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Construction of cognitive skills test of Textiles

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Abstract
This study was conducted to construct a reliable and valid test in Textiles named as the Cognitive Skills Test of Textiles (CSTT) to measure the effect of teaching instructions on six basic cognitive skills. The important steps of test construction followed by the researchers are planning, preparation of test items (content analysis and blue print), try outs, item analysis, reliability and validity. After try outs and item analysis only 60 items covering 10 questions on each basic cognitive skill remained in the final form of test. It was observed during try-outs that 10 minutes are sufficient to fill the general information part and review the test while 1 minute is enough to attempt one item. Researchers finally decided to provide 75 minutes for completion of the test to err on the side of caution. The answer sheets were scored with the help of scoring key which was prepared by the investigator. Each correct answer was awarded one mark and incorrect was awarded zero.
Test was further standardized by experimental validation that included establishing reliability and validity. Product moment method of correlation was applied to calculate coefficient of correlation which was treated as reliability of half test and it was found to be 0.79. To calculate the reliability Spearman-Brown Prophecy formula was used and it was found to be 0.88. Therefore, the test is found highly reliable. Content validity was established, in terms of consistency of test items with objectives as well as content, by giving the test to 20 subject experts in degree colleges. The experts agreed with the investigator with the distribution of content and objective of the content as well as with the scoring procedure.

Keywords: Textiles, cognitive skills, academic achievement, reliability, validity

Introduction
Data collection is an important part of the research process. In order to collect the requisite data, the researcher had to select and devise appropriate tools or test for measuring the attributes concerned and to administer these tools successfully. According to dictionary, test is defined as a series of questions on the basis of which some information is sought. In education test is more than this concept. An educational test is a standardized procedure to measure quantitatively or qualitatively one or more than one aspect of a trait by means of a sample of verbal or non-verbal behaviour. Cognitive Skills Test of Textiles (CSTT) measures the six cognitive skills *viz*. observation, classification, communication, measurement, prediction and inference) in the field of Textiles. The main objective for construction of this test was to measure the academic achievement of postgraduates' in home science. Cognitive Skills Test of Textiles falls in the category of group, verbal, objective, speed, achievement and mainly teacher made test. The preliminary part of test consists of some general questions regarding gathering information about the name, age, class, school, section, address and gender of the respondents as well as socio economic and educational status of their parents. The final part consists of specific questions based on six cognitive skills in topics of textiles. There were multiple choice objective questions in test.

Test Construction
In *planning step* of the test construction, constructor outlined the major objectives in general terms, specified the population for whom the test was intended, indicated the possible conditions under which the test was used, decided the nature of content or test items included, the type of instruction, method of sampling, probable length and time limits for the completion of test. During the *preparation of test items* constructor decided to construct an objective test including multiple-choice, pictorial form and matching type test items from the textiles syllabus of M.A.

Home Science since the major objective of this test was to measure the academic achievement of post graduate students in textiles. Researcher arranged the items on the basis of six basic cognitive skills *viz.* observation, classification, communication, measurement, prediction and inference.

Initially at the time of first *experimental try-out* (Pre-try-out on approximately 80 examinees) there were 100 items in test while at the time of second experimental try-out (the try-out proper) there were only 80 items. The aim of II try-out was to provide data for item analysis and for this the number of examinees were around 200 at post graduate level. These 80 items were given to 10 subject experts for their guidelines on wording, diagrams, language and correctness of content. After this II try-out and expert advice session only 75 items were made ready for final tryout. Subsequent to final trial administration and the process of item analysis only *60 items* covering *10 questions on each basic cognitive skill* were remained in the final form of test. It was observed during try-outs that 10 minutes are sufficient to fill the general information part and to review the test while 1 minute is enough to attempt one item. The researcher finally decided to provide 75 minutes for completion of test and it was sufficient time. Index of difficulty and index of discrimination were calculated for each item and item analysis worksheet was prepared to get a quick view of item analysis results. The *reliability* was measured by Split Half Method by putting all odd numbered test items in to one half and all even numbered test items in to another half. Care was taken to put highly comparable items in to two halves. Scores obtained on these two halves were organized & tabulated. Product moment method of correlation was applied to calculate coefficient of correlation which is treated as reliability of half test and it was found to be 0.79. To calculate the reliability of whole test Spearman-Brown Prophecy formula was used and it was found to be 0.88. Therefore, the test is found highly reliable. A test is valid if it fulfills the purpose of the test. *Content validity* was established, in terms of consistency of test items with objectives as well as content, by giving the test to 20 subject experts in degree colleges. The experts agreed with the investigator with the distribution of content and objective of the content as well as with the scoring procedure. In this way content validity of the test was established

Item Analysis of Test

This is an important step of test construction process. The aim of item analysis was to eliminate bad items and to construct a test of good items. It was done to obtain Difficulty Value and Discrimination Index of items.

