Construction and Validation of Achievement Test in Science

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Abstract: *Achievement test is tool for teachers for evaluation of students in school situation. It is a test of knowledge based on something learned. The main purpose of an achievement test is to determine one's knowledge in a particular subject. It helps in measuring the amount of success of an individual in specific field. In school environment it is used as an instrument to measure success of an individual in particular subject or group of subjects. It gives the knowledge about what an individual acquire by testing his abilities. The present study was conducted with the purpose to construct and validate an Achievement test in Science for VIII grade students. The test consisted of 141 items covering all aspects of Science text-book of standard VIII prescribed by JKBOSE(J&K Board of School education). After doing rigorous item analysis, 100 items were retained in the final version of the test. Test-retest reliability was calculated and value of coefficient of correlation was found to be 0.82. Validity of the achievement test was established by Content validity method.*

Keywords: Construction, Validation, Achievement Test, Science, JKBOSE

1. Objective of the Study

To construct and validate the achievement test in Science for VIII standard.

2. Methodology Adopted

The following steps were taken by the investigator during construction and standardization of the achievement test in Science:

- Planning the test
- Preparation of the test
- Administration of the Test /Pilot testing/First tryout
- Final tryout of the test
- Preparing final form of test
- Standardization of test : Establishing Reliability And Validity

3. Planning the Test

Planning of a test is a first and very important step in the construction of an achievement test. A standardized achievement test needs very careful planning. For proper planning of the test, the investigator kept following aspects in mind such as: to whom, what, when and how to measure. It includes designing the test and preparation of the blue print. Keeping in view the above mentioned facts following decisions were taken by the investigator such as:

Designing of the test which 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. In this test investigator opted science subject of VIII standard under JKBOSE for the preparation of the test. In this achievement test, investigator had decided to prepare multiple choice questions (MCQs). After this a blueprint was prepared keeping in view the content area and objectives of learning as per Blooms taxonomy of educational objectives.

(a) Objectives of the test
Objectives in this achievement test were defined in behavioural terms focusing on knowledge, understanding, application and skill, from all the units of science textbook of VIII class prescribed by the JKBOSE.

(b) Content of the test
The achievement test covered the content from all the units of physics, chemistry, and bio-science of Science textbook prescribed by JKBOSE of standard VIII.

(c) Preparation of blue print
After designing preparation of blueprint is the last stage of the planning of test. Here test constructor put various type of question in blueprint and allots them marks depending on the time. The tester writes down his decisions in the form of a blueprint.

Table 1: Blue Print of Syllabus

Content	Units	Knowledge	Understanding	Application	Skill	Total
PHYSICS	Force and pressure	3	3	3	-	**9**
	Friction	2	4	3	-	**9**
	Stars and the solar system	3	2	1	-	**6**
	Sound	3	2	3	-	**8**
	Light	3	3	-	-	**6**
	Some natural phenomenon	3	1	3	-	**7**
CHEMISTRY	Chemical effects of electric current	4	3	1	-	**8**
	Materials: metals and non-metals	4	3	1	-	**8**
	Pollution of air and water	4	2	2	-	**8**
	Combustion and flame	3	6	2	-	**11**
	Coal and petroleum	3	5	2	-	**10**
BIOLOGY	Reproduction in animals	3	5	-	-	**8**
	The cell	4	3	-	-	**7**
	Adolescence	2	4	3	-	**9**
	Conservation of plants	4	2	1	-	**7**
	Microorganisms: friend and foe	3	3	5	-	**11**
	Food production and management	4	4	1	-	**9**
TOTAL		**55**	**55**	**31**	**-**	**141**

Table 2: Distribution of Weightage to Content

Content	Weightage	Percentage
Physics	45	31.9
Chemistry	45	31.9
Biology	51	36.1
Total	141	100

Table 3: Distribution of Weightage to Objectives

Objectives	Weightage	Percentage
Knowledge	55	39.0
Understanding	55	39.0
Application	31	21.9
Total	141	100

Table 4: Distribution of Weightage to Content & Objectives

Content	Knowledge	Understanding	Application	Weightage	Percentage
Physics	17	15	13	45	31.9
Chemistry	18	19	8	45	31.9
Biology	20	21	10	51	36.1
Total	55	55	31	141	100

4. Preparation of the Test

Preparation of preliminary draft of a standardized test includes two stages;

- Item-Writing
- Item-Editing

After careful preparation of the blue print, items were written by the investigator for achievement test. The test item includes only multiple choice questions. The first version of the achievement test was prepared and it included 141 items from all the units of Science of VIII standard based on the text-book prescribed by J&K board of school education. This version of the test was reviewed by the subject experts, science teachers, language experts and specialists. Proposed items were edited, revised and rewritten to refine them as per directions of the experts. In this way, the first version of the achievement test was prepared and it included 141 items which were multiple choice in nature. This version was prepared for pilot testing/ tryout.

