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CONSTRUCTION AND STANDARDIZATION OF AN ACHIEVEMENT TEST IN MATHEMATICS

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Abstract

"Achievement test is a test designed to measure knowledge, understanding and skills in a specified subject or a group of subjects". It is a test for evaluation of student performance after a period of instructions. A test is done after a period of instructions for evaluation purpose. The present study was conducted to construct and standardize an Achievement test in Mathematics for VIII grade students to measure their achievement. In the present study multiple choice questions (MCQ) type Mathematics Achievement test is constructing according to the blue print. The Construction of test items is an important phase in the development of a test as the reliability; validity of the test depends upon the test items. It is a pre-pilot study. The test consisted of 25 items covering all aspects of text-book of standard VIII prescribed by Maharashtra Board, after doing item analysis, 10 items were retained in the final draft of the test. Reliability was calculated by split half method of reliability and value of coefficient of correlation was found to be 0.99. Validity of the achievement test was established by content validity method. The purpose of an achievement test is to determine student's knowledge in a particular subject area. It helps in evaluating the effectiveness of teaching instructions. It also provides the feedback to the students as well as to the teachers. The achievement test has the focus on the realization of objectives of teaching and learning. Among such steps, achievement test in Mathematics can help the students. Therefore, in this research paper an attempt has been made to construct and standardized an achievement test in Mathematics so that it will be helpful in improving problem solving skills of students.

Keywords: *achievement test, construction, standardization*

Introduction

Mathematics has played very important role in building up modern civilization by perfecting all sciences.

"Mathematics is a science of all science and arts of all arts."-- Kant

It is one of the basic subjects in curriculum at all levels, beginning from primary level to engineering, science, and commerce and computer science.The objective of teaching mathematics at primary level is to develop concept of different numbers and basic operations. The goal of education is to develop problem solving skills in mathematics. If students will not practice, they will not understand the concept and leave that concept or skills. So naturally their basic skills will not be perfect. Standardized testing has assumed a prominent role in recent efforts to improve the quality of education.

Statement of the Problem: - "Construction and Standardization of an Achievement Test in Mathematics for Class VIII students.

Objective of the Study:-Objectives of this research study were as follows:

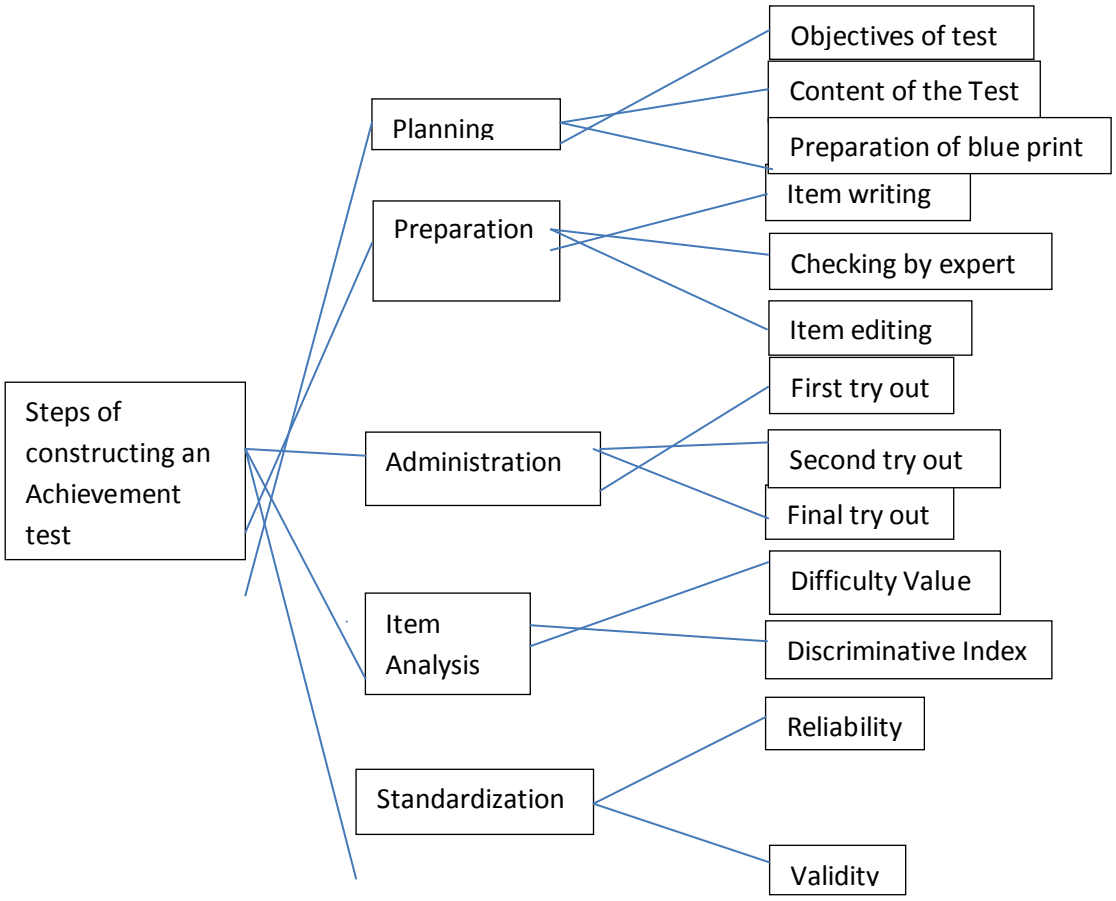
1. To construct an achievement test in Mathematics to measure the performance level of each pupil on different areas of mathematics in the syllabus of standard VIIIth.
2. To standardize the constructed achievement test of Mathematics for the students completing VIIIth standard.
3. Preparation of the test manual for the achievement test constructed and standardized in this study.

