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Research Article

Development and Validation of Chemistry Test Anxiety Scale (CTAS) for Secondary School two Students in Abia State

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Abstract: The study centred on the Development and Validation of Chemistry Test Anxiety Scale CTAS). Four research questions guided the study. The research design adopted for the study was instrumentation. The researchers developed an instrument titled "Chemistry Test Anxiety Scale (CTAS) consisting of 115 items. Multi-stage sampling procedure (simple random sampling and non-proportionate stratified random sampling) were used to obtain a sample of 600 students from a population of 24,000 Senior Secondary School two (SS II) students from public schools in Abia State. Data were analysed using Pearson product moment statistics, Cronbach alpha reliability technique and confirmatory factor analysis via SPSS. The CTAS yielded favourable results with regards to factor structure, internal consistency and sub- scale total correlation. The CTAS is adequately explained by three factors. Analysis of the internal consistency reliability of the CTAS yielded coefficients of 0.929 using Cronbach Alpha. The sub-scale total correlation of the CTAS yielded coefficients of 0.887, 0.520 and 0.350, all statistically significant at 0.05 alpha levels. Based on the findings it was recommended among others that Government and educational bodies should provide science equipment in schools to enhance teaching and learning of chemistry so as to discourage rote learning of materials which is one of the major causes of anxiety in sciences.

Keywords: Validation, Chemistry Test Anxiety.

INTRODUCTION

There have been great advances in chemistry throughout the 20th century by its inclusion in primary and secondary education as a part of science lessons this is necessary to meet the quest for technological advancement. Moreover, chemistry has become an essential area in terms of medical sciences, textile technology, agricultural sciences, synthetic industry, printing technology, pharmaceuticals, chemical engineering which have (a) very important place in the field of science, yet most students shy away from chemistry and dread test (s) and examination (s) in chemistry. The nation cannot advance technologically if it neglects effective teaching and efficient assessment techniques of chemistry in schools. This not-withstanding the instrument used in secondary schools in Abia State for students' assessment during chemistry test (s) and examination(s) are not properly developed; thus hinder the continuous assessment of secondary school students in Abia State. However instructional strategies that take ~~(s)~~ into cognisance only cognitive variables may fail to consider individuals' affective characteristics such as intentions, goals, experience and emotions [1]. Thus, Laukenman, Bleicher, Fub, Glaser-Zikuda, Mayring, Rhoneck, Marlow & Greenburg [2] opined that to help students improve their scientific thinking and capabilities, instructors need to take into account both affective and cognitive factors of learning. Nevertheless, in most of our secondary schools especially in Abia State, teachers neglect the assessment of the affective factors and are inefficient in the development of instrument (s). Most often, if these instruments exist, they are neither valid nor reliable and hinder the assessment of the affective domain in schools.

Test serves to provide objective measurement upon which school decisions are based. Instructionally test provides feedback, motivation and over learning. On the other hand, test helps to check and assess programme and research. Test in guidance help to diagnose, special aptitudes or abilities. Irrespective of these important functions of test, test and examinations in science subjects especially in Chemistry, poses a significant source of worry and anxiety for students. The general depreciation in interest, achievement and enrolment of students in Chemistry in particular, and other science subjects in general is a torn in the flesh to science teachers, science educators, scientists and science policymakers. It is a food for thought for

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parents, teachers, science educators and government in general and Abia State in particular when students start to shy away from Chemistry and perform poorly. This menace may be due to the quality and types of assessment procedures implored in our school system as well as students' anxious behaviour towards test or examination. To the best of the research's knowledge schools in Abia State lack valid and reliable test anxiety scales particularly in Chemistry and this prompted the researcher to indulge in the development of a chemistry test anxiety scale. Anxiety is one of the affective emotional learning variables that significantly affect learning and achievement process. The fact that a student's achievement in the examination is low does not imply that the student is less intelligent but perhaps due to test anxiety. Thus, Einat [3] opined that highly test anxious students are often worried due to test situation, having negative thoughts and consequently low achievement. Similarly, Davis [4] observed that test anxiety causes low academic achievement due to its effect on memory and concentration. Cheraghian, Fereidvoni, Moghadam, Baraz-Pardjani (and) Bavarsad [5] state that test anxiety is a kind of anxiety which happens when a person is taking a test or is being evaluated by a test administrator and that is one of the disorders caused by anxiety.

Anxiety is defined as an unpleasant emotional state of uncertainty, fear, worry, discomfort, loss of control and expectation that something bad will happen [6]. On the other hand, Lorimer & Lechner [7] opined that anxiety expresses a state of great fear (of a person, situation or object), apprehension or nagging worry. In fact, anxiety is a response to any stimulus that emanates pain and or fear. Hence, when people find themselves in situations where there are high levels of uncertainties, expectations, indefiniteness, of generalised levels of helplessness or loss of a specific (cherished) object, they are bound to be anxious [8]. In a school set up, worries about success in tests and examinations (,) meeting the academic expectations of parents and teachers, difficulty in understanding topics taught in the class, emotional feelings associated with failure are likely causes of anxiety among students therefore(,) affects their academic performance. Test anxiety is hypothesized to have an interfering effect on achievement through occupying cognitive resources. However, it may not be the idea of perceiving examination as a threat that is responsible for interference effects but how the students respond to that threat [9].

