



ORIGINAL RESEARCH PAPER

Education

CONSTRUCTION AND STANDARDIZATION OF ACHIEVEMENT TEST IN SCIENCE

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Renu Bala

Research Scholar, Panjab University, Chandigarh, India

Dr. Gurmit Singh*

Associate Professor, Malwa Central College of Education, Ludhiana, Punjab, India.
*Corresponding Author

ABSTRACT

The achievement test in Science has been developed and standardized by the investigator for class IX under Punjab School Education Board. The procedure of the development of achievement test in Science consists of planning, preparation, item selection, tryout, scoring and item analysis. The test initially consisted of 180 items, after discussion with experts and administration on students the items were reduced to 90. After thorough item analysis the final draft of the test consisted of 60 items.

1. Introduction

Knowledge of the progress of the students as well as redesigning the strategies of teaching according to the needs of the students has always been a matter of concern for the teachers. Hence, testing and evaluation have always been integral parts of the teaching learning process. Teaching learning process without evaluation turns out to be meaningless and hence good tools of evaluation are the prime requirement of any learning process. Achievement tests play an important role to achieve this objective in education. It is a mechanism to measure students' knowledge and abilities and provide a snapshot of students' performance. It is the accomplishment of proficiency of performance in a given skill or body of knowledge. Therefore, it can be said that achievement implies the overall mastery of a pupil in a particular context.

An achievement test is a test of knowledge or proficiency based on something learnt or taught. The purpose of an achievement test is to determine students' knowledge in a particular subject area. It helps in evaluating the effectiveness of teaching instructions. It also provides the feedback to the students as well as to the teachers. The achievement test has the focus on the realization of objectives of teaching and learning. The test scores are used to ascertain the level of further instruction to the student learner. High achievement scores indicate a mastery grade level material and the readiness for advanced instruction. Low achievement scores point towards the need for remedial teaching or repetition of the course. According to Kuh, Kinzie, Buckley, Bridges, and Hayek (2006) academic achievement is defined as students' success in educationally purposeful activities, acquisition of desired knowledge, skills and competencies, persistence, attainment of educational outcomes and post college performance. According to Craighead and Charles (2001) academic achievement may be defined as a measure of knowledge and understanding of skills in a specified subject or a group of subjects. Whereas according to Shelat (2015) academic achievement refers to the scholastic achievement at the end of the academic year evaluated by some standardized achievement tests. Before constructing the achievement test the investigator reviewed the various tests already available for testing in the field of Science. After reviewing them need was felt to develop an achievement test based on the latest syllabus recommended by Punjab School Education Board for Science at IX level. To achieve the said purpose various tests were consulted, discussions were held with Science teachers and experts in the field of teaching both at school and college level.

1.1 Construction methodology of achievement test

Achievement test in Science was developed with an objective to evaluate the knowledge, understanding and application of the content matter achieved by secondary class students. Before constructing the achievement test topics pertaining to class IX under Punjab School Education Board were thoroughly analyzed and previous board papers were went through. Experts in the field with Science and assistant professors from various teacher

education institutes were concerned for their valuable opinions to plan the achievement test for Science.

1.2 Purpose of constructing achievement test

The purpose of achievement test was to measure the achievement of secondary school students under Punjab School Education Board in the subject of Science.

1.3 Target population

This achievement test is meant for those students who have just passed IX class under Punjab School Education Board.

1.4 Types of test items

The achievement test consists of all the multiple choice test items related to the selected topics devised by the investigator as these test items are supposed to be more reliable for assessing the achievement of the students. Burton, Sudweeks, Merrill, and Wood (1991) gave rules while writing multiple choice test items which are as follows

1. Construct each item to assess a single written objective
2. Base each item on a specific problem stated clearly in the stem
3. Include as much of the item as possible in the stem, but do not include irrelevant material
4. State the stem in positive form
5. Word the alternatives clearly and concisely
6. Keep the alternatives mutually exclusive
7. Keep the alternatives homogenous in content
8. Keep the alternatives free from clues as to which response is correct
 - Keep the grammar of each alternative consistent with the stem
 - Keep the alternatives parallel in form
 - Keep the alternatives similar in length
 - Avoid textbook, verbatim phrasing
 - Avoid the use of specific determiners
 - Avoid including keywords in the alternatives
 - Use plausible distractors
9. Avoid the alternatives "all of the above" and "none of the above"
10. Use as many functional distractors as are feasible
11. Include one and only one correct or clearly best answer in each item
12. Present the answer in each of the alternative positions approximately an equal number of times in a random order
13. Lay out the items in a clear and consistent manner
14. Use proper grammar, punctuation and spelling
15. Avoid using unnecessarily difficult vocabulary
16. Analyze the effectiveness of each item after each administration of the test

