CONSTRUCTION AND STANDARDIZATION OF AN ACHIEVEMENT TEST OF MATHEMATICS FOR NINTH GRADE STUDENTS

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ABSTRACT

This paper reveals the details of the construction and standardization of achievement test in Mathematics from 9th class P.S.E.B Text-Book. Bloom's taxonomic objective formed the basis of the blue print. Multiple choices, matching type, true/false test items were constructed and expert opinions were taken. The Test initially consists of 95 items. After review and evaluation of statements by the experts, items were reduced to 90. After item analysis, 72 items were retained in the final draft of the test. The split half reliability of the scale was found to be 0.79. For validity, face validity and content validity was calculated and test was found to be valid. Scoring of scale was 0 and 1.Each right answer has one mark and wrong has 0 marks.

Keywords: Construction, Standardization, Achievement Test, *Mathematics*

Our modern civilization is the gift of mathematics. Mathematics has been recognized as one of the central strings of human intellectual activity throughout the centuries. From the very beginning, mathematics has been a living and growing intellectual pursuit. It has its roots in everyday activities and forms the basic structure of highly advanced technological developments. It also offers opportunities for opening the mind to new lines of creative ideas and channeling thoughts. For scientists, technologists, engineers, doctors, specialists and others, mathematics is there to have catalytic impact upon their understanding in order to serve mankind all over the globe, productively and usefully.Mathematics is defined as the study of patterns of structure, shape, figures, numbers and space. Mathematics in its strict sense is described as an abstract science which investigates the conclusions of spatial-numerical relations. It is study of facts that can't be expressed in concrete fashion. With the learning of Mathematics the cognitive and conative powers of the learners is sharpened. That's why; the great scientist Albert Einstein recognized it as the Queen of the Sciences in his book 'Ideas and Opinions'. Etymologically mathematics has been derived from Greek word 'Manthanein' which means 'learning' and 'Techne' means 'art or simple method'. So Mathematics means 'Inclined to learn'.Mathematics should be visualized as the vehicle to train a child to think, reason, analyze, and articulate logically (NPE, 1986).

Theoretically, the concept of education in India is broad, but practically major focus of contemporary Indian education is academic achievement of the pupil. It has always been a vital part and the Centre of educational research. Despite a major change in the modes of assessment and definitions of objectives of education, the academic achievement of a

pupil continues to be the primary concern and the most important goal of education and research.Academic achievement in particular subjects plays a very important role in the attainment of the idea of harmonious development of the child. In this swiftly changing world and with the increasing advancement, the place of education has become so crucial that every parent today sets lofty goals for his/her child. Today at the time of admission, for entrance in jobs, for scholarship, for further studies good academic record is the chief measure. Whatever one's interest or attitude may be one cannot undermine academic achievement in a subject. Possibly, no one would disagree with the significance of academic achievement in child's life. The success or failure of a learner is assessed in terms of his/her achievement in particular subject.Achievement is the amount of success of an individual in a specific field or area of accomplishment. Achievement tells what a particular student has been able to learn and acquire. Achievement signifies accomplishment or gain or performance and carried out successfully by an individual or group on completion of a task, whether of be academic, manual, personal or social nature.Teachers teach and help the learner to learn. Good (1959) in the Dictionary of Education, referred to academic achievement as the knowledge attained or skill developed in the school subjects, usually designated by test scores or marks assigned by the teacher. Assessment of student's achievement in particular subject is always a main concern among teachers, educators and planners. For valid and reliable results we need some standardize test to assess the achievement of students in Mathematicsto evaluate pupil's knowledge, understanding and application of the fundamental concepts and rules covered.

Research studies have been carried out on the construction of and standardized of achievement test in different subject viz. English, Biology, Physics, Chemistry, Mathematics,

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Economics, General Science, Hindi, Punjabi, Home Science, Environment concept etc. Review of literature showed that an achievement test in Economics for class IX students constructed and standardized by Singh (2005). Craig (2008) examined the utility of standardized achievement test scores as predictors of geography skills in an undergraduate population at an urban university. Kanchan (2009) constructed and standardized environment concept achievement test for Sr. Sec school students. Some efforts for development of achievement tests were made by Aram et al. (1957), The Gujarat Research Society (1963), Singh (2005), Craig (2008), Singh (2011) and many others. Many of these are not standardized and neither published for use by the school teachers. Moreover knowledge is dynamic and science and technology are advancing at a fast pace, leading to changes in sources of knowledge, methods of delivery of content and self-study. Due to changes in the syllabus and reorganization of content there exists an inadequacy of latest tests which urgently demands the designing of tests in this important area of study. The review of the related literature also clearly shows the dearth of standardized achievement test in science, mathematics and mathematics for 9th class. Moreover very few studies are undertaken to construct and standardized achievement test for mathematics of ninth grade. So there was dire need to construct and standardized the achievement test in mathematics for ninth grade students.