Therefore, test anxiety, according to Zeidner & Matthew [10] has distinct cognitive, physiological-affective and behavioural components. These authors opined that the cognitive component refers to negative thoughts which arise during examinations and other assessments, self-deprecating statements such as "I am going to fail exam." The physiological-affective component refers to the person's perception of their physiological state which might include tension, trembling, feeling sick and so forth, while the behavioural component refers to poor study and test-taking skills, and inattentive, distractive behaviours during tests. Thus King, Ollendick and Gullone [11], viewed test anxiety as having a debilitating effect on assessment task performance; highly test anxious students may, for example, become easily distracted during an examination, have difficulty in reading and understanding questions and assessment demands and or experience difficulty in the recall of learned material.

As a matter of fact, some students respond to test anxiety with a catastrophic response in which they find it difficult to read and interpret questions and to recall material required to respond to assessment demands. In contrast, other students respond positively to test anxiety in which they will persist in trying to answer questions and experience a return of material required. In fact, anxiety is a common undeniable phenomenon in the lives of human beings that affect their performance and effectiveness in different situations. This implies that anxiety creating situations may sometimes enhance individual's performance. Some students develop high anxiety during testing that it interferes with their test performance [12].

Two types of anxiety namely trait anxiety and state anxiety. Trait anxiety is a stable feature or behaviour of the person while state anxiety is triggered by certain conditions of the environment like examination, accident, punishment, etc. Hence, Rohen [13] opined that academic anxiety is a kind of state anxiety which relates to the impending danger from the environment of the academic institutions including teachers, certain subjects like Mathematic(s) Chemistry, English language, etc. Isaacs cited in Okonkwo [14] viewed anxiety as a generalised pervasive fear which is partly the feeling of apprehension partly the behaviour of avoiding frightening situations and partly the associated bodily changes such as sweating, a fast pulse and tense muscles. In other words, anxiety can create feelings of fear, worry, uneasiness and dread.

On the other hand, Lynn [15] reported that low anxiety leads to an emotionally stable person that is void all kinds of anxiety symptoms. This author believed that anxiety in its moderate level manifests into strong motivation but when high becomes disadvantageous as it turns into neurosis. Therefore, anxiety could either be useful particularly in the sense of a person being anxious to achieve something or otherwise depending on the degree of its intensity. Similarly, Kahan [16]; (and) Donnelly [17] are of the opinion that an average level of anxiety is useful in keeping people hardworking and responsible of what they have to do and also helpful for people in having a more sustainable and prosperous life. High level of

anxiety threatens an individual's mental and physical health and has negative effect on their personal, social, familial, occupational and educational performance [18]. In another dimension, symptoms of anxiety are grouped into five categories, namely: cognitive, emotional, psychological, perceptual and behavioural symptoms.

Gear and Cunningham [19] viewed anxiety as the cause of physical condition termed psychosomatic illness, with its associated symptoms like headaches, sleeplessness, dizziness, and other serious symptoms. According to these authors, physical disturbances like nervous dyspepsia, nervous diarrhoea, illness such as asthma and ulcerative colitis manifests when there is both physical and physiological factor (s). Also, Coutu [20] distinguishes between fear and anxiety and posited that while fear is rational emotional response to a real threat, anxiety is an irrational emotional response to an imagined threat. This author further stressed that anxiety symptoms become worse when a person is under stress and that the symptoms include constant worrying, trembling and muscle tension, feeling tense and unable to relax, feeling tired, unable to remain focused, feeling irritable and feeling nauseous. Therefore, it stands to reason that students' experience during examination is anxiety and not fear.

Kenyon [21], opined that anxiety is an unpleasant psychological state involving tension, nervousness, fear and worry often accompanied by physical symptoms such as trembling, dizziness, and heart palpitation, which is experienced from time to time in response to specific challenges in our environment.

The different anxiety theories are categorized into: psychoanalytic learning (behavioural), physiological, phenomenon logical/existential, cognitive and uncertainty theories. The different theorists opined that anxiety can only be fully understood through its cognitive aspect and the basic aspect of anxiety being uncertainty with respect of what the threat is, how to deal with unconscious or how to face a multitude of possible futures. The theorist agreed that anxiety can be distinguished from fear or fright and view anxiety as clearly, negative, unpleasant emotion but motivating that can be associated with wide range of stimuli or events and seems to be inevitable in everyday life.