Method of Construction and Standardization of an achievement Test.

This test was constructed on the basis of the objectives of teaching; knowledge, understanding and application and skills in Mathematics. Steps are as follows:-

1. Planning the test
2. Preparation of the test
3. Administration of the Test
4. Item analysis
5. Standardization of test: a. Reliability b. Validity

Figure :Flow Chart of Plan & procedure followed in Standardisation of an Achievement Test



1. **Planning of the test:-**

Planning of a test is very important step in the construction of an achievement test. An achievement test needs very careful planning. For proper planning of the test, the investigator has to keep following aspects in mind such as: to whom, what, when and how to measure. It includes designing of the test and preparation of the blue print. Designing of the test includes important aspects such as objectives of the test, content of the test, nature of the test, scoring schemes, number of items, type of items, length of test, weightage to objectives, weightage to content, weightage to questions, allotment of time and marking scheme.

Planning is not only an important but an essential aspect of test construction. A good test cannot be constructed by merely 'throwing together' different types of questions framed on related units. Test in present study constructed in a systematic and organized way. Planning for item difficulty, directions to the examiner, arrangement for try-out, test reproduction, provision for expert review has done carefully in present study,

In construction of the achievement test of mathematics researcher has drawn the questions which tested the proficiency of the students with respect to different concepts included in the prescribed syllabus of 8th standard mathematics. These questions were based on the topics Number Systems, Algebra, Geometry, and mensuration & Statistical Data Analysis. These test items has drawn as per the instructional objectives knowledge, understanding, skills and application of the mathematical concepts present in these chapters. Test has only multiple type questions to avoid subjectivity in evaluation. The test item constructed according to the blue print

1.1 Objectives of the test

Objectives in this achievement test were defined by Bloom's Taxonomy as knowledge, understanding, application and skill, from all the units of Mathematics of VIIIth class prescribed by the Maharashtra Board of School Education.

1.2 Content of the test

The achievement test covered the content from all the units of Mathematics textbook prescribed by the Maharashtra Board of School Education of standard VIII.

1.3 Preparation of blue print

After designing, preparation of blueprint is the last stage of the planning of test. Here investigator keptdifferent types of question in blueprint and allots them marks depending on the time and according to difficulty level. The researcher prepared mind map of all questions in the form of a blueprint. Initially 40 Questions were prepared, but after the expert view and ambiguity in items, 25 questions were finalised for try outs.

2. Preparation of items:-

2.1 Writing the test items:-To serve the purpose of the test design each item or a question of the test was related to the curriculum. Researcher selected the questions based on a pre-determined instructional objective on the specific content area. The language of the question was well within the comprehension of pupils. A question is the basic element in the test construction. Considering characteristics of good questions Validity, Reliability, Difficulty level, Discriminating power Practicability, researcher has selected each question of the test constructed and standardized in present study.

2.2 Checking by experts:- Researcher has written questions one by one as per blue print. List of 40 Questions were given to the expert teachers teaching to 8th standard as per

following table. (K- Knowledge, U- Understanding, A- Application, S- Skills).As per suggestions of the experts each test items modified and reconstructed.

Sr. No.	Question	This Question will test following				Suggestions for Reconstruction	Item selected /Reconstructed
		K	U	A	S		
1	1						
2	2						

2.3 Items editing:-The difficulty level is a very important characteristic of a question. Present arranged in ascending order of difficulty level. Easy questions have kept in preliminary part of the test so students will have confidence to solve further questions. Test has easy, average and difficult questions as per following table.

Sr. No	Difficulty level of questions	Percentage
1.	Easy questions	15
2.	Average questions	70
3.	Difficult question	15
	Total	100

3. Administration of the Test:-

3.1 First try out

After finalizing the test items, were administered on 50 students for First try-out.

