Construction and Standardization of Mathematics Achievement Test for IXth Grade Students

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ABSTRACT

In the present article multiple choice questions (MCQ) type Mathematics Achievement test is constructing according to 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. The discriminative Index find out the difficulty value of each item. The nature of questions for achievement test consisted of matching type and multiple choice questions. This achievement test is constructing for Geometry content of Mathematics for IXth grade student.

Keywords: Construction, standardization, mathematics achievement

The achievement tests constitute an important tool in the school evaluation programme. It is necessary for the teacher to know how for the pupil have attained in particular subject area. Achievement test also measure skills and knowledge learned in a given grade, usually through planned instruction and training. In Mathematical achievement learning of mathematical concepts which influences on students performance in mathematics.

According to N.M. Downie (1961), "Any test that measures the attainments or accomplishments of an individual after a period of training or learning is called an achievement test."

Conceptual Framework of Achievement Test

This test was constructed on the basis of the objectives of teaching; knowledge, understanding and application in mathematics at the secondary stage. Keeping in view these objectives, the syllabus of mathematic was analyzed from mathematics text books of IX class prescribed by NCERT. Identify the important concepts of Mathematics Geometry at IX level. Then the items were prepared from the content of geometry. A mathematics achievement test is one which is designed to measure knowledge understanding or skill in specified subject or group of subjects.

Before constructing the Mathematics achievement test, investigator analyses the various tests available for testing in the field of Mathematics. It was felt that lack of suitable test to evaluate achievement in Mathematics Geometry. The achievement tests give reliable information regarding the decisions taken in the context of Mathematics education.

Construction of Mathematical achievement Test

A good test is prepared through a systematic process. The process of test development was completed through five basis steps namely: test conceptualization, test construction, item scoring and analysis, reliability and validity and test standardization. For the construction of an achievement test the investigator was adopted the following steps which as shown in below:

Fig. 1: Steps of Test Construction

Preparation Draft for Achievement Test

After the review of literature, Achievement test was prepared of IXth class for geometry content. An achievement test on the module of Content Difference: Geometry content was prepared by the investigator. The preliminary draft was given to expert in education and experienced mathematics teacher. After receiving their opinions, items in difficult language were modified to simple language statement and 20 items were eliminated from the draft.

Objective of Achievement Test

The review of the literature indicates that standardized tools for the mathematics achievement are available for IXth grade, but no such tool is available for geometry content. In the present work, investigator has prepared the achievement test in mathematics of IXth standard students. The most important steps in planning, a test was to identify the instructional objective. As researcher has taken the subject mathematics, so major objective were categorized as knowledge, comprehension, application and skill. The instructional objectives were defined in behavioral term from selected units of mathematics text book prepared by NCERT for IXth grade. Achievement test have many purpose:

1. Diagnose strength and weaknesses
2. Assess level of competences
3. Assign Grade
4. Achieve Certification
5. Advanced Placement
6. Content evaluation
7. Informational Purposes

Weightage to instructional objectives and content

To decide the weightage to be given to different content areas, objective and different form of questions, and expert opinion of the concerned Math's teachers was taken in to consideration.

Content of the Test

At this state, the investigator has to determine which content to be tested in this paper. The test covers the content of Geometry. All the content was cover into eight chapters and these chapters as shown in the table below.

Table 1: Content selected for achievement test

Sl. No.	Selected content
1	Lines and Angles
2	Triangle
3	Quadrilaterals
4	Circle
5	Cube and Cubiod
6	Cylinder
7	Cone
8	Sphere

Fig. 2: Weigthage given to every objective in percentage form

Blue Print

Blue Print is a detail plan of any action or outline. It provides the users with basis instruction on the rationale for the process in creating test blue print. In education area, blue print provides students an interactive approach for education planning, curriculum expectation and the learning objective. A test Blue Print ensures appropriate items representation of content. The details of test after second try out is given in the form of blue print. The graphical presentation is given below:

Key of the test

The marking scheme helped to prevent inconsistency in judgment . In the item scoring for multiple type

Table 2: Number of items

Sl. No.	Instructional objective	Angles	Triangles	Quadriletral	Cube and Cubiod	Circle	Cylinder	Cone	Sphere	Total	Per.(%)
				CONTENT/UNIT							
1	Knowledge	3	1							4	10
2	Understanding	2	2	1				3	1	9	22.5
3	Application		3	2	2	1	2	2	1	13	32.5
4	Skill	4	1	2	3	2	1		1	14	35
	Total	**9**	**7**	**5**	**5**	**3**	**3**	**5**	**3**	**40**	**100**

question were scored 1 for correct response and zero for wrong response.

Table 3: Scoring pattern of multiple choice question items

Item Type	Correct Responces	Wrong Responces
Multiple Choice	1	0

First try out

The pilot testing was done on a sample of forty IXth students, selected on the basis of purposive sampling. The number of the students in the first draft was kept small because it was used to check the ambiguity of items and appropriateness of language. After administration of preliminary draft, suggestions and observations were taken from these students in relation to understanding of statements, appropriate of language, repetition if any. Some of the statements were modified as per the observation given by the IXth class students. The edited scale constituted sixty items. The pilot test helped the investigator to give the final test.