Most often people anxiety state is assessed through mere observable signs like biting of nails, scratching, abnormal rapid heartbeat, sweating palms, biro biting, body shivering, etc. In the view of Friedman and Bendas-Jacob [22] observation is not very efficient in studying anxiety state of students. Equally, Collin [23] stressed that it is not easy to identify test anxious student through mere visual perception instead of self-report through questionnaires is effective measure. This is because anxiety being a psychological construct must be measured independently mainly through self-report which involves asking the individual what he/she thinks, feels, says and does.

Therefore, a more efficient method for studying student's anxiety state is to ask questions about their feelings, reactions and mood under examination conditions using scales as the instruments. Consequently, most secondary schools in Abia State lack such valid instrument. As a matter of fact, it appears there is no test anxiety scale in Chemistry that is designed in line with Nigerian culture and secondary school teachers especially in Abia State are not efficient in the development of affective instrument. A non-test instrument like interview or rating scale (like the CTAS) or inventories or checklists does not involve item analysis in form of item distracter and item difficulty level. However, the needful is to ensure validity and reliability of such instrument. Therefore, every measuring instrument must possess unquestionable validity which is the extent to which that instrument actually and adequately measures only what it purports to measure. Also, for an instrument to validly measure a trait, it must compulsorily be reliable in the measurement of that trait. Thus while a reliable test may not possess validity, a valid test must necessarily possess reliability. Therefore, for measuring instrument to effectively and accurately measure any variable, construct or trait it must be reliable and valid. Nevertheless, assessment instrument particularly in chemistry lack this indispensable quality, thus the researcher is prompted to develop and validate the CTAS. Nworgu cited in Okonkwo [14] opined that construct validity is best determined using factor analysis, which is a statistical procedure for the identification of psychological traits.

Construct validity of the instrument is determined by correlating students' scores in the sub-test or test item with their scores in the total test; thus ensuring the homogeneity of the test items. Therefore, any sub-test whose correlation with the total test is too low will be discarded as it does not measure the same general factor as the total test. The more the sub-test correlates with the total test, the more the degree of homogeneity of the test which in turn is the degree of its construct validity [24].

Thorndike and Hagen cited in Onunkwo [24] opined that construct validity is the accuracy with which an instrument describes an individual with respect to some psychological traits. These psychological traits are identified and construct validity established using factor analysis and sub-scale total correlation procedure. Ukwuije and Orluwene [5] opined that factor analysis is the basic method of grouping many items that are highly correlated with

each order to produce few factors. Factor analysis function to produce tests that load on only one factor, unifactorial tests that is highly reliable and valid as it measures a factor [26].

A mathematics test scale developed by Otuoku [27] showed high validity and reliability coefficients of 0.74 and 0.55 respectively. Also Ogidi [28] developed and standardized a non-verbal intelligent test with internal consistency validity of 0.97. The extent to which tests measure common traits determines their correlation. Through observation and analysis of the pattern of inter-correlations, the operation of one or more underlying traits or other sources of common variance is inferred and such a correlation is known as the factorial validity of the test. The most commonly used factoring methods are the principal component analysis and principal axis factoring. The factors are interpreted such that items which are factorial complex are reviewed and eliminated, while those whose loadings are less than a minimum cut-off of 0.30 or 0.35 are eliminated as not being factorial valid. Hunt, Clark-Carter (ˉ) and Sheffield (date) developed and validated a mathematics anxiety scale in United Kingdom which was valid and reliable and yielded three factors. Bomo [29] developed a scale of students' attitude towards mathematics in Rivers and Bayelsa States which yielded seven factor structures with high construct validity and reliability. In another dimension, Okonkwo [14] developed and validated a 57 item physics test anxiety scale for secondary school students in Abia State which yielded 7 factors. Also, Orluwene [25] developed and validated a chemistry achievement test in River (s) State that yielded a reliability coefficient of 0.95 and four factor structures. Considering the fact that secondary schools particularly in Abia State lack valid and reliable affective instrument for the assessment of their student anxiety during Chemistry test (s) and examination (s), it is imperative to develop and validate a chemistry test anxiety scale (CTAS) for secondary schools in Abia State. To achieve this purpose, the following research questions were investigated.

1. How appropriate are the items of CTAS in terms of their factor loading?
2. What is the construct validity of the CTAS using sub-scale total correlation?
3. What is the reliability coefficient of CTAS using Cronbach Alpha reliability technique?
4. What is the split-half reliability of CTAS?

METHOD

The research design implored in this study was instrumentation. The population consisted of 24,000 secondary two chemistry student in Abia State. The sample of the study was 600 respondents (300 males and 300 females) drawn using multi-stage sampling procedure (simple random sampling, and non-proportionate stratified random sampling). An instrument captioned Chemistry Test Anxiety Scale (CTAS) developed by the researchers was used to collect data. The instrument was responded on a 5-point scale with responses like rarely, very little, little, much, and very much with score figures of 1, 2, 3, 4 and 5 respectively for positive items and 5, 4, 3, 2, and 1 respectively for negative items. The validity of the instrument was ascertained using factor analysis via principal component analysis and sub-scale total correlation. The reliability was determined using Cronbach alpha reliability technique.