Preparation of Directions for the Test Items
There was only one section of the achievement test which includes 141 items of multiple choice in nature. Every statement has four alternatives, the students were asked to tick the right answer from four alternatives.

Preparation of Directions for Scoring and Administration of the Achievement test Clear and precise directions were prepared for the administration of the test and scoring key was prepared in advance for the achievement test.

Administration of the Test /Pilot Testing/First Tryout
The first version of the achievement test was administered to 100 students of 8th class for whom the same was prepared. This testing was done to know the difficulty level of the test and to remove language difficulty faced by the students.

Final Tryout of the Test
The final tryout test was administered to randomly selected 370 students of 8th class from the 13 government and

private schools of three districts namely Samba, Kathua and Jammu. The answer key was collected from the students and after this, collected answer a key was scored by the investigator with the help of scoring key. Each correctly marked response was given mark '1' and wrong attempted response '0'and their scores were collected for item analysis.

Item Analysis

After scoring of test items item analysis was done. Item analysis was conducted in order to appraise the effectiveness of different items. For item analysis, the scores obtained were arranged in decreasing order in order to create two groups namely Upper group (R_u) and Lower group (R_L). Marks obtained by the first 100 students were considered as the students of upper group and the marks obtained by the last 100 students were considered as the students of the lower group.

Item analysis includes following aspects:

- **Difficulty level of item**
- **Discriminatory power of item**
- **Effectiveness of distractors**

Difficulty level of item provides information whether test was too easy or too difficult. It provides the proportion of persons who correctly answer an item. Maximum index of difficulty is 100 percent. Too difficult or too easy items were rejected, i.e. Items with indices of difficulty lower than 20 and higher than 80 were too difficult and too easy. An average index of difficulty from 21-79 were taken. It is calculated by using formula:

$$DL/DI = \frac{R_u + R_L}{T}$$

Where DL/DI= difficulty level/index

R_u = number of students who answers correctly from the upper group

R_L= number of students who answers correctly from the lower group

T = total number of students in both the groups

Discriminatory power of item provides us information to what extent the test was able to discriminate between high and low achievers. A good item should discriminate between those who score high (top 27% cases) on the test and who score low on the test (bottom 27% cases). There are various ways of calculating discriminatory index; the investigator has followed the following steps for the calculation of discriminatory index for the present test

- Scores obtained were arranged in descending order
- Top 27% cases were formed the upper group and the bottom 27% cases formed the lower group.

For the calculation of the discriminatory index following formula was used

$$DP = \frac{R_U - R_L}{T/2}$$

Where DP= discriminatory power

R_u = number of correct answers from upper group

R_L= number of correct answers from lower group

T = total number of students of both the groups

Distractor analysis helps us to know the effectiveness of different alternatives or distractors. After calculating the difficulty value, discriminatory index and distractor analysis, a total of 100 items were selected for final form of test.

Preparing final form of test

Depending on the item analysis, a final form of test was prepared. Out of 141 items, 100 questions were considered as the best questions for the test.

5. Standardization of an Achievement Test

It includes Reliability and validity measures of test. Reliability refers to degree of consistency of test scores. There are various methods such as test-retest, split half, alternate forms, scorer reliability. In order to estimate reliability of present achievement test, investigator used test-retest method of reliability. For obtaining test-retest reliability, the final version of the test was administered over a sample of 120 students and the second administration of the test was carried out after a gap of two weeks. Scores obtained in both the measures were correlated by using product moment method of correlation and the value of coefficient of correlation was found to be 0.82. The value indicates that the test was highly correlated.

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.In which expert judgment was taken into consideration.To estimate content validity of an achievement test, test was given to eight science teachers and six experts to compare test items with the content and objectives of content. Out of the eight experts, four experts have solved the test so the scoring key could be verified. The experts agreed with the investigator with the distribution of content and objective of the content as well as with the scoring scheme. In this way content validity of the achievement test was established.

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