(a) Difficulty Level (D.I.): - Difficulty level of a test is an index of easiness or difficulty of a test from the point of view of examinees. It is calculated item-wise and its index is the percentage of examinees that solve it correctly.

(b) Discriminative Power (D.P.):- Discrimination Power of a test item refers to the degree to which it discriminates between high and low achievers on the test.

(c) Method of calculation of D.I. & D.P. used in cognitive skill test: - Top- bottom 27% criterion, using Bi-serial correlation was employed by constructor to calculate D.I. & D.P. of cognitive skill test. First test maker arranged the answer sheets from the highest to the lowest order. From those arranged answer sheets the top 27% and the bottom 27% of the answer sheets, were separately taken. Next the proportions of the two groups passing a given item are found. Entering Flanagan's table with the proportion of successes in the two groups, bi-serial correlation from the intersecting column and row was read. This was the discriminative power of an item and the mean of the two proportions was the difficulty index of that item. The items with discriminative power of 0.25 or more and difficulty indices of 0.40 to 0.70 were kept in the final draft of test. Simplified item analysis worksheet was prepared and attached to get a quick view of difficulty index & discriminative power of each item.

Table 1: Item analysis worksheet

Item no.	✓ % In top 27% group	✓ % In bottom 27% group	Difficulty Index	Discriminative power
1*	70	48	0.59	0.22
2	66	30	0.48	0.37
3	80	50	0.65	0.31
4	78	36	0.57	0.45
5*	70	70	0.70	0.00
6	76	55	0.65	0.29
7	82	40	0.61	0.43
8*	66	62	0.64	0.04
9	70	42	0.56	0.29
10	73	25	0.49	0.44
11	86	54	0.70	0.38
12	78	30	0.54	0.49
13	84	46	0.65	0.39
14	66	28	0.47	0.41
15*	58	40	0.49	0.20
16	64	36	0.50	0.29
17	81	47	0.64	0.34
18	78	39	0.58	0.42
19*	74	52	0.63	0.24
20	66	30	0.48	0.37
21	76	48	0.62	0.30
22	82	36	0.59	0.49
23*	68	50	0.59	0.17
24*	67	47	0.57	0.21
25	72	28	0.50	0.44

26	79	51	0.65	0.31
27	70	40	0.55	0.33
28	68	38	0.53	0.29
29	83	45	0.64	0.43
30*	80	60	0.70	0.23
31	75	35	0.55	0.41
32*	63	52	0.57	0.13
33	74	46	0.60	0.30
34	70	41	0.50	0.40
35	66	32	0.49	0.37
36*	63	39	0.51	0.24
37	87	50	0.68	0.42
38	79	47	0.63	0.34
39	71	33	0.52	0.37
40	58	30	0.44	0.29
41	67	28	0.47	0.41
42	64	32	0.48	0.33
43	75	48	0.61	0.30
44	74	40	0.57	0.37
45	78	36	0.57	0.45
46	75	31	0.53	0.44
47*	70	55	0.62	0.17
48	82	52	0.67	0.36
49	86	50	0.68	0.42
50*	63	40	0.51	0.23
51	71	38	0.54	0.33
52	79	43	0.61	0.38
53	74	36	0.55	0.41
54	59	30	0.44	0.29
55	70	32	0.51	0.40
56	78	35	0.56	0.45
57	68	36	0.52	0.33
58	87	48	0.67	0.45
59	79	51	0.65	0.31
60	82	51	0.66	0.36
61	63	28	0.45	0.37
62*	75	56	0.65	0.22
63	78	51	0.64	0.31
64	87	46	0.66	0.45
65*	62	79	0.70	0.19
66*	64	76	0.68	0.21
67	83	44	0.63	0.43
68	72	33	0.42	0.40
69	67	30	0.48	0.37
70	56	24	0.40	0.34
71	63	40	0.51	0.25
72	75	36	0.55	0.41
73	82	43	0.62	0.43
74	84	55	0.69	0.32
75	74	28	0.51	0.48

***** Rejected items

Note: The items with discriminative power of 0.25 or more and difficulty indices of 0.40 to 0.70 were kept in the final draft of the test.