RESULTS

Research question 1: How appropriate are the items of the CTAS in terms of their factor loading?

Table-1: Total Variance Explained for the CTAS

Total Variance Explained						
Component	**Initial Eigenvalues**			**Extraction Sums of Squared Loadings**		
	Total	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	20.666	13.596	13.596	20.666	13.596	13.596
2	9.583	6.305	19.901	9.583	6.305	19.901
3	3.952	2.600	22.501	3.952	2.600	22.501
4	3.841	2.527	25.028	3.841	2.527	25.028
5	3.301	2.172	27.199	3.301	2.172	27.199
6	3.069	2.019	29.219	3.069	2.019	29.219
7	2.545	1.674	30.893	2.545	1.674	30.893
8	2.493	1.640	32.533	2.493	1.640	32.533
9	2.384	1.568	34.101	2.384	1.568	34.101
10	2.179	1.433	35.535	2.179	1.433	35.535
11	2.074	1.365	36.899	2.074	1.365	36.899
12	2.024	1.332	38.231	2.024	1.332	38.231
13	1.912	1.258	39.489	1.912	1.258	39.489
14	1.868	1.229	40.718	1.868	1.229	40.718
15	1.825	1.200	41.919	1.825	1.200	41.919

16	1.725	1.135	43.053	1.725	1.135	43.053
17	1.707	1.123	44.176	1.707	1.123	44.176
18	1.649	1.085	45.262	1.649	1.085	45.262
19	1.619	1.065	46.327	1.619	1.065	46.327
20	1.574	1.035	47.362	1.574	1.035	47.362
21	1.500	.987	48.348	1.500	.987	48.348
22	1.454	.957	49.305	1.454	.957	49.305
23	1.434	.944	50.249	1.434	.944	50.249
24	1.397	.919	51.168	1.397	.919	51.168
25	1.357	.893	52.061	1.357	.893	52.061
26	1.349	.888	52.949	1.349	.888	52.949
27	1.324	.871	53.819	1.324	.871	53.819
28	1.307	.860	54.679	1.307	.860	54.679
29	1.294	.852	55.531	1.294	.852	55.531
30	1.273	.838	56.368	1.273	.838	56.368
31	1.224	.805	57.174	1.224	.805	57.174
32	1.216	.800	57.973	1.216	.800	57.973
33	1.185	.780	58.753	1.185	.780	58.753
34	1.158	.762	59.515	1.158	.762	59.515
35	1.153	.759	60.273	1.153	.759	60.273
36	1.111	.731	61.004	1.111	.731	61.004
37	1.095	.720	61.724	1.095	.720	61.724
38	1.083	.713	62.436	1.083	.713	62.436
39	1.073	.706	63.143	1.073	.706	63.143
40	1.055	.694	63.837	1.055	.694	63.837
41	1.039	.684	64.520	1.039	.684	64.520
42	1.025	.674	65.194	1.025	.674	65.194
43	1.009	.664	65.859	1.009	.664	65.859

Extraction Method: Principal Component Analysis.

Table 1 displays the total variance explained for the Chemistry Test Anxiety Scale (CTAS). 43 factors are extracted, that is, factors with eigen values greater than 1. These factors accounted for 65.9% of variance of the data generated from the CTAS.

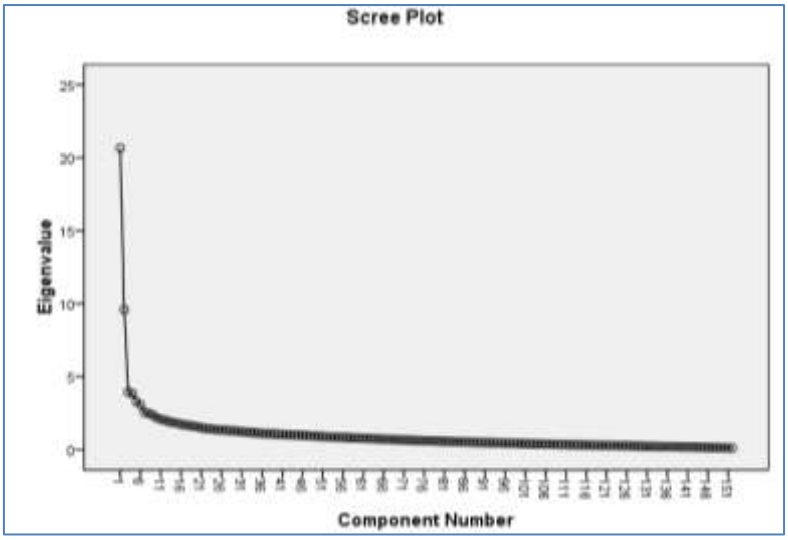

Fig-1: Unidimentionality of the CTAS

Figure 1 indicates the scree plot of the eigen values of the factors of the items of the Chemistry Test Anxiety Scale. The figure reveals that, there is a dominant factor with eigen value of 20.666 greater than the second factor with eigen value of 9.583 and the eigen values of the remaining factors are all about the same. This shows that the CTAS is unidimensional. That is, it measures one underlining construct continuum.

