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Development and standardization of academic achievement test in mathematics for students of 7th standard

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Abstract

The purpose of present paper was to develop and standardize mathematics achievement test for students of 7th standard. In order to evaluate their mathematics progress, the first draft of test comprised of 60 questions that covers all the units of mathematics textbook prescribed for board of school education in Haryana. The first draft after following items analysis consisted of 41 items that were kept in the test for final draft. After the final tryout the questionnaire consisted of 32 items. The test-retest method was used to calculate reliability, and the co-efficient of correlation was found to be 0.84. The concurrent validity of the test was found to be 0.75. Hence, the constructed achievement test in mathematics has a good value of validity and reliability coefficient. The test could be used by the teachers to evaluate student's performance in mathematics.

Keywords: development, standardization, mathematics achievement

Introduction

The word Mathematics is derived from the ancient Greek word máthma, which means "to learn." Mathematics is a methodological process of constructing and organizing information in more testable form that provides perfect explanation of universal phenomena and enable the mankind to predict the universe in better way and mathematics helps in the development of pupils' scientific and analytical skills. Mathematics is a best tool for human society to understand the secret of the universe. It is like a key that unlock all puzzles of nature. We can't imagine our life without mathematics. Mathematics helps us to inculcate problem-solving, flexible thinking, logical and reasoning ability among the mankind. However, students understanding in mathematics remain a significant issue, apart from a few brilliant students from known universities, colleges and schools; it is a general impression that our student's mathematics standards are exceedingly low.

Significant progress in this area could be accomplished if suitable initiatives to strengthen analytical skills are implemented from the very beginning of the schooling. Students can take benefits from achievement tests in mathematics as an achievement test enables the students to know their understanding in a particular subject and helps the teacher to understand about the students learning and equip them to either repeat the topic or to change his/her strategy or methodology of instructions. The achievement test focuses on the achievement of teaching and learning objectives. 2017 (Sharma & Poonam). The educational objectives are evaluated based on the students' final behavior.

Method of Constructing and Standardization of Achievement Test

The knowledge, understanding, application, and skill in mathematics at the secondary school levels are the foundation stone for futuristic mathematical and numerical skills. In mathematics, there is large number of accessible achievement tests. The investigator studied all the available achievement tests in the field of mathematics before designing his own. For the development of the test the investigator kept in mind the most recent syllabi recommended by the Haryana Board of Secondary Education (BSEH.) for mathematics at the seventh grade level. For framing the achievement test, a good number of mathematics textbooks were used as a source material.

The questions were chosen under the assistance and guidance of experienced subject specialists for the seventh grade students. The test items include multiple-choice questions.

Planning stage for the test development

For the construction of an achievement test planning stage is very first and important stage. For better planning, the investigator first kept in mind the standard, teaching method, class level and previous knowledge of the students. First of all the investigator developed a blue print of the test which was followed by objective specification of the test,

content, methodology, number of items, duration of the test, time allotment and marking procedure of the test. For the development of the present achievement test due consideration was given to blooms taxonomy of educational objectives

Objectives of the Achievement test

The aims and objectives of the achievement test were based on bloom's taxonomy of writing objectives in behavioral terms that was mainly focused on knowledge, understanding, application, and skills.

Table 1: Chapter distributions as per bloom's taxonomy

Objectives	Questions	Percentage
Knowledge	13	21.67
Understanding	15	25
Application	18	30
Skill	14	23.33
Total	60	100

Content selection for the test

The second stage in the development of achievement test was selection of the content. Content selection is an important stage in the creation of an achievement test. In the present study investigator selected the following topics for the test construction.

Table 2: Chapter wise content distribution

Unit	Content	Questions	Percentage
1	Number System	15	25
2	Basic Algebra	20	33.33
3	Geometry	15	25
4	Statistics	10	16.67
	Total	60	100

Preparation stage of the achievement test

The preparation stage of the achievement test included following steps

- Questions writing stage
- Experts opinion stage
- Editing of the test items

In preliminary stage, a rough draft based on all the selected units from the whole syllabi was framed. The preliminary draft consisted of 60 questions based on four component of bloom's taxonomy i.e. knowledge, understanding, application, and skill. The draft questionnaire consisted of multiple choice test items. After drafting the test questions were shown to subject experts for further editing, suggestions or replacement of the test items.

Preliminary Draft Try- Out of Achievement Test

The seventh-grade students from various schools were given the test to try out the preliminary draft of the achievement test. At the first stage, the following points were kept into consideration:

- The testing conditions were kept as pleasant as possible for both the researcher and the student.

- Cheating was prohibited in the examination.
- The query of the students was solved by the investigator.

Item analysis was completed after scoring. Item analysis was carried out in order to pick items objectively and scientifically. Item analysis is a method of evaluating the usefulness of test items by looking at the replies of the students. The difficulty value and discrimination power were determined using Kelley (1939) [5] item analysis criteria. The following approach was used to calculate the difficulty value and discriminative index:

- i). After collecting answer sheets of the students these were arranged in descending order.
- ii). From the all cases 27% cases at the bottom formed the lower group and 27% cases of top formed the upper group.