Objective of the study

• To construct an achievement test in mathematics for ninth class students

• To standardize the achievement test by determining reliability and validity of the test

Planning

For a given tool, planning was done on the behalf of the investigator regarding the purpose of the test, Content of PSEB board, time and resources at the disposal of the test maker, nature of the population, length of the test, type and nature of test items, method of scoring etc. which was decided in advance.

Target population

This test is meant for IX class students of Mathematics studying in P.S.E.B affiliated schools

Content Covered

The content covered under the test consisted of 15 chapters from the Mathematics book for class IX prescribed by P.S.E.B. A blue print was prepared by keeping in mind the blooms taxonomy of objectives. Each item of the test was concerned with the selected topics of mathematics and on the basis of blue print. An item construction criterion was followed as proposed by various authors (Garret 1981, freeman 1960, Best and Kahn 1995). All the statements were carefully worded.

Identification and compilation of items in the first draft of the test

The items for the test emerged after days of discussion and brainstorming session with the supervisor and school teachers. Keeping in mind wide applicability, objectivity of scoring and ease in administration of test, investigator decided to develop a test comprised of multiple choices, matching type and fill in the blanks type of questions related to different levels as shown in blueprint. Initially 95items were prepared.

Second draft of the test and item analysis

The pre try out was done at two stages. Firstly, it was tried out on a sample of 10students of 9th class students from Govt. Sr. Sec. School Haibowal,Ludhiana. These students were asked to point out any difficulty in understanding the items. Whenever the students pointed out a difficulty, it was noted down and necessary modifications were made. Secondly, the first draft of the statement was given to 12experts.

Sr. No.	Category	No. of experts		
1	Teacher Educators (Teaching of Mathematics) 04			
2	School Teacher's (Teaching Mathematics) 04			
3	Research Scholars	03		
	Total	11		

 Table 1: Expert opinions on First draft of Achievement test in Mathematics

In order to improve the items, comments of the experts were obtained along with their suggestions and opinion. On the basis of their feedback some items were modified and some were deleted. After this exercise second draft of the test was finalized, it consists of total 90 items.

The final draft

The second draft of the test included 90 items. The modified test was administered on 150 students of schools affiliated to Punjab School Education Board, Mohali. These students were from class 9th belonging to Moon light public school,Ludhiana (50); Harsimranpublic school,Ludhiana (50); Govt. Sr. Sec. School Haibowal, Ludhiana (50). The test was administered for the purpose of item analysis. Rapport was established with the group. They were told the objective of administering the test and assured that their responses would be kept confidential and used only for research purpose. Once they were clear about all these, each student was given a copy of Test along with a blank answer sheet on which he/she had to respond. Before responding to the test, the students read the instructions given in the test. They were told that there was no time limit for responding. Each correct response was awarded 1 mark and incorrect was awarded 0 marks. Item analysis was done and two kinds of information, namely item difficulty and discriminating power of items were computed.

For this test, item analysis was carried out in accordance with Kelley's (1939) method. Kelley (1939) showed that by taking upper and lower groups of 27% of total sample, one could say with the greatest confidence that those in the upper group were superior in ability measured by the test to those in the lower group.

Discrimination Index

The discrimination index power, i.e., the validity index an item refers to the degree to which a given item discriminates among them. For calculating the Discriminating power (D.P.) the following formula, was used

$$\mathbf{D} \cdot \mathbf{P} \cdot = \frac{\mathbf{R}_{\mathrm{U}} - \mathbf{R}_{\mathrm{L}}}{\mathrm{N}/2}$$

For calculating the Difficulty Value (D.V.) the following formula, was used

$$D.V. = \frac{R_{U} + R_{L}}{N}$$

Where

 R_{u} = Number of right response in the upper group.

 R_1 = Number of right response in the lower group.

N = Total number of students in both the groups.

For the selection of items the criteria recommended by Ebel (1966) were given due consideration. The evaluation criteria for selection of test items according to index of discrimination power is given in table 2

Index of discrimination power	Item Evaluation
0.40 and above	Very good item
0.20 to 0.39	Good but marginal (usually subject to modification)
Below 0.19	Pooritems

Table 2: Evaluation criteria for selection of test items according to index of discriminating power

The evaluating criterion for determining the difficulty values is summarized in table 3

Table 3: Evaluation criteria for selection of test items according to index of difficulty value

Index of difficulty value	Item evaluation
Above 0.67	Poor item
0.60 to 0.67	Good but marginal (usually subject to modification)
0.20 to 059	Very good item
Below 0.20	Pooritem

Following this criteria, the items which were accepted, modified and rejected from the first draft are given in table below

Table 4: Distribution of discriminating power on the first draft of Achievement test in Mathematics