Table-2: Component Matrix of the CTAS

Item	Factor 1	Factor 2	Factor 3	Factor7	Factor 8
52	0.667				
53	0.650				
101	0.615				
89	0.589				
147	0.586				
35	0.580				
55	0.579				
62	0.569				
120	0.568				
104	0.566				
54	0.561				
94	0.558				
76	0.550				
108	0.550				
139	0.549				
143	0.549				
105	0.548				
148	0.547				
51	0.544				
65	0.541				
11	0.540				
117	0.536				
75	0.534				
151	0.533				
67	0.531				
118	0.527				
66	0.522				
49	0.520				
34	0.518				
125	0.517				
112	0.511				
82	0.509				
18	0.497				
88	0.497				
73	0.497				
27	0.489				
31	0.488				
29	0.485				
41	0.485				
01	0.482				
141	0.470				
140	0.467				
09	0.460				
123	0.460				
135	0.459				
17	0.456				
33	0.452				
07	0.451				
133	0.446				
02	0.435				
146	0.434				
46	0.428				
77	0.424				
59	0.423				
04	0.415		`		
87	0.405				
144	0.403				
86	0.403				
64	0.402				
68	0.399				
114	0.399				
79	0.398				
03	0.396				
16	0.392				
43	0.375				
44	0.375				
61	-0.371				
150	0.370				

14	0.362				
152	-0.351				
37	-0.339				
25	-0.339				
47	0.335				
91	-0.324				
102		0.621			
113		0.568			
109		0.539			
84		0.525			
99		0.502			
98		0.497			
38		0.488			
127		0.482			
39		0.478			
70		0.468			
103		0.456			
128		0.437			
97		0.431			
138		0.426			
32		0.423			
149		0.421			
107		0.414			
106		0.413			
115		0.413			
136		0.412			
90		0.405			
126		0.404			
142		0.399			
19		0.398			
80		0.396			
124		0.395			
100		0.394			
63		0.385			
56		0.365			
42		0.358			
71		0.355			
85		0.354			
28		0.347			
129		0.338			
15		0.333			
137		0.324			
131		0.321			
116		0.303			
48			0.375		
13			-0.366		
119			0.340		
36			0.316		
08			0.301		
30				-0.340	
74				0.313	
93					0.444
130					0.391
92					0.304

Table 2 shows the factor loading of each item of the CTAS. During the analysis of data, items with factor loading below 0.30 were suppressed. Thus, factor loading with absolute values of 0.30 and above are reported in this table. From the table, 74 items loaded into factor 1, 38 items loaded into factor 2, 5 items loaded into factor 3, 2 items loaded into factor 7 and 3 items loaded into factor 8. Thus, 122 items have factor loading of absolute values above 0.30. The remaining 30 items with factor loading of absolute value below 0.30 are discarded. On the whole, the items of the Chemistry Test Anxiety Scale are appropriate in terms of their factor loading.

Research Question 2: What is the construct validity of the CTAS using sub-scale total correlation?

Table-3: Construct Validity of the CTAS via Sub-Scale Total Correlation

Correlations							
		Total	**Factor_1**	**Factor_2**	**Factor_3**	**Factor_7**	**Factor_8**
Pearson Correlation	Total	1.000	.887	.520	.164	-.078	.350
	Factor_1	.887	1.000	.075	-.018	-.156	.228
	Factor_2	.520	.075	1.000	.273	.058	.240
	Factor_3	.164	-.018	.273	1.000	.051	.019
	Factor_7	-.078	-.156	.058	.051	1.000	-.186
	Factor_8	.350	.228	.240	.019	-.186	1.000
Sig. (1-tailed)	Total	.	.000	.000	.000	.029	.000
	Factor_1	.000	.	.032	.326	.000	.000
	Factor_2	.000	.032	.	.000	.079	.000
	Factor_3	.000	.326	.000	.	.104	.317
	Factor_7	.029	.000	.079	.104	.	.000
	Factor_8	.000	.000	.000	.317	.000	.
N	Total	600	600	600	600	600	600
	Factor_1	600	600	600	600	600	600
	Factor_2	600	600	600	600	600	600
	Factor_3	600	600	600	600	600	600
	Factor_7	600	600	600	600	600	600
	Factor_8	600	600	600	600	600	600

Table 3 indicates the sub-scale correlation of the Chemistry Test Anxiety Scale. Correlation of scores from Section I (factor 1), Section II (factor 2), Section III (factor 3), Section IV (factor 7), and Section V (factor 8) with the total scores of the CTAS yielded coefficients of 0.887, 0.520, 0.164, -0.078 and 0.350 respectively. Section I, Section II, section III, section IV, and section V consist of 74, 38, 5, 2 and 3 items respectively with Section III and Section IV eliminated due to low and negative correlation respectively. Thus, the construct validity of CTAS is established via sub-scale total correlation. The new CTAS now consist of 115 items.