Even / Odd	0-4	5-9	10-14	15-19	20-24	25-29	30-34	f	dx	fdx	fdx^2	fdx.dy
30-34					$_{33}11^{3}$	$_{120}20^{6}$	$_{27}3^{9}$	34	+3	102	306	180
25-29					$_{64}32^{2}$	$_{120}30^{4}$	$_{60}10^{6}$	72	+2	144	288	244
20-24				$_{6}6^{0}$	$_{6}6^{1}$	$_{42}21^{2}$	$_{24}8^{3}$	41	+1	41	41	72
15-19			$_{0}3^{0}$	$_{0}4^{0}$	$_{0}5^{0}$			12	0	0	0	0
10-14			$_{22}22^{1}$					22	-1	-22	22	22
5-9		$_{36}9^{4}$	$_{20}10^{2}$					19	-2	-38	76	56
0-4								0	-3	0	0	0
f	0	9	35	10	54	71	21	200		227	733	574
dy	-3	-2	-1	0	+1	+2	+3					
fdy	0	-18	-35	0	54	142	63	206				
fdy^2	0	36	35	0	54	284	189	598				
fdx.dy	0	36	42	0	103	282	111	574				

Fig 1: Test reliability (Split-half method)

$$r = \frac{N\sum fdx.dy - \sum fdx.\sum fdy}{\sqrt{N\sum fdx^2 - (\sum fdx)^2 \times N\sum fdy^2 - (\sum fdy)^2}}$$

$$= \frac{200\times574 - 227\times206}{\sqrt{200\times733 - (227)^2 \times 200\times598 - (206)^2}}$$

$$= \frac{114800 - 46762}{\sqrt{146600 - 51529 \times 119600 - 42436}}$$

$$= \frac{68038}{\sqrt{95071\times77164}} = \frac{68038}{\sqrt{85650.79}}$$

$$\boxed{r = 0.79}$$

$$r_{11} = \frac{2\,r\,\frac{1}{2}\times\frac{1}{2}}{1 + r\,\frac{1}{2}\times\frac{1}{2}}$$

[Because $r\,\frac{1}{2}\times\frac{1}{2} = 0.79$]

$$r_{11} = \frac{2\times0.79}{1+0.79} = \frac{1.58}{1.79}$$

$$\boxed{r_{11} = 0.88}$$

Blue print of test

A test blueprint describes the key elements of a test, including the content to be covered, the amount of emphasis allocated to each content area, and the number of test items. It included identifying the major skill domains and establishing the relationship between weightage allocating to each skill domain and content area.

It helps to know the strengths and weakness of the test, to tally the questionnaire and the blueprint, and to determine the content validity of the test. Blueprinting also ensures that the selected test items give appropriate emphasis on thinking skills and assessment of in-depth knowledge. A blueprint may also help you identify areas where your question pool may be lacking. It is an important and essential part of test construction.

Skills / Content	Observation 16.7%	Communication 16.7%	Classification 16.7%	Measurement 16.6%	Inference 16.7%	Prediction 16.6%	Total 100%
Fibers 20%	3	2	2	2	2	1	12
Yarns 20%	2	2	2	2	2	2	12
Weaving 20%	2	2	2	2	2	2	12
Fabric Finishes 20%	1	2	2	2	2	3	12
Fabric Labels and Performance 20%	2	2	2	2	2	2	12
Total 100%	10	10	10	10	10	10	60

