prepare Nitrocellulose glue? (a) pyridine (b) Benzene (c) pyroxylin (d) resin. [Applying]
80. Adhesives are applied using a____ process (a) speedy (b) slow (c) costly (d) cumbersome. [Applying]

MODEL ANSWER TO FDCAT

Question	Answer	Hint
1	C	The estimated cost of the article when finished
2	D	None of the above
3	A	Solving practical problems
4	A	Technical reports
5	C	Elements of Design
6	C	Shape
7	B	Line
8	D	Mass
9	A	Texture
10	A	HIJ
11	B	ABC
12	D	GHIJ
13	D	Quality
14	D	Colour
15	A	Use suitable methods of construction
16	D	All of the above
17	D	Balance
18	D	Fit for purpose
19	C	Cost of materials
20	A	Contemporary
21	D	Abdominal width
22	A	Average popliteal height of the intended user
23	D	Ergonomics
24	A	Winter
25	C	Tractor
26	B	Fibres
27	A	Safeguard saws
28	C	Debarking
29	B	Prevent mistakes and remove only the hatched area
30	D	Cutting tool
31	A	Select the face and edge of all the pieces
32	B	Prevent mistakes and remove only the hatched area
33	A	Select the face and edge of all the pieces
34	A	Try square
35	C	90^0 and 180^0
36	A	Pencil over the cut line
37	A	Otherwise the pin may be guided by the grain and not the user
38	A	Vice
39	B	Bast
40	B	Conifer
41	B	Cambium
42	D	Medullary rays
43	C	Dark
44	A	Narrow
45	D	Box heart
46	A	Through and through
47	D	Quarter Sawn
48	D	Stain
49	A	Poisonous
50	A	Pressure
51	B	The use of all types of coated abrasives
52	D	Cutting tenons
53	D	Circular saw
54	C	True water
55	B	Conversion of Logs
56	C	2

57	D	Green wood
58	C	Seasoning
59	A	300mm
60	B	Decreased stiffness
61	D	Uniformity of seasoning
62	A	Water seasoning
63	C	Electric seasoning
64	B	Snake
65	A	Rupture of tissues
66	D	5-10yrs
67	C	Deodar
68	A	Medullary rays are less distinct
69	B	Druxiness
70	B	Check
71	D	Fungus
72	A	Bevel
73	D	Square
74	A	Chamfered corner
75	A	Shelves and drawers
76	A	Contact cement
77	D	Thermo-plastic
78	C	Araldite glue
79	C	Pyroxylin
80	A	Speedy