

Construction of an Achievement Test for the students of VIII class in the Subject of Mathematics



Education

KEYWORDS :

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ABSTRACT

The development of test items is an important stage in the construction of a test as the reliability, validity and objectivity of the test depends upon the test items. In the present paper objective type achievement test according to blue print was prepared. Also an analysis was made to find out the difficulty value and discriminative Index of each item. The nature of questions for achievement test consisted of true false, fill in the blanks and multiple choice questions.

Introduction

An Achievement Test is a test of knowledge or proficiency based on something learned or taught. The purpose of an achievement test is to determine student's knowledge in a particular subject area. The preparation of a good test is a systematic process having well defined stages. In the present study, for developing the achievement test the following procedure was adopted by the investigator

- (i) Planning of the test
- (ii) Preparation of the test items
- (iii) Preparation of Directions regarding the achievement test items
- (iv) Preparation of Directions for scoring and administrating of the Achievement Test
- (v) Administration of the test (Item Analysis)
- (vi) Standardization of Achievement Test

(i) Planning of the test

This is a very important preliminary stage, when investigator needs to consider in detail what exactly investigator wishes to measure, what are the manifestations of achievement test and which circumstantial factors could influence the results of the measurement. It is especially important to define clearly the purpose of the test because that increases the possibility for achieving high validity. The investigator is also supposed to make a decision about the test format, which would be most appropriate for the desired purposes. In the present paper Achievement Test consisted of true false, fill in the blanks and multiple choice questions.

For the preparation of Achievement Test the following points are also of crucial importance

- ❖ Objectives of the Test
- ❖ Content of the Test
- ❖ Preparation of the Blue-print

a) Objectives of the Test

In the present study, for the purpose of constructing Achievement Test, objectives were defined in behavioral terms focusing on Knowledge, Understanding, Application and Skill, from the selected units of Mathematics textbook of class VIII prescribed by C.B.S.E related to topic Mensuration.

b) Content of the Test

At this stage, the investigator has to determine what content is to be tested. In the present paper, the test covered the content of the following units.

1. Area of a Trapezium
2. Area of a General Quadrilateral and a Polygon
3. Area of a Rhombus and a Kite
4. Curved and Total Surface Area of a Cuboid
5. Curved and Total Surface Area of a Cube
6. Volume of a Cuboid
7. Volume of a Cube

8. Curved and Total Surface Area of a Right Circular Cylinder
9. Volume of a Right Circular Cylinder

c) Preparation of the Blue-print

Preparation of the blue print helped the investigator to have an objective based Achievement Test giving due weightage to objectives, content area and forms of questions. To decide the weightage to be given to different content areas, objectives and different forms of questions, experts' opinions of the teachers were taken into consideration.

Table-1: Blue Print of the Achievement Test

| Objectives → Contents ↓ | Cognitive levels of Objectives | | | | Total |
|--|--------------------------------|--------------------|------------------|-----------|------------|
| | Knowl- edge | Under- standing | Applica- tion | Skill | |
| Area of a Trapezium | 1 | 1 | 2 | 1 | 05 |
| Area of a General Quadrilateral and a Polygon | 4 | 6 | 4 | | 14 |
| Area of a Rhombus and a Kite | 4 | 2 | 2 | 1 | 09 |
| Curved and Total Surface Area of a Cuboid | 5 | 2 | 5 | 1 | 13 |
| Curved and Total Surface Area of a Cube | 3 | 3 | 6 | 2 | 14 |
| Volume of a Cuboid | 5 | 3 | 2 | 2 | 12 |
| Volume of a Cube | 2 | 4 | 4 | 2 | 12 |
| Curved and Total Surface Area of a Right Circular Cylinder | 6 | 4 | 1 | 1 | 12 |
| Volume of a Right Circular Cylinder | 2 | 2 | 3 | 2 | 09 |
| Total | 32 | 27 | 29 | 12 | 100 |

(ii) Preparation of test items

After preparation of blue print, the investigator started preparing test items for Achievement Test. The test items included true/false, fill in the blanks, multiple choice questions. Total number of items framed was 100 from the unit 'Mensuration' in the subject of Mathematics of VIII class based on the text-book prescribed by Central Board of Secondary Education. In order to ensure adequate coverage in the test items to achieve the indented purpose of the test items, information based on Experts' opinion, discussion with teachers and Literature already available were taken into account. This enabled the investigator to prepare items covering the entire unit 'Mensuration'. These items were examined by school teachers & experts whose comments about the content, structure and language of the items were taken into account and changes were made accordingly. In this way, the first draft of test was developed.