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
- Item analysis
- Standardization of the test
- Reliability
- Validity

2. Planning of the test

Planning is the first and the most crucial part of organizing any activity. An achievement test also needs careful planning for its construction. Careful planning of the achievement test was done while deciding the sample for which achievement test was to be made, content, objectives of the test, duration of the test, difficulty level of the test, administration procedure and scoring etc. For this thorough study of the National Council of Educational Research and Training Science for IX class was done. After this a blueprint was prepared keeping in view the content area and objectives of learning as per Bloom's taxonomy of educational objectives.

2.1 Objectives of the test

Objectives in this achievement test were defined in behavioral terms focusing on knowledge, understanding and application from the 6 units of Science curriculum of IX class prescribed by Punjab School Education Board.

S. No.	Objective	Percentage of items measuring objective
1.	Knowledge	82
2.	Understanding	58
3.	Application	40

2.2 Content of the test

Subject matter of class IX Punjab School Education Board was thoroughly analyzed for the construction of achievement test in Science. Six chapters, two each from the three different branches of Science i.e. physics, chemistry and biology were taken to have a well proportionate test covering all the disciplines of Science.

Unit	Name of the Unit	Number of the Items
2.	Force and Laws of Motion	30
3.	Matter in our Surrounding	30
4.	Is matter around us pure?	30
5.	Fundamental unit of life	30
6.	Tissue	30

2.3 Size of the test

Size of the test refers to the number of test items contained in the test. A good lot of test items is always advisable keeping in view the future screening during the process of the successive try-outs. Moreover, it also adds to the reliability of the test. Therefore, first version of achievement test was prepared with 180 items.

2.4 Preparation of the blueprint

Blue print serves as the guidelines to ensure if each objective is given due consideration or not. It also assures the proportionate division of all the units taken in the achievement test. The investigator prepared the blue print consisting of 180 items which are shown as below

3. Preparation of the test

Preparation of the achievement test needs diligent and intelligent working. It includes mainly three steps

- Item writing
- Checking by experts
- Item editing

After thoroughly analyzing the content matter the investigator prepared a preliminary draft of achievement test comprising of 180 items. Due consideration was given on covering the major objectives of teaching that is knowledge, understanding and application in Science at secondary stage. Each item was fed with 4 options in which only one option was the appropriate answer. Here the students were expected to answer the questions by selecting the right option from among the four listed responses. This test was given to 5 Science teachers from the schools of Punjab School Education Board to view the content and language

of the test critically, correct the ambiguity if any, ensure whether the test covers all the objectives and give suggestions for the improvement of the test. Scoring key was also made for the preliminary draft. The feedback and suggestions from the experts prove to be bacon light and 52 test items were removed from the test a test consisting of 128 items was prepared.

4. Administration of the test

4.1 Individual try out

The test was administered on a student of X class who had just passed IX from Punjab School Education Board. Problematic test items in terms of understanding the statement or difficult words were noted down resulted in the removal of 14 test items. The revised test after individual try out came out to have 114 test items.

4.2 Small group try out

The test was administered to 35 students of class X studying in Government Senior Secondary School, Jalandhar (Punjab, India) who had already studied the selected content. This attempt was made to check the difficulty level as well as to remove language problems faced by the students if any occurring in the construction of the test. The test was again revised considering the problems faced by the students and the language difficulty faced by them. 24 items were removed from the test during this process and five items were changed grammatically. After revision the test came up with a total test items count of 90.

4.3 Final try out of the test

Final draft of the achievement test with 90 test items was administered to a total sample size of 150 students of X class of Punjab School Education Board of three different schools of Jalandhar district of Punjab (India), who had already studied the content of the test. After the completion of the tests, the test papers were collected back. The scoring was done with the help of answer key prepared by the investigator. For every correct response one mark was given. No score was provided for wrong and attempted answers. Analysis of the performance of students was based on the scores obtained by them.