Research Question 3: What is the reliability coefficient of CTAS using Cronbach Alpha reliability technique?

Table-4: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.928	.929	115

Table 4 shows the coefficient of reliability of the Chemistry Test Anxiety Scale via Cronbach Alpha Technique to be 0. 929. This implies that, the CTAS is highly reliable.

Research question 4: What are the developed items of the Chemistry Test Anxiety Scale (CTAS)?

Table-5: The 115 items of the developed CTAS FACTOR 1 (SECTION I)

S/N	ITEMS
1.	I am afraid of Chemistry examination (s)
2.	A mention of Chemistry examination makes me feel nervous
3.	I am always under a terrible strain during chemistry examination(s)
4.	I get headaches prior to taking a Chemistry test.
5.	I often feel sick in my stomach during chemistry examination(s)
6.	I feel uneasy when the date of Chemistry examination is fixed.
7.	I fear Chemistry so much that I often feel like staying away from Chemistry test (s).
8.	I feel dizzy or light headed during chemistry test(s)/examination (s)
9.	My mind goes blank that I am unable to think clearly during chemistry test (s) and examination (s)
10.	I hate Chemistry examinations.
11.	I do not feel happy after Chemistry examinations
12.	My palms become sweaty prior to taking a Chemistry test.
13.	I approach chemistry test(s) with a feeling of hesitation due to fear of not being able to perform well
14.	I experience a great deal of fear If I were to take chemistry examination
15.	I easily forget the facts I know during chemistry test(s)/examination(s) due to tension
16.	I feel a sense of insecurity when answering chemistry problems in examination(s)
17.	I wake up scared when I have chemistry examination to take

18.	I seldom feel the need for cramming before Chemistry examination(s).
19.	During Chemistry examination(s) I find myself thinking of things unrelated to the actual course material.
20.	My head gets blank during Chemistry test(s).
21.	I fear of worst happening(s) during chemistry test(s)/examination(s)
22.	Chemistry examination periods are periods of stress
23.	Thoughts of doing poorly interfere with my performance on Chemistry test(s).
24.	I wriggle in my seat a lot during chemistry test(s)/examination(s)
25.	I usually get depressed after taking a Chemistry test.
26.	During chemistry test(s)/examination(s) I feel wobbliness
27.	I feel very panicky when I have to take a surprise Chemistry examination.
28.	I cancel a lot in Chemistry examinations.
29.	Thinking of the Chemistry section of a general entrance examination makes me feel uneasy.
30.	During chemistry examination(s) I get very worried that I forget the acts I already know
31.	I am not happy taking chemistry test(s) because of fear of failure
32.	The mere mention of Chemistry examination makes me uneasy.
33.	When I take a Chemistry test, I often forget the answers to questions I previously knew the answers to due to nervousness.
34.	I find myself cramming for a Chemistry test at the last minute.
35.	During Chemistry examinations, I sometimes wonder if I'll ever get through school.
36.	When I am asked Chemistry questions in a quiz, I become nervous.
37.	When I have a Chemistry assignment to submit in the next class period I am disturbed.
38.	I feel nervous on receiving my question paper in a Chemistry examination.
39.	I feel I have not prepared enough for a Chemistry test, so I am tensed up.
40.	My heart beats faster on hearing the instruction to start a Chemistry examination.
41.	I do have blurred vision so can't read the questions clearly during chemistry test(s)/examination(s)
42.	I feel like fainting when taking chemistry test(s)/examination(s)
43.	If chemistry was a compulsory subject, I'm finished.
44.	While taking chemistry examination(s), I am often angry that my stomach upset me
45.	Chemistry examination periods are periods of stress (to me)
46.	I do not like taking Chemistry examinations.
47.	When in a Chemistry examination hall, I suddenly forget a formula needed to solve a problem.
48.	When taking Chemistry examination, it seems my brain is not as efficient as it normally is.
49.	I wish examinations in chemistry were not conducted at all
50.	Once I see difficult questions in Chemistry examinations, my heart slips.
51.	I find it difficult to sleep the night prior to any chemistry test/examination
52.	I become confused in a Chemistry examination hall when the time is against me.
53.	I never feel like I have enough time to complete a Chemistry test.
54.	Even when I'm well prepared for a Chemistry test, I feel very anxious about it.
55.	I find it difficult to concentrate in a Chemistry testing condition.
56.	My teacher continuously looks over my shoulder when I'm taking a Chemistry test, so it makes me nervous.
57.	My hands feel sweaty during chemistry examination
58.	I am easily distracted by my surrounding when taking a Chemistry examination.
59.	I try to stop worrying about a Chemistry examination as soon as it is over, but I just cannot.
60.	I don't think of ways of avoiding Chemistry examination(s).
61.	I find it difficult to sleep the night before chemistry test
62.	I feel like everyone around me expects me to fail on a Chemistry test.
63.	While preparing for Chemistry examination(s), I do think too much of failure.
64.	While preparing for a Chemistry examination, I am fearful of failing.
65.	I feel uneasy when faced with a difficult Chemistry problem.
66.	I perspire a lot while taking an end of year examination in Chemistry.
67.	During Chemistry examinations, I take the attitude, if I don't know it now; there is no point worrying about it.
68.	I often worry about my performance during chemistry test(s)/examination(s)
69.	When I realise that a Chemistry examination has been shifted two days ahead, I feel happy.
70.	I do not bite my biro while writing (a) chemistry test/examination.
71.	While taking a Chemistry examination, I don't think of the effect of my getting a poor grade.
72.	In Chemistry test, where I have been doing poorly my fear of bad grade doesn't cut down my efficiency.
73.	Nervousness while taking a Chemistry test affects my performance.