First try out Analysis

Mean	**31.6000**
Standard Error	1.1183
Median	34.0000
Mode	38.0000
Standard Deviation	7.9076
Sample Variance	62.5306
Kurtosis	0.8522
Skewness	-1.1949
Range	32.0000
Minimum	8.0000
Maximum	40.0000
Sum	1580.0000
Count	50.0000

Q. No	**No. of Stu. who given Correct ans.**	**No. of Stu. who given Wrong answer**	**Total Marks**	**Not attempted**	**Difficulty Value**	**Discrimination Index**	**Remark**
1	38	10	76	2	0.76	-0.16	
2	32	2	64	16	0.64	0.56	
3	2	48	4	0	0.04	0	D
4	19	31	38	0	0.38	0.28	
5	37	13	74	0	0.74	0.28	
6	33	17	66	0	0.66	0.44	
7	9	37	18	4	0.18	-0.04	D
8	46	4	92	0	0.92	0.16	D
9	50	0	100	0	1	0	D
10	32	18	64	0	0.64	0.4	
11	38	11	76	1	0.76	0.4	
12	13	33	26	4	0.26	-0.36	
13	24	24	48	2	0.48	0.08	D
14	49	1	98	0	0.98	0.04	D
15	37	9	74	4	0.74	0.36	
16	44	6	88	0	0.88	0.24	
17	18	27	36	5	0.36	-0.08	D
18	39	7	78	4	0.78	0.36	
19	11	37	22	2	0.22	0.2	
20	47	2	94	1	0.94	0.12	D
21	28	21	56	1	0.56	0.8	
22	35	13	70	2	0.7	0.52	
23	41	7	82	2	0.82	0.28	
24	34	14	68	2	0.68	0.64	
25	34	15	68	1	0.68	0.4	

Second try out Analysis:

After First try-out, the test items were administered on the 68 students VIII class of Utkarsha School Pune. This attempt was made to check any point of difficulty as well as any language problem occurring in the construction of the test. All the students were given different answer sheet on which students mark their responses, after giving the required instructions about the test.. Out of 25 items 8 items were discarded. Therefore out of 25 items 8 items (Q. No.3, 7,8,9,13,14,17, 20) were removed from the draft. Thus, the second draft of the achievement test is consisting 17 items keeping in view the nature of content as well as difficulty level.

	28.3230
Mean	
Standard Error	0.9625
Median	28.0000
Mode	36.0000
Standard Deviation	7.9371
Sample Variance	62.9982
Kurtosis	-0.3101
Skewness	-0.2694
Range	38.0000
Minimum	8.0000
Maximum	46.0000
Sum	1926.0000
Count	68.0000

Question No.	**No. of Stu. who given Correct answer**	**No. of Stu. who given wrong answer**	**Total Marks**	**Not attempted**	**Difficulty Index**	**Discrimination Index**	**Remark**
1	61	7	122	0	0.9	0.206	
2	19	47	38	2	0.28	0.32	
4	16	50	32	2	0.24	0.056	D
5	30	37	60	1	0.44	0.47	
6	38	29	76	1	0.56	0.29	
10	47	18	94	3	0.69	0.08	D
11	30	34	60	4	0.44	0.412	
12	16	34	32	8	0.24	0.23	
15	58	7	116	3	0.85	0.176	
16	55	12	110	1	0.81	0.265	
17	41	22	82	5	0.6	-0.029	D
18	46	18	92	4	0.68	0.118	D
21	21	43	42	4	0.31	0.441	
22	31	31	62	6	0.46	0.676	
23	51	13	102	4	0.75	0.441	
24	38	24	76	6	0.56	0.471	
25	35	28	70	5	0.51	0.5	

3.3 Final try-out

The test was administered to 118 students of VIII class who had completed the syllabus for final try-out. The answer sheets were collected from all the students. The answer sheets were scored with the help of scoring key which was already prepared by the investigator. Correct answer has been awarded two mark and incorrect has been awarded zero. Out of 17 items 4 items were discarded. Therefore out of 17 items 4 items (Q. No.4,10,17,18) were removed from the draft. Thus, the Final draft of the achievement test is consisting 13 items keeping in view the nature of content as well as difficulty level.

