Gurukul International Multidisciplinary Research Journal (GIMRJ)*with* International Impact Factor 8.357
Peer Reviewed Journal
https://doi.org/10.69758/GIMRJ/2505S01V13P004

e-ISSN No. 2394-8426
Special Issue on Scientific Research May'25
Issue–V(I), Volume–XIII

CONSTRUCTION AND STANDARDIZATION OF ACHIEVEMENT TEST IN SCIENCE

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ABSTRACT:
The achievement test in science has been developed for class VIII under Punjab School Education Board by the investigator. The procedure for the development of achievement test in science consisted of Planning, Preparation, Trying Out the Test (Item Analysis, Final Draft of the Test, Administering the Test over the norm group under uniform conditions), Evaluating the Test (Scoring the Test answer as per scoring key, Deriving norms and other statistical measures, Evaluating the quality of the Test- Validity, Reliability and Objectivity of the Test). The test initially consisted of 124 items and after following the steps for standardization the test consisted of 60 items.
KEY WORDS: Achievement, Test, Construction, Standardization, Science.

1.INTRODUCTION

One of the most crucial elements in the development of a country is high-quality education. Education being a tool to diminish illiteracy, poverty, superstition, ignorance and conflict, education is today recognized as being essential for realizing the ideas of peace, love, freedom and social justice. Additionally, it is necessary to foster and grow one's interest and enjoyment of learning. The method of teaching and general learning environment has a significant impact on effective learning. Moving quickly in the current era of liberalisation, privatisation and globalisation (LPG). In order to survive under these conditions, one must be innovative, a trailblazer and a developer in addition to having the skills and mindset to deal with day to day issues. Students cannot develop these necessary characteristics through the current method based education system. Education, including its three pillars of teacher, student and curriculum must change to reflect the changes in society. Changes to these three pillars should be made while keeping teaching strategies and evaluating the knowledge of students in mind. Hence, good tools of evaluation are the prime requirements of any learning process. Achievement tests play an important role in fulfilling the requirement of evaluation.

The term "Achievement" describes the marks, degree of proficiency or grade a student achieves in a given topic. It gauges how well students have learned, understood, applied and improved their skills as a result of receiving instruction in a particular subject from a teacher. Crow and Crow (1969) defined Academic Achievement as the degree to which a student is benefiting from teaching in a certain area of learning or the event to which a skill or knowledge has been transferred. Horrock (1969) defined Achievement as "the state or level of an individual's talent, the breadth and depth of his knowledge and his proficiency in a particular

area of learning and conduct". Landson and Billings (1999) states Academic Achievement at its best symbolises intellectual development and the capacity to contribute to the creation of knowledge; at its worst, academic success represents the mindless indoctrination of the young into the orthodoxy of the old. What a person has attained in the past is usually quite a good indicator of his future ability (Aiken, 1985). Thus, an achievement test helps to test or determines the knowledge in different domain in a particular subject area.

1.1 Construction of achievement test

A Criterion Referenced Test measures student's Achievement based on certain criteria or standard. It is not the informal form of the test or the simple class test taken by the class teacher. A proper set pattern has to be followed for the standardization of any test. Starting from setting of instructional objectives for the selected content, various approaches, method and techniques to be used in teaching, time period for the conduct of the test, various physical conditions and the evaluation procedure should be standardized.

For the present study, a Criterion Referenced Test was prepared by the investigator. Certain topics were selected from syllabus of VIII class prescribed by Central Board of Secondary Education, New Delhi. The investigator set various objections on the selected topics of Science which the students have achieved after the completion of the teaching learning process.

1.2 Purpose of constructing achievement test

The purpose of constructing an achievement test in science was to measure the achievement of students in science of VIII class prescribed by Punjab School Education Board. The focus is to check the practical knowledge gained to be used in day to day life of the students.

1.3 Target population

For the present study, a Criterion Referenced Test was prepared on certain topics from syllabus of VIII class prescribed by Central Board of Secondary Education, New Delhi.