5. Item Analysis

Scoring was followed by item analysis. Item analysis is a statistical technique which is used for selecting and rejecting the items of a test on the basis of their difficulty value and discriminative value. It was done to retain the best items in the test and remove the inappropriate ones.

$$\text{Difficulty value } (Dv) = \frac{R_U - R_L}{N/2}$$

$$\text{Discriminative power } (Dp) = \frac{R_H - R_L}{N/2}$$

Where:

RU= Number of right responses in the upper group

RL= Number of right responses in lower group

N= Total number of students

On the basis of difficulty value and discriminating power a total of 60 items were selected for the final draft.

Objective-wise distribution of items included in the final draft is depicted below:

Unit No.	Name of the Unit	Knowledge	Understanding	Application	Total
1.	Motion	4	5	1	10
2.	Force and laws of motion	6	4	2	12
3.	Matter in our surroundings	5	5	1	11
4.	Is matter around us pure	4	2	2	8
5.	Fundamental unit of life	5	2	2	9

6.	Tissues	6	2	2	10
	Total	30	20	10	60

6. Reliability

Reliability 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, 1951). While according to Chakrabartty (2013), reliability measures consistency, precision, repeatability and trustworthiness of a research. In the present study the reliability of the achievement test was ensured through test-retest method. The reliability study of achievement test was conducted over a sample of 50 students. The second administration of the test was carried out after a gap of 2 weeks on the same group of students. The product moment coefficient of correlation for the two test scores was found to be 8.71

7. Validity of the test

Validity is defined as the extent to which a concept is accurately measured in a quantitative study (Heale & Twycross, 2015). While according to Robson (2011) validity of a research instrument assess the extent to which the instrument measures what it is designed to measure. It is the prime requirement of any kind of test. The test was validated against the criteria of "content validity" and "face validity". The content validity is concerned with the relevance of the contents of the items, individually and as a whole. The face validity refers to the extent a test measures what it appears to measure. To determine content validity and face validity of the achievement test was given to 10 Science teachers and five experts from teacher education institutes.

REFERENCES

1. Anastasi, A. (1982) Psychological Testing. 5th Ed., New York: Mac Millan Publishing Company, 135.
2. Burton, S.J., Sudweeks, R.R., Merrill, P.F. & Wood, B. (1991) How to prepare better multiple choice test items: Guidelines for university faculty. Brigham Young University Testing Services and The Department of Instructional Science. Available at <https://testing.byu.edu/handbooks/betteritems.pdf>
3. Chakrabartty, S. N. (2013). Best Split-Half and Maximum Reliability. IOSR Journal of Research & Method in Education, 3(1), 1-8. Available at <http://www.iosrjournals.org/iosr-jrme/papers/Vol-3%20Issue-1/A0310108.pdf>
4. Craighead, W.E. & Charles, B.N. (2001). The Corsini Encyclopedia of Psychology and Behavioral Science. New York: Wiley and Sons.
5. Heale, R. & Twycross, A. (2015). Validity and Reliability in quantitative studies. Evidence-Based Learning, 18(3), 66-67. Available at <https://ebn.bmj.com/content/ebnurs/18/3/66.full.pdf>
6. Kelley, T.L. (1939). The selection of upper and lower groups for the validation of test items. Journal of Educational Psychology, 30(1), 17-24. Available at https://www.researchgate.net/publication/232494422_The_selection_of_upper_and_lower_groups_for_the_validation_of_test_items
7. Kuh, G.D., Kinzie, J., Buckley, J.A., Bridges, B.K., & Hayek, J.C. (2006). What matters to student success: Review of the Literature, mission report for the national symposium on post secondary student success, spearheading a dialogue on student success Washington, DC: National Secondary Education Cooperative. Available at https://nces.ed.gov/npec/pdf/kuh_team_report.pdf
8. Robson, C. (2011). Real World Research: A Resource for Users of Social Research Methods in Applied Settings, (2nd Ed.). Sussex, A. John Wiley and Sons Ltd.
9. Shelat, N.A (2015). A study of the factors affecting academic achievement of Bangladesh primary school children of Dhaka city. Unpublished Ph.D. thesis, Maharajaraja Sayajirao University, Baroda.