Item Analysis

Item analysis helps to detect the strength and weakness of test items. The two extreme groups, the high and low 27% formed the criterion group for the calculation of difficulty and discrimination indices of the test items. The following formulae were used.

$$P = \frac{R_u + R_1}{N_u + N_1}$$

P = Difficulty level
R_u = Higher group given corrected response
R_1 = lower group given corrected response
N_u = Total number of person of higher group
N_1 = Total number of person of higher group

On the basic of these formulas level and question find difficulty level. Sometimes students given answer on guessing. To remove these guessing researcher use these formulas given under:

$$S = R - \frac{W}{K - L}$$

S = Correct score

R = Number of correct response

W = Number of incorrect responses

K = Number of response options or choice used in the item

The process of Item Analysis is carried out by using two contracting test groups composed from the upper and lower 27% of the testees on which the items are administered or trial tested. The upper and lower 27% when used are better estimate of the actual discrimination value. They are significantly different and the middle values do not discriminate sufficiently. In other to get the groups, the graded test papers are arranged from the highest score to the lowest score in a descending order. The best 27% are picked from the top and the poorest 27% from the bottom while the middle test papers are discarded.

Ebel and Frisbie (1986) gave the following rule of thumb for determining the quality of the items, in terms of the discrimination index. Table 4 shows the values DI and their corresponding interpretation.

Table 4: Discrimination index

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

Table 5: Distribution of discriminating index of items of first draft of achievement test

Range	ITEMS	Total
> 0.39	1,2,4,6,9,10,11,14,15,16,17,20,24,29,35,37, 38,40,44,46,49,50,51,52, 53,57,58,59,	28
0.30-0.39	3,19,25,28,30,31,32,33,36,41,48,55	12
0.20-0.29	7,26,42,43,	4
0.00-0.20	5,8,21,22,23,34,39,45,47,54,60,	11
< 0.01	12,13,18,27,56,	5
	Total	**60**

Final Try -out

After first try out of the mathematics achievement test was given and administered on another group of 40 students of IX^(th) class. Same process of first try out was followed for finding difficulty value and discriminating index.

Table 6: Item analysis Final Try out draft

Level of Difficulty	Medium (.034-0.66)	Remark	Total
> 0.39	1,2,4,6,9,10,11,14,15,16,17,20,2 4,29,35,37, 38,40,44,46,49,50,51,52,53,57, 58,59,	Excellent items	28
0.30-0.39	3,19,25,28,30,31,32,33,36,41, 48,55	Good Items	12
Total			**40**

Tryout is an essential step in the construction and standardization of a test. It helps to detect the difficulty and discriminating power of the test whereby the test items may be arranged in a sequential manner. The investigator established a rapport with the respondents and apprised them about the purpose of the test. Then the instruction and statement of test was explained in the class. The marking scheme were used in two form: Correct answer was given one marks, wrong answer was given zero mark. The draft of the Achievement test is given in Table 6.

Reliability of the Tool

The reliability of the tool was estimated by Split – half method. The tool was administered and d the odd on the group of 40 students. In split half method 80 questions were divided in two halves. The first set of scores represents performance on the odd–numbered items 1,3,5,7, etc. and the second set of scores on even numbered items 2,4,6,8, etc. Coefficient of correlation was computed between the first and second set of scores. Spearman –Brown Prophecy was used to find out the reliability formula give under:

$$rtt = \frac{2r}{1+r}$$

rtt = Reliability coefficient of whole test

r = Reliability coefficient of half -test

The reliability coefficient between two ratings was found to be 0.86. The reliability of the tool was estimated by test-retest method. The tool was administered and repeated on the same group of 40 students after a time interval of 4 weeks. Coefficient of correlation was computed between the first and second set of scores. The reliability coefficient between two ratings was found to be 0.84.

Validity of the tool

The validity coefficient reported here show that the achievement test used in the study is reasonably

Table 7: Number of items in the final draft of achievement test at different cognitive levels of objectives i.e. Knowledge, Understanding, Application and Skill

Sl. No.	Instructional objective	Angles	Triangles	Quadriletral	Cube and Cubiod	Circle	Cylinder	Cone	Sphere	Total No.
				CONTENT/UNIT						
1	Knowledge	1, 3,4,(3)	10(1)	18						4
2	Understanding	2 ,6(2)	12,13(2)	20,21				33,34,35(3)	38(1)	9
3	Application		14,15,16(3)	17,19(2)	25,26(2)	29(1)	31,32(2)	36,37(2)	40(1)	13
4	Skill	5,7,8,9,(4)	11(1)		22,23,24(3)	27,28	30(1)		39(1)	14
	Total	**9**	**7**	**5**	**5**	**3**	**3**	**5**	**3**	**40**

Note: Figures in parenthesis shows Number of questions.

valid. Content validity of the test, which requires the determination of the adequacy of each item was ensured through careful planning of the test, satisfying the adequacy of sampling of test items models of the construct to be measured and the meticulous analysis of the test items of experts. The statistical validity of the test items included in the test was compared with the objectives of the topics taught. It was found that there was correlation between the items and objectives. So it can be clam that test has got content validity. The coefficient of correlation was 0.87. The validity coefficient reported here show that the achievement test used in the study is reasonably valid.

Norms

A standardized test must have norms which should be the average performance of a group or groups that the examiner has taken for the administration of the final form. Norms are measure of achievement which represents the typical performance of a group or groups. Norms are used for interpreting the scores of the individual or a class. This achievement test follow the age norms.

CONCLUSION

Achievement tests have been used for the certification and selection to assess student progress at the end of secondary school and for admission to higher education. It has been widely used in occupation and professional licensing situation as well. An achievement test is also used for purposes of guidance and counseling. It has found useful in remedial teaching programmes as well as in determining the class to which a student should be admitted into. Administration of these tests at regular intervals is helpful to teacher in knowing the kinds of difficulties faced by the pupils in learning. So finally we can say that the achievement test may use as aid in the evaluation of teaching the importance of instructional techniques and the revision of curriculum content.

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