1.4 Test Items

Considering the content and instructional objective formed, blueprint of test was prepared. The blueprint prepared considers the three dimensions i.e knowledge, understanding and application. Multiple choice questions were preferred for the test as these are considered to be superior. Multiple choice questions are easy to answer, requires less time, keeps students interested and are better than others.

1.5 Steps of construction of achievement test

The Standardization involves following steps:

1. Planning the Test
2. Preparing the Test
3. Trying Out the Test
   - Item Analysis
   - Final Draft of the Test
   - Administering the Test over the norm group under uniform conditions
4. Evaluating the Test

- Scoring the Test answer as per scoring key
- Deriving norms and other statistical measures
- Evaluating the quality of the Test(Validity, Reliability and Objectivity of the Test)

1.5.1: Planning the Test

Before constructing the Achievement Test in Science, the prescribed syllabus for VIII class by Central Board of Secondary Education, was thoroughly studied. The investigator had gone through various Science books and Achievement Tests prepared and standardized earlier by different investigators. The investigator had discussed with various Science experts teaching in Government, Aided and Private Schools as well as experts of Science in different Colleges. Efforts were put by the investigator to identify the important concepts of VIII class Science subject. Considering the content and instructional objective formed, blueprint of test was prepared. The blueprint prepared considers the three dimensions i.e knowledge, understanding and application. Multiple choice questions were preferred for the test as these are considered to be superior. Multiple choice questions are easy to answer, requires less time, keeps students interested and are better than others. Ziedner (1987), Backer and Johnson (1999).

1.5.2: Preparing the Test

After making proper planning about every aspect of the test preparation was started by the investigator. A preliminary draft was made by the investigator including questions from knowledge, understanding and application domains. The preliminary draft consisted of 124 items from various topics of Science. A response sheet and the scoring key were simultaneously prepared along with the test items.

For selection of items, various textbooks of Science prescribed by CBSE for VIII class students were examined carefully. The following points were kept in mind while assembling the items of the test:

- The objectives formed were given due consideration
- The Test items covered the topics selected from syllabus properly
- The Science teaching staff of various schools were consulted.

Table: 1.1: Concept wise Distribution of Items included in the Preliminary Draft

S.NO	Name of the Concepts	No. of Items
1.	Microorganisms: Friend and Foe	12
2.	Synthetic Fibres and Plastics	09
3.	Material: Metals and Non- Metals	11
4.	Conservation of Plants and Animals	13
5.	Cell- Structure and Functions	16
6.	Force and Pressure	13
7.	Friction	12
8.	Sound	12
9.	Some Natural Phenomena	11
10.	Pollution of Air And Water	15

	Total	**124**

Table: 1.2: Objective wise Distribution of Items included in the Preliminary Draft

S. No.	Objective	No. of Items
1.	Knowledge	51
2.	Understanding	48
3.	Application	25
	Total	**124**

The Test containing 124 items was shown to different experts in various Schools, Colleges and Assistant Professors from B.Ed Colleges. Their opinions and suggestions were taken very deeply and seriously by the investigator. Each item was evaluated by the experts in terms of the language difficulty, vagueness and ambiguous terms.

1.5.3: Try Out of the Test

Step I: Individual Try Out:

The test was administered on a student in our own Family of IX class who had just passed VIII from CBSE. The individual was viewed very keenly by the investigator during the conduct of the test. Various points where the individual felt any difficulty such as difficult word, not understanding the meaning etc. were modified in the light of the feedback provided by the individual. The revised test after the individual try out consisted of 100 items.

Step II: Small Group Try Out:

After the individual try out, the first draft of the test consisting of 100 items was administered on a small group of 10 students. These students were given similar conditions after establishing a good rapport with them and were noted keenly by the investigator. There was no time limit set by the investigator.