Final try- out Analysis

Mean	**29.7118**
Standard Error	0.74166
Median	31
Mode	36
Standard Deviation	8.05653
Sample Variance	64.90772
Kurtosis	-0.243726
Skewness	-0.60893
Range	38
Minimum	8
Maximum	46
Sum	3506
Count	118
Count	68.0000

Question No.	**No. of Stu. who given Correct answer**	**No. of Stu. who given wrong answer**	**Total Marks**	**Not attempted**	**Difficulty Index**	**Discrimination Index**	**Remark**
1	99	16	198	3	0.84	-0.05	D
2	51	50	102	17	0.43	0.661	
5	67	50	134	1	0.57	0.559	
6	71	46	142	1	0.6	0.492	
11	68	45	136	5	0.58	0.61	
12	29	77	58	12	0.25	-0.051	D
15	95	16	190	7	0.81	0.153	D
16	99	18	198	1	0.84	0.254	
21	49	64	98	5	0.42	0.695	
22	66	46	132	6	0.56	0.712	
23	92	21	184	5	0.78	0.373	
24	72	39	144	7	0.61	0.678	
25	69	44	138	5	0.58	0.593	
22	31	31	62	6	0.46	0.676	
23	51	13	102	4	0.75	0.441	
24	38	24	76	6	0.56	0.471	
25	35	28	70	5	0.51	0.5	

D=Discarded

Out of 13 items3 items were discarded. Therefore out of 13 items 3 items (Q. No.1,12,15) were removed from the draft. Thus, the Final draft of the achievement test is consisting 10 items keeping in view the nature of content as well as difficulty level.

4. Item Analysis - Item analysis is the statistical treatment to each item to determine its difficulty level, and the power of discrimination. Researcher carried out this statistical analysis and arranged the questions as per the ascending order of its difficulty level.

4.1 Arranging answer sheet in descending order:-All the 118 answer sheets were arranged in descending order.

4.2 Difficulty Value

The percentage of students correctly answering the item is called the item difficulty, and it is denoted as the P value. The range is from 0% to 100%, the higher the value, the easier the item. If P values above 0.90 then test items are very easy items and might be a concept not worth testing. P-values below 0.20 indicate that item is difficult and should be reviewed for possible confusing language or the contents needs re-instruction.The maximumdiscrimination between high and low achievers havingOptimum difficulty level is 0.50. Generally, items of moderate difficulty are to be preferred in test.

Difficulty index = No. of correct response / Total no. of response * 100

4.3 Discrimination Index Discrimination index was calculated by the 27% rule. The group was divided into three parts. The best 27% is named as the upper group and the 27% from the worst end will be termed as the lower group. The remaining students were constituted the middle group. For item validity that is the discriminatory values of each item upper and lower group performance was considered.

Discriminatory index was calculated using the following formula.

$$\textbf{D.I.}= \frac{U - l}{N/2}$$

Where D.I. = Discriminatory Index

U = the number of students in upper group who response correctly.

L = the number of students in the lower group who response correctly.

N = the total number of students.

An item with the discrimination index equal to 0.18 was remained and below 0.18 was rejected.

Ebel and Frisbie (1986) gave the following rule of thumb for determining the quality of the items, in terms of the discrimination index. Table shows the values DI and their corresponding interpretation.

Range	Grade	Recommendations
> 0.39	Excellent	Preserve
0.30-0.39	Good	Possibilities for enhancement
0.20-0.29	Average	Need to verify/review
0.00-0.20	Poor	Reject or review in depth
< -0.01	Worst	Remove

5. Standardization of Achievement Test

25 items constituted in the final form of the Achievement test. Achievement test was standardized by experimental validation of the testwhich includedthe process of establishing reliability and validity.

5.1 Reliability of the test:-

. Reliability refers to degree of consistency of test scores obtained by same individual when re-examined with test on different sets of equivalent items or under other variable examining condition. There are different methods such as test-retest, split half, alternate form and parallel form etc.Reliability is very important aspect of any test and measuring instrument.It is a degree of consistency of test scores obtained by same individual when re-examined with test on different sets of equivalent items or under other variable examining condition. In the present research paper, the reliability of the test was measured by split half method. The reliability co-efficient of the present test was 0.99149.and spearman brown correlation is .995729.This shows that achievement test has high reliability.

	Split half Method
Correlation	0.991494901
Spearman-Brown correction	0.995729
	Reliability Statistics
Cronbach's Alpha	0.74582

This result shows that the test is most reliable

5.2 Validity of the test: - Validity refers to the attainment of purpose for which the test is prepared. There are different methods of estimating validity such as face validity, content validity, construct validity, predictive validity and concurrent validity. The investigator opted

for content validity. The content validity is concerned with the relevance of the contents of the items, individually and as a whole. Expert judgement was taken into consideration. To estimate content validity of an achievement test, test was given to Mathematics teacher and experts to compare test items with the content and objectives of content. 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 achievement test was established.

Conclusion:-This Pre-pilot study was carried out to construct and standardize a reliable and valid achievement test in Mathematics. The test was standardized on the sample of 118 students studying in Utkarsha School, Maharashtra school, Shankar- raochavhan more vidyalaya of Pune city. Theoretical and empirical literature related to the study was reviewed. The reliability of the test was determined through split half method of reliability which was 0.99 and content validity of the test was estimated. Hence, the constructed achievement test in Mathematics has a high reliability and validity. The test can be used by the teachers to assess student's achievement in Mathematics when they have covered the content areas of VIII class.

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