Sr.No.	D.P.	Frequency	Test Items	Remarks
1.	More	32	1, 8,13,21, 23, 28, 27, 30, 31, 34, 38,	Accepted
	than or		42, 43, 49, 51, 52, 54, 56, 58, 59, 61,	
	Equal to		65, 67,68, 69, 73, 75, 79, 82, 86, 87, 89,	
	0.40			

Sr.No.	D.P.	Frequency	Test Items	Remarks
2.	0.20 to 0.39	43	3,4,5,6,9,10,11,14,15,16,17,19,20,22,26, 32, 33, 36, 37, 39, 41, 44, 46, 47, 48, 50, 53, 62, 63, 64, 66, 70, 71, 74, 77, 78,80,81,83,84,85,88,90	Subject to modification
3.	0.19 &below	15	2,7,12,18,24,25,29, 35, 40, 45, 55, 57, 60, 72, 76	Rejected

Table reveals that 32 items have discriminating power equal to 0.40 or above hence these were selected to be included in final draft, 43 items have D. P. range 0.20 to 0.39. These items were revised and modified and included in the final draft. The remaining 15 items have D.P. below 0.19, hence, these were rejected. Test items having D.P. 0.20 to 0.39 were modified in the light of clarity of language, complexity of content and difficulty level of items.

Table 5: Distribution of difficulty value of the first draft of Achievement test in Mathematics

Sr. No.	D.V.	Frequency	Test items	Remarks
1.	More than 0.67	2	12,25	Rejected
2.	0.60 to 0.67	22	4,9,11,15,16,18,19,26,27,32,36,4 0,53,64,66,70,74,77,78,84,85,90	Subject to modification
3.	0.20 to 0.59	54	1,3,5,6,7,8,10,13,14,17,20,21,22,2 3,28,29,30,31,33,34,35,37,38,41,4 2,43,44,45,47,48,49,51,52,54,55,5 6,58,59,61,63,65,67,68,69,71,72,7 3,75,79,81,82,86,87,89	Accepted
4.	0.19 and below	12	2, 24, 39,46,50, 57,60,62, 76, 80,83, 88,	Rejected

Thus, the items having difficulty value above 0.67 and below 0.20 were rejected. Items having D.V. between 0.20 and 0.59 were accepted as such. The items whose difficulty values were between 0.60 to 0.67 were accepted after revision and modification. Out of 90 items, 54 were accepted as such, 22 revised and modified, 14test items were rejected.

In total, on the basis of D.V's and D.P's 22 test items were rejected, 40 items were modified for inclusion in the test and 28 items were selected as such for the final draft of the test.

Final test items after item analysis

On the basis of selection criteria based on DP and DV value, out of 90 items, 68were selected, which fulfilled both the criteria. Out of 68 items, 34 were related with knowledge level, 20 with understanding and 14 were related to application level.

Reliability and Validity

Split half Reliability

The final draft of the test was administered on 118

students selected randomly from different P.S.E.B. School of district Ludhiana.From the self-correlation of the half tests, the reliability coefficient of the whole test was calculated. The self-correlation of the half tests as found by Pearson's Product moment coefficient of correlation was 0.75. **Face validity**

The final test items were given to 4 experts with a request to state their opinions and judgments regarding the suitability of test items. Experts showed no doubt over any test item, so, in this way face validity was ensured.

Content validity

Content validity was established by approaching 8 experts in the field of Mathematics (4Teacher Educators and 4 School Teacher teaching Mathematics). All the topics were provided to the experts. All the experts have reported that none of the item of the test was deviating from the given topics and content. The Content validity was therefore ensured.

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References

- Craig, T. R. (2008).*The utility of standardized achievement Test scores as a Predictor of Geographic knowledge and Abilities in Undergraduates at an urban Ohio University*. Retrieved on 22 Nov 2010 form http://etd.ohiolink.edu/view.ogi? acc_num=akron 1213040235
- Ebel, R. L. &Frisbie, D. A. (1986).*Essentials of education measurement*. Englewood Cliffs, NJ: Prentice Hall.
- Freeman, F. S. (1960). Theory and Practice of Psychological Testing, New York: Holt, Rinehart & Winston Inc
- Garrett, H. E. (1981). *Statistics in Psychology and Education*. Mumbai: Vakils, Feffer and Simons Pvt. Ltd

- Good, C.V. (1959). *Dictionary of Education*. New York: McGraw hill Co. Inc.
- Kanchan, G. (2009).Construction and standardization of an achievement test on environment concept for Sr. Sec School.
- Kelly, T. L. (1939). Statistical methods in educational measurement. *Journal of statistcis and operational research.9, p17-24.*
- Singh, P. (2005). Effect of Participative Class Room Climate on Academic Achievement of 9th Grade Students in Relation To Learning Approaches in Economics, an unpublished dissertation, Panjab University Chandigarh.