74.	I do not wish Chemistry certificates were awarded without examinations.
	FACTOR 2 (SECTION II)
75.	I like taking chemistry test9s) and it does not scare me
76.	I feel at ease during chemistry test(s) so I like taking chemistry examination(s)/test(s)
77.	I really enjoy chemistry examination because it does not make me panic
78.	When preparing to take a Chemistry examination, I feel happy.
79.	I feel happy after Chemistry examination(s).
80.	After taking Chemistry examinations, I often discuss about the questions because I am not sure to perform well
81.	During a Chemistry examination, I feel my solutions are correct.
82.	After taking chemistry examination(s) I do not discuss about the questions because I am sure to perform well
83.	While taking a chemistry examination, I feel I am sure of what I am doing..
84.	I don't have an uneasy, upset feeling before taking a Chemistry examination.
85.	Chemistry examination is interesting and enjoyable
86.	My heart beat is not faster during chemistry examination(s)
87.	I never get worried and so do not forget the facts I already know during Chemistry examinations.
88.	I don't get frightened during chemistry examination(s)
89.	I have confidence preparing for a Chemistry examination.
90.	It is not hard for me to keep my mind on my chemistry exam(ination) questions
91.	I enjoy chemistry examination(s)/test(s) a great deal
92.	Chemistry examination does not make me feel uncomfortable, restless, irritable and impatient
93.	I do not feel restless during chemistry exam(inations)
94.	I don't always feel very weak during chemistry examinations
95.	I do not usually get depressed during Chemistry examinations.
96.	I do not lose concentration during chemistry test(s)
97.	I am not restless during chemistry test(s)/examination(s)
98.	I don't make a lot of mistakes in reading the questions within the first few minutes of Chemistry examination(s).
99.	I am usually confident about taking a Chemistry test.
100.	While taking chemistry examination I don't often get sick
101.	I do not hate Chemistry examinations
102.	If I know I was going to take a test, I would feel confident and relaxed.
103.	I don't tend to lose my composure during Chemistry test(s).
104.	I normally feel relaxed during Chemistry examination(s).
105.	When taking a Chemistry test, my emotional feelings do not interfere with my performance.
106.	My Chemistry examinations are usually taken in a relaxed environment.
107.	Little things don't distract my attention during a Chemistry examination(s).
108.	I do feel very comfortable during chemistry examinations
109.	My hands don't tremble when I receive the instruction to start a Chemistry examination.
110.	I am encouraged by feeling of success during chemistry examinations
111.	I am very attentive during chemistry examinations
112.	My hands do not tremble during chemistry examinations
113.	**FACTOR 3 (SECTION III)**
114.	Chemistry examinations are boring.
115.	During Chemistry examinations I do not feel very comfortable
116.	Chemistry examinations are interesting

Table 5 shows the 115 items of the developed CTAS, 74 items from factor 1 (section I) 38 items from factor 2 (section II) and 3 items from factor 8 (section V) that have high and positive coefficient of 0.887, 0.520, and 0.350 respectively during the sub-scale total correlation of the CTAS. This implies that the new developed CTAS have 3 factors (3 sections) comprising of 115 items.

SUMMARY OF FINDINGS

The findings of the study are as follows:

1. The items of the Chemistry Test Anxiety Scale (CTAS) are appropriate in terms of their factor loading.
2. The CTAS is unidimensional with eigen value of 20.666 greater than the second factor with eigen value of 9.583 and the eigen value of the remaining factors are all about the same.