Step III: Final Try Out (Large Group Try Out) for the Draft:

After the small try out, final try out of the test consisting of 85 items was done on 100 students of IX (who have just passed their VIII class) class as they have covered the whole topics in the VIII class. These students were given similar conditions after establishing a good rapport with them and were noted keenly by the investigator. There was no time limit set by the investigator. The students were given question booklet and answer sheet. The scoring was done according to the scoring key manually by the investigator. Each correct answer was given one mark and there was no negative marking.

1.5.4: Evaluation of the Items:

The evaluation of each item was done by calculating the Difficulty Value and the Discriminatory Power for each item.

Item Analysis:

Item Analysis uses statistics and expert judgment to evaluate tests based on the quality of individual items, item sets and entire sets of items, as well as the relationship of each item to other items. It "investigates the performance of items considered individually either in relation to

some external criterion or in relation to the remaining items on the Test" (Thompson & Levitov, 1985, p. 163). It uses this information to improve item and Test quality.

Item Analysis of the Test is fundamentally done to discover ambiguities, pieces of information, incapable distracters and specialized deformities that may have been over looked during Test development. Also, it yields two sorts of data; in particular records of thing, for example, Difficulty Value and Index of Discrimination. The appropriate response sheets were assessed and arranged in sliding request of scores. Kelley (1939) criteria of Item Analysis were utilized to discover the Difficulty Value and Discrimination Power.

Difficulty Value:

Difficulty Value of Test items provides the extent to which the Test item is doing its job. It expresses difficulty or the percent of responses which are correct. The higher the numerical values of the Index of Difficulty the easier the item (Ebel, R.L.,1965). The Difficulty Value of an item refers to the proportion of certain sample of subjects who actually knows the answer of an item. Difficulty Value of an item ranges from 0 to 1. The larger value, the easier is the item.

Difficulty Value (D.V) = R_H+R_L/N OR $\frac{R}{T}$

Where R_H = No. of correct responses in Higher Group
Where R_L = No. of correct responses in Lower Group
N= total no. of students in both the Groups
T= total no. of students who attempted the Item

Discriminating Power:

Discriminating Power or Discrimination Index is a basic measure which refers the extent to which a test item discriminates or differentiates between students in high and low group. Discriminating Power is the degree to which single item separates the superior from the inferior individuals in the traits or group of traits being measured. Discrimination Index is defined as the index of discrimination between superior and inferior item. An item can have positive, negative or no Discrimination Index. The Discrimination Index or Discriminating Power of an item can be calculated by using the following (Ebel, R.L/1965, p.347)

Discriminating Power (D.P) = R_H-R_L/$\frac{N}{2}$

Where R_H = No. of correct responses in Higher Group
Where R_L = No. of correct responses in Lower Group
N= Total no. of Students in both the Groups

Final Draft of the Test

On the basis of Difficulty Value and Discrimination Power 25 items were deleted. The Final Draft of Achievement Test in Science consisted of 60 items from the content selected in Science subject of VIII class.

Table 1.3: Concept wise Distribution of Items included in the Final Draft

S.NO	Name of the Concepts	No. of Items
1.	Microorganisms: Friend and Foe	04
2.	Synthetic Fibres and Plastics	05

3.	Material: Metals and Non- Metals	04
4.	Conservation of Plants and Animals	09
5.	Cell- Structure and Functions	05
6.	Force and Pressure	06
7.	Friction	07
8.	Sound	06
9.	Some Natural Phenomena	09
10.	Pollution of Air And Water	05
	Total	**60**

Table 1.4: Objective wise Distribution of Items included in the Final Draft i.e. Blueprint of Achievement Test in Science (Final Draft)