After collecting the answer sheets correct responses for each item were calculated in both the groups. The difficulty value and discrimination index of the test items was calculated by using following formula:

$$\text{Difficulty Value (DV)} = \frac{n_u + n_l}{N}$$

$$\text{Discriminative index (DP)} = \frac{n_u - n_l}{\frac{N}{2}}$$

Where:

n_u = Correct responses in the upper group.

n_l = Correct responses in the lower group.

N = Total number of students.

The test items were analyzed and assessed in first draft to improve the quality of items.

Table 3: No. of test items in the accepted and rejected list.

S. N.O.	F	Item No.	Remarks
1.	41	1, 2, 4, 6, 7, 8, 9, 11, 12, 13, 14, 15, 18, 19, 21, 24, 25, 26, 27, 28, 30, 31, 32, 33, 25, 36, 37, 38, 40, 41, 43, 45, 46, 47, 50, 52, 55, 56, 58, 59, 60	Accepted test items
2.	19	3, 5, 10, 16, 17, 20, 22, 23, 29, 34, 39, 42, 44, 48, 49, 53, 54, 57	Rejected test items

Table 3 shows that 19 items out of total 60 items were rejected while a total of 41 items were accepted for the second draft of the achievement test. Thus, the second draft of the achievement test consisted of 41 test items.

Final Try- Out

For the final tryout achievement test was administered on 50 students randomly. After collecting the answer sheets the item analysis was done in the terms of difficulty value and discriminative index.

Table 4: Discriminative index of the test items

Sr. No.	DP	F	Item No.	Remarks
1.	0.40 and above	23	2, 6, 8, 9, 13, 15, 21, 24, 27, 28, 31, 32, 35, 36, 40, 43, 46, 47, 50, 52, 55, 58	Very good items
2.	0.30 - 0.39	10	1, 4, 12, 19, 26, 30, 33, 37, 45, 60	Reasonably good items
3.	0.20 – 0.29	8	11, 14, 18, 25, 38, 41, 56, 59	Marginal items

Table 4 shows that 23 items were categorized into very good items having discriminative power more than 0.40 and 10 items were in the category of reasonably good items as per

the table given by Ebel (1972).8 items with discriminative index between 0.20 to 0.29 were categorized as marginal items.

Table 5: Difficulty value of the test items

Sr. No.	DP	F	Item No.	Remarks
1.	Above 0.75	3	8, 14, 37	Easy Items
2.	0.50 – 0.75	19	2, 4, 6, 7, 13, 18, 24, 27, 28, 30, 32, 33, 36, 46, 47, 50, 55, 56, 58	Reasonably good items
3.	0.25 – 0.49	13	1, 9, 15, 19, 21, 26, 31, 35, 38, 40, 43, 45, 52	Marginal items
4.	Below 0.25	6	11, 12, 25, 41, 59, 60	Difficult items

As shown in Table 5; 3 items were categorized as very easy items having difficulty value above 0.75 and 6 items were categorized into difficult items having difficulty value below 0.25. And 13 items were categorized as marginal items having difficulty value between 0.25 to 0.49 and 19

items were categorized as reasonably good items having difficulty value between 0.50 to 0.75. After modifying the marginal items, a total of 32 items were retained for the final draft.

Table 6: The selected and rejected items for the final draft

Sr. No.	F	Item No.	Remarks
1.	32	1, 2, 4, 6, 7, 9, 13, 15, 18, 19, 21, 24, 26, 27, 28, 30, 31, 32, 33, 35, 36, 38, 40, 43, 45, 46, 47, 50, 52, 55, 56, 58	Selection items
2.	9	8, 14, 11, 12, 25, 37, 41, 59, 60	Rejected items

Table 6 shows the number of test items that were selected or rejected for the final draft after performing the item analysis of each test items

Reliability

Any test and measuring instrument must have a high level of reliability. The degree of consistency of test scores obtained by the same subject when tested on multiple sets of equivalent items or under other varied examining conditions is referred to as reliability. The reliability of the achievement test was calculated by using test re-test method of reliability. The current test had a reliability coefficient of 0.84

Validity

The test's validity relates to how well it measures what it's supposed to measure. "The validity of a test must be proved prior to its use," Mouley (1970) said. Validation is a part of its creation, not its application to solving a problem." The validity of the test was evaluated in this study by utilizing the concurrent validity approach. Criterion Validity is a subset of concurrent validity. Concurrent validity is a measure of how well a new test compares to an old one. It

can also be referred to the process of testing two groups at the same time or having two groups of people take the same test. A similar test developed by L.N Dubey (1971) [2] i.e. Mathematics Achievement Test was used to calculate concurrent validity of the under development achievement test. Concurrent validity of the test under construction has an r-value of .75. Hence, the constructed achievement test in mathematics has a good value of validity and reliability coefficient. The test could be used by the teachers to evaluate student's performance in mathematics.

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