3. The construct validity of the CTAS was verified using sub-scale total correlation evidence. The sub-scale total correlation yielded coefficients of 0.887, 0.52 and 0.350 for section 1, Section II and section III of the CTAS respectively.
4. The internal consistency of the CTAS using Cronbach Alpha technique yielded a coefficient of 0.929. This indicates that the CTAS is very reliable.
5. It was also found that the developed CTAS has 115 items comprising of 3 sections.

DISCUSSION OF FINDINGS

This result revealed that, the items of the Chemistry Test Anxiety Scale (CTAS) are appropriate according to their factor loading. 43 factors were extracted with eigen values greater than 1. However, with the 0.30 absolute value loading criterion, 122 items loaded appropriately into 5 factors. 74 items loaded into factor 1, 38 items loaded into factor 2, 5 items loaded into factor 3, 2 items loaded into factor 7 and 3 items loaded into factor 8. Factor 3 (section III) and factor 7 (section IV) could not survive sub- scale total correlation evidence of construct validity of the CTAS, thus, were eliminated. The CTAS now have three factor structures: factor 1 (section 1) consisting of 74 items, factor 2 (section II) which consist of 38 items and factor 8 (section V) consisting of 3 items given a total of 115 items. Sub-scale total correlation of the three factor structures with the total scores yielded coefficient of 0.887, 0.0520 and 0.350 respectively. Thus, the CTAS can be explained by three factors. The items of factor 1 (Section I) depicts the student who exhibits high manifestation of Chemistry test anxiety as he or she is highly anxious, afraid, tensed up, unease whenever Chemistry examination is mentioned or is in progress. This is because he has the impression that chemistry examination is difficult therefore he is nervous, experience sweaty palms, gets headache prior to the commencement of the examination. As soon as he is instructed to start, his heart beats faster so that his head becomes blank that he forgets the facts he already know. The items of factor 2 (Section II) describe a student who experience anxiety to a little extent. This is because he has some interest in the subject so perceive chemistry test/examination as being interesting and enjoyable such that examination/test in chemistry does not scare him so much nor make him panic or become restless. This implies that student's anxiety during chemistry test/examination may be increased due to lack of interest. The items of factor 8 (Section V) depicts a student's who has anxiety because he perceives chemistry examination as boring and uninteresting thus tends to anxious behaviour during chemistry examination.

The results of this study are inconsistent with that of Okonkwo [14] who developed and validated Physics Test Anxiety Scale for secondary school students in Aba Education Zone. The Physics Test Anxiety was explained by 7 factors associated with 57 items. Similarly, Bomo [25] developed a scale of students' attitude towards Mathematics in Rivers and Bayelsa States which was explained by seven factors with high construct validity and reliability. But consistent with that of Hunt *et al* who developed and validated a mathematics anxiety scale that yielded three factors of high validity and reliability index. The scree plot showed that there is a dominant factor with eigen of 20.666 greater than the second factor with eigen value of 9.583 and the eigen values of the remaining factors are all about the same. This indicates that the CTAS is unidimensional i.e. it measures one underlying construct. The findings are similar to the results from the study conducted by Oku [30] on Development and Validation of Chemistry Achievement Test using the One-Parameter Logistic Model of Items Response Theory, which yielded a dominant factor with eigen value of 7.691 greater than the second factor with eigen value of 3.687 and the eigen values of the remaining factors being of close range. Similar results were found in related studies by Asiegbu [31] and Emekene [32]. The internal consistency reliability of the CTAS was verified, via Cronbach Alpha technique. Cronbach Alpha analysis yielded a coefficient of 0.929. This is equally in line with the work of Ogidi [28-34] who developed and standardized a non-verbal intelligence test that revealed a high internal consistency reliability of 0.97.

CONCLUSION

The study focused on Development, Validation of Chemistry Test Anxiety Scale. Based on the findings, the following conclusions are drawn.

1. The items of the CTAS are appropriate in terms of their factor loading.
2. The items of the CTAS are capable of delineating the anxiety level of students towards chemistry test, quiz and assignment.
3. The items of the CTAS are consistent in measuring chemistry test anxiety
4. The CTAS is a reliable and valid scale.

RECOMMENDATIONS

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

1. Government and educational bodies should provide science equipment in schools to enhance teaching and learning of chemistry. This will discourage rote learning which a major cause of anxiety in the sciences is.
2. There should be regular training and re-training exercises for chemistry teachers to develop new approach of presenting learning materials to students.
3. Chemistry syllabus should graduate in difficulty i.e from simplest to complex with

instructional objectives stated in measurable form. This will help to stamp out anxiety towards learning of chemistry gradually.

4. Students from time to time be assessed with this instrument to ascertain their anxiety state for accurate report to their parents and guidance for proper guidance and counselling

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