Table-2: Number of items in the first draft of achievement test at different cognitive levels of objectives i.e Knowledge, Understanding, Application and Skill

| Objectives → Content ↓ | Cognitive levels of Objectives | | | | Total |
|--|--------------------------------|----------------------------|-----------------------|-----------|-------|
| | Knowledge | Understanding | Application | Skill | |
| Area of a Trapezium | 11 (1) | 40 (1) | 73,87 (2) | 72 (1) | 05 |
| Area of a General Quadrilateral and a Polygon | 1,2,34,70 (4) | 14, 35, 36, 38, 39, 42 (6) | 5,6,8,9(4) | | 14 |
| Area of a Rhombus and a Kite | 3,4,41,74 (4) | 7,10 (2) | 13,43(2) | 75 (1) | 09 |
| Curved and Total Surface Area of a Cuboid | 16, 17, 48, 49, 50(5) | 18,52(2) | 21,56,57,86,91 (5) | 94 (1) | 13 |
| Curved and Total Surface Area of a Cube | 20,44,45 (3) | 23,51,81(3) | 54,61,76,78,83,84 (6) | 96,77 (2) | 14 |
| Volume of a Cuboid | 12, 46, 53, 71, 93 (5) | 19,24,92(3) | 88,47 (2) | 79,95 (2) | 12 |
| Volume of a Cube | 25,62 (2) | 15,55,60,82(4) | 22,59,85,90 (4) | 58,80 (2) | 12 |
| Curved and Total Surface Area of a Right Circular Cylinder | 29, 32, 33, 37, 65, 69 (6) | 30, 63, 64, 66(4) | 89 (1) | 97 (1) | 12 |
| Volume of a Right Circular Cylinder | 67,68 (2) | 28,31(2) | 98,99,100 (3) | 26,27 (2) | 09 |
| Total | 32 | 27 | 29 | 12 | 100 |

Note: Figures in parenthesis shows Number of questions.

(iv) Preparation of Directions Regarding the Achievement Test Items

The test was divided into three sections viz. True/False, Fill in the Blanks and Multiple Choice Questions. For the first section, the students were asked to write T for true or F for false. For the second section, the students were asked to respond /write in the blank. For the third section, the students were asked to tick(√) the right answer from the given options.

(v) Preparation of Directions for scoring and Administration of the Achievement Test.

Clear and precise directions were prepared for administration of test. To facilitate the objectivity in scoring, scoring key was prepared for the achievement test.

(vi) Administration of the test (First Try-Out)

After preparing the test items and scoring key, the first try out was administered on a sample of 50 students. The achievement test was administered to VIII class students who had already studied the content. No time limit was fixed for tryout of the test. After the first try out the answer sheets were scored as per the scoring key and scoring directions already prepared by investigator. One mark was assigned to each correct answer and zero to incorrect answer.

Item Analysis: An analysis was made to find out their difficulty value and discriminative Index

Item difficulty: According to Louis Cohen, Lawrence Manion and Keith Morrison the following formula was used for item difficulty:

Where

A = the number of students who answered the item correctly

N = the total number of students who attempted the item.

The maximum index of difficulty is 100 percent. Items falling below 33 percent and above 67 percent were likely to be too difficult and too easy respectively.

Table-3: Distribution of Difficulty Value (D.V) of items of first draft of achievement test

| Level of Difficulty | Items | Total |
|------------------------|--|-------|
| High Difficult (<0.33) | 14,36,39,42,55,60,62,70,88,96 | 10 |
| Medium (0.34-0.66) | 1,2,3,4,6,7,8,9,10,11,13,15,16,18,19,20,21,22,23,24,26,27,29,30,31,32,34,35,38,41,43,44,45,46,47,48,49,50,51,52,53,54,56,57,58,59,61,63,64,65,66,67,68,69,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,89,90,91,92,94,95,98,99,100 | 80 |

| | | |
|-------------|------------------------------|-----|
| Easy(>0.67) | 5,12,17,25,28,33,37,40,93,97 | 10 |
| | Total | 100 |

Discriminative Index

A good item should discriminate between those who score high (top 27% cases) on the test and those who score low (bottom 27% cases). Although there are various similar ways of calculating the discrimination index, in the present study the investigator has followed the following steps for Discriminative Index:

- ❖ Scores obtained by different students were arranged in descending order.
- ❖ The top 27% cases formed the highest group and the bottom 27% cases formed the lower group.