Objectives	**Knowledge**						**Understanding**						**Application**						**Total**
Topics	B	MCQ	A	M	O	P	B	MCQ	A	M	O	P	B	MCQ	A	M	O	P	
1 Force	2	1							1					2					6
2 Friction	1	2					1	1	1							1			7
3 Cell	2								1	1							1		5
4 Sound	1	2						1	1					1					6
5 Micro-organism	1	1					1	1											4
6 Material	1	1						1						1					4
7 Natural Phenomenon	1	2	1	1			1	1						1				1	9
8 Conservation of Plants and Animals	2	4								2				1					9
9 Synthetic fibres	1	1						3											5
10 Pollution	1	1	1				1							1					5
TOTAL	**13**	**15**	**2**	**1**			**4**	**8**	**4**	**3**				**7**	**0**	**1**	**1**	**1**	**60**

B – Blank, MCQ – Multiple Choice Questions, A –Alternate (True/False), M – Matching, O – Order formation, P – Picturization.

1.6: Time Limit of the Test

The time taken by the students should be standardized to avoid any disturbance, irregularity and indiscipline in the class. After keenly observing the time during Try Outs of the Test, the investigator considered the average time taken by the students was 60 minutes.

1.7: Reliability of the Test

Reliability is the consistency of person's scores on a series of measurement. Reliability is essential to the effectiveness of any data gathering procedure (Best & Khan, 1989). It refers to the consistency of the scores obtained by the same individual when re-examined with the same

Test on different occasions or with different sets of equivalent items or under the valuable examining conditions (Anastasi, 1982). Guilford (1967) defines reliability as the proportion of true variance in the observed Test scores. The Reliability estimates the reproducibility of Test scores. There are different methods for calculating the Reliability of the Test. In these different methods of calculating Reliability one method and sometimes other method will provide the better measure.

There are four procedures in common used for computing the Reliability Coefficient of a Test. These are:

1. Test- Retest (Repetition)
2. Alternative or Parallel form method
3. Split- Half method.
4. Rational Equivalence Method

The Reliability of this Test was calculated by using Test- Retest method. The Test–Retest method is found to be convenient as compared to the other forms of the Reliability methods. The Alternative or the Parallel form method was not amendable as the investigator had not formed any Parallel form of the Test. Splitting of the scores of the same Test into two different halves seems to be little odd in Split- Half method. So this method was used for calculating the Reliability of the Achievement Test in Science. The Rational Equivalence method is not very easy to be followed as the investigator has selected the content and the items are formed on certain basis. So using the Equivalence method for calculating the Reliability of the Achievement Test in Science was not followed. Thus, only the Test- Retest method seems to suit the situation better than any other method.

In the present study the Reliability of the Achievement Test was ensured through Test-Retest method. The Test-Retest method was conducted on 50 students for calculating the Reliability of the Test. The second time Test was applied on same 50 students after a gap of 2 weeks. The Reliability (Product Moment Coefficient of Correlation) of the Achievement Test in Science came out to be 0.82.

Table 1.5: Reliability of Achievement Test in Science

Reliability Method	Number of Items	Reliability Value
Test – Retest method	85	0.82

1.8: Validity of the Test

Validity means truthfulness. Validity of a Test refers to the degree to which it measures what it intends to measure. The Validity of a Test, or of any measuring instrument depends upon the fidelity with which it measures what it purports to measure. A Test is valid when the performances which it measures correspond to the same performances as otherwise independently measured or objectively defined. A Test is valid for a particular purpose or in a particular situation only. The Achievement Test of Science was validated against the criteria of "Content Validity" and "Face Validity". The Face Validity of a test means the test measures what it appears to measure. The Content Validity of a Test is employed in the selection of items in

Achievement Tests and in many trade Tests. The Content Validity of the Test was determined by giving the Test to various experts in the subject matter. Thus, the Test was determined to be valid in terms of Face and Content.

1.9: Scoring Key for Achievement Test in Science

A scoring key was developed by the investigator before the try outs. The scoring key was given to the experts along with the preliminary draft test items. The scoring of the answer sheets was done by the investigator herself manually according to the answer key. All the correct answers are given one mark and there was no negative marking for any wrong answer.

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