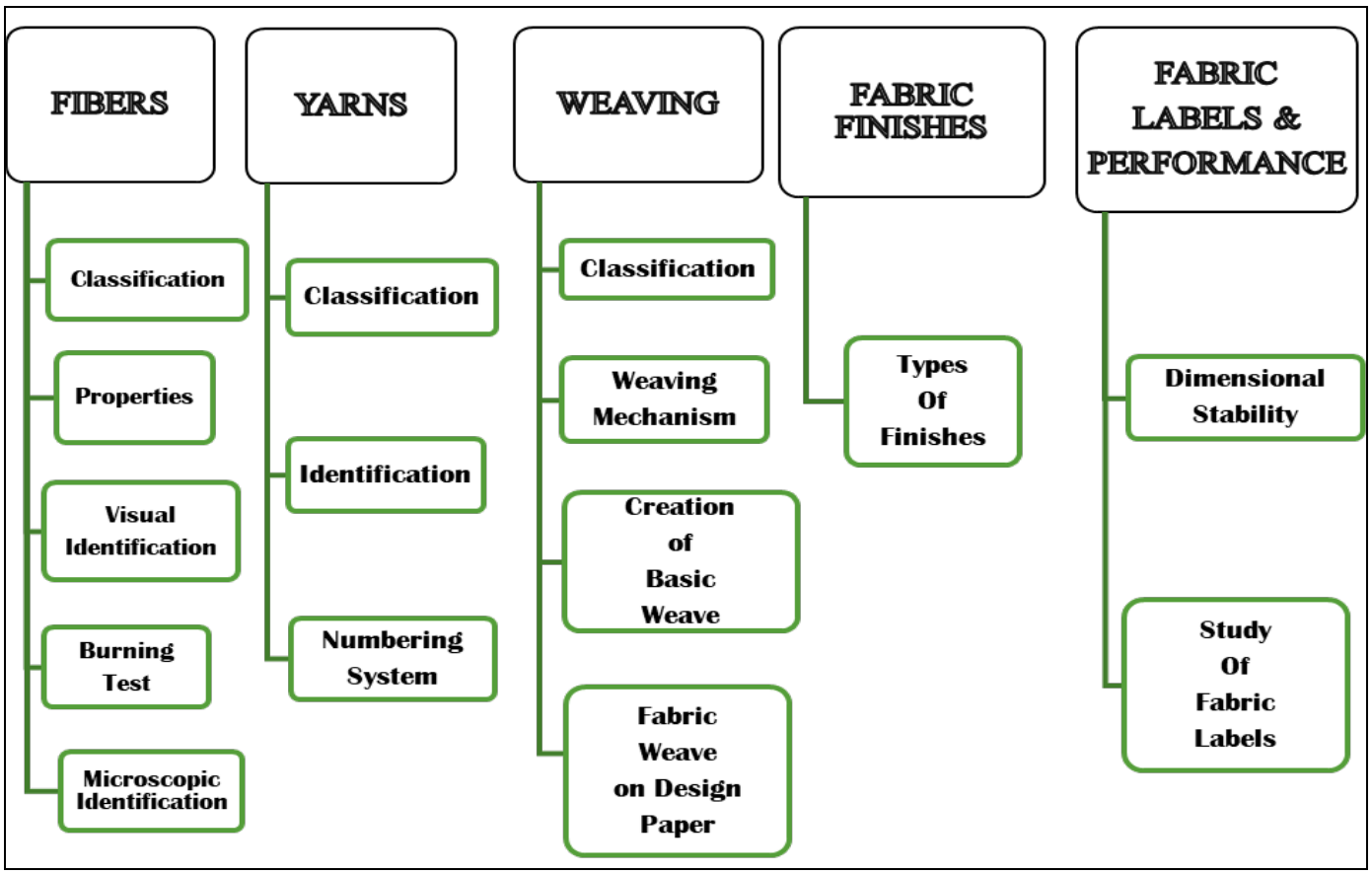

Fig 2: Content analysis of test

Conclusion

This study was carried out to construct a reliable and valid test in Textiles named as Cognitive Skills Test of Textiles (CSTT) to measure the effect of teaching instructions on six basic cognitive skills. The important steps of test construction were followed strictly by researcher as planning, preparation of test items (content analysis and blue print), item analysis, reliability and validity. The test can be used by the teachers to assess students' achievement in Textile when they have covered the content areas of undergraduate and postgraduate syllabus of textile.

Before constructing this test, investigator first reviewed achievement test available in the field of home science. After reviewing them, need was felt to develop an independent test based on the syllabi of textiles. Text books of Textiles were utilized as source for framing items. The text books was studied thoroughly and concepts were understood. Questions were selected with the help and advice of subject experts and also by choosing repeated questions by verifying many question banks as well as UGC NET exam papers of home science.

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