The following formula was used for Discriminative Index

$$DI = \frac{(RU - RL)}{0.5 N}$$

Where

DI = Discrimination index

RU = Number of correct answers among the 27% of those with highest test scores.

RL = Number of correct answers among the 27% of those with lowest test scores.

N = Total number of students in both group i.e highest test scores and lowest test scores.

The higher the discrimination index, the better the item can determine the difference between those with high test scores and those with lowest ones. 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 of the answers according to their D value

| DI | Quality | Recommendations |
|-----------|-----------|-------------------------------|
| > 0.39 | Excellent | Retain |
| 0.30-0.39 | Good | Possibilities for improvement |
| 0.20-0.29 | Mediocre | Need to check/review |
| 0.00-0.20 | Poor | Discard or review in depth |
| < -0.01 | Worst | Definitely discard |

Table-4.1: Distribution of discriminating index of items of first draft of achievement test

| Discriminating Index | Items | Total |
|----------------------|---|-------|
| >.39 | 1,3,6,7,8,13,18,19,21,22,23,26,27,31,32,34,35,38,41,43, 44,45,46,47,48,49,50,51,52,54,56,57,58,59,61,63,64,65,66,68,69,71,73,75,77,78,80,82,83,85,86,87,89,91,92,95,98,99 | 58 |
| 0.30-0.39 | 2,4,9,11,15,16,24,29,30,72,74,76,79,81,94,100 | 16 |
| 0.20-0.29 | 10,12,14,17,25,28,37,53,97 | 09 |
| 0.00-0.20 | 36,39,40,42,55,60,67,70,84,88,90,93,96 | 13 |
| <0.01 | 5,20,33,62 | 04 |
| | Total | 100 |

Table-4.2: Item Analysis Chart (First try out)

| Level of Difficulty → Discriminating Index ↓ | High Difficult (<0.33) | Medium(0.34-0.66) | Easy (>0.67) | Total |
|---|--------------------------------|--|------------------------|-------|
| >.39 | ----- | 1,3,6,7,8,13,18,19,21,22,23,26,27,31,32,34,35,38,41,43,44,45,46,47,48,49,50,51,52,54,56,57,58,59,61,63,64,65,66,68,69,71,73,75,77,78,80,82,83,85,86,87,89,91,92,95,98,99 | ----- | 58 |
| 0.30-0.39 | ----- | 2,4,9,11,15,16,24,29,30,72,74,76,79,81,94,100 | ----- | 16 |
| 0.20-0.29 | 14 | 10,53 | 12, 17, 25, 28, 37, 97 | 09 |
| 0.00-0.20 | 36, 39, 42, 55, 60, 70, 88, 96 | 67,84,90 | 40,93 | 13 |
| <0.01 | 62 | 20 | 5,33 | 04 |
| Total | 10 | 80 | 10 | 100 |

Second Try- Out

After first try out the achievement test was revised and administered on another group of 45 students of class VIII. Same process (same as first try out) was followed for finding difficulty value and discriminating index.

Table-5: Item analysis chart (Final draft)

| Level of Difficulty → Discriminating Index ↓ | Medium(0.34-0.66) | Remarks | Total |
|---|--|-----------------|-------|
| >.39 | 1,3,6,7,8,13,18,19,21,22,23,26,27,31,32,34,35,38,41,43,44,45,46,47,48,49,50,51,52,54,56,57,58,59,61,63,64,65,66,68,69,71,73,75,77,78,80,82,83,85,86,87,89,91,92,95,98,99 | Excellent Items | 58 |
| 0.30-0.39 | 2,4,9,11,15,16,24,29,30,72,74,76,79,81,94,100 | Good Items | 16 |
| Total | 74 | | 74 |

(vii) Standardization of Achievement Test

After item analysis 74 items were selected for the final form of the Achievement Test. The achievement test was further standardised by experimental validation of the test that included establishing reliability and validity.

Reliability of the test

The test retest method was used to calculate reliability. The reliability coefficient of the present test was 0.92. This shows that achievement test has highly reliable.

Validity of the test

In the present paper content validity was determined by inspection of test-items, judgment of subject expert(s) and careful analysis of actual subject-matter studies and instructional objectives against the Blue-Print of the test.

Conclusion

On the bases of the above discussion/findings here we conclude that the items of Achievement Test were distributed over all the units of the instructional objectives: Knowledge, understanding, Application and Skill.

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