Achievement Test:
How it Can be a Reliable and Valid Tool in Educational Research?

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Abstract

The development of achievement test is a crucial part of experimental and developmental research in the field of education. A consistent and accurate achievement est can enumerate the certified outcome of participants. The present study deals with the construction of an achievement test in a systematic manner and logical technique for the pupils of Class VIII in geography. In the present investigation, objective type achievement test with blueprint was prepared and an enquiry was completed to find out the difficulty level and discriminative index of each item. The nature of questions for achievement test consisted of true or false or fill in the blanks and multiple choices. This study can be useful for analysts, educators and other related professionals to set up a reliable and valid achievement test. The study uncovered that the scholastic achievement test for segment instruction is consistent and appropriate.

INTRODUCTION

An achievement test is an assessment of acquired ability or understanding. The most well-known kind of achievement test is a standardised test created to identify the ability or understanding learned in a particular class, normally through strategic instruction or curriculum transaction. Achievement test is different from tests that measure inclination, a progressively broad and stable psychological trait. Scores of achievement test show the scholastic

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status of the individual learner in various subjects in a general or specific sense.

Achievement shows how much the students get benefited by a scholastic programme (Ozguven, 1998). In instructive investigations, numerous assessment devices like interviews, questions, idea maps, and achievement tests may be utilised to decide the degree of learners' comprehension of information and ideas. From qualitative point of view, achievement test can deal with less members, empowering more detailed research and from quantitative perspective a large number of students can deal with (Griffard, 2001).

The purposes of achievement test are:

(i) Achievement test estimates the present capability, authority and comprehension of general and explicit subject matters.

(ii) It endeavours to quantify what and how an individual has learnt, viz., the present standard of execution.

(iii) It assists with estimating some part of the scholarly skills of learners: what a learners know any be able to do.

(iv) It assists with discovering where every learner remains in different scholarly regions.

(v) It motivates the students before a new task is taken up.

(vi) By examining the consequences of the learners on achievement tests, the instructor can decide whether or not the learners are working as per their most extreme limit.

(vii) Achievement tests are utilised for assessing and improving the educational programmes meant for learners at different grade levels.

(viii) Achievement test is intended to recognise the a various categories of achievers, as consequence of which the instructors or guidance workers have the option to plan advancement programme for the learners.

(ix) Achievement tests are useful to recognise and characterise the learners in different groups based on their accomplishment.

(x) Achievement tests are expected to promote learners to the next higher classes or new courses considering the obtained result as a measuring stick for advancement of the structures.

(xi) Achievement tests are utilised to empower the guardians to know the strength and weaknesses of their children in academic accomplishments, by which they can have the option to give unique assistance and direction to their children.

(xii) It uncovers students' academic troubles which can be comprehended by the instructors.

(xiii) Achievement test scores are very useful indicators for professional direction since these are mostly related to aptitudes and interests.

In such circumstances, the achievement test should be based on efficient testing system in every school, by which administrators can undertake appropriate guidance service for every pupil.

Reliability is the level of precision by which an exam or accomplishment test measures, what it internals to measure with a given variable. An achievement test with good reliability implies that the test taker will get a similar test score over repeated testing as long as no external variable have influenced the score. The quality of an achievement test which estimates what it should measure is known as validity. An achievement test is legitimate when it produces reliable scores over time. It estimates what it internals expects to measure.

The study aims to construct an achievement test in which the consistency and accuracy are confirmed and the test can determine the accomplishments of Class VIII elementary school students during their study period and their self-assurance to learning for the 'Inside and Outside of the Earth' topic. The study was conducted at Radhanagar Junior High School, Howrah, West Bengal.

Rationale

The term 'achievement' signifies one's learning fulfilments, achievements and proficiencies, which are identified with the student's status of instructive improvement. It is a precise strategy for measuring students learning through instruction. Achievement test is a significant apparatus in assessment and has incredible importance in estimating instructional advancement.

Asamoah and Ocansey (2019) reported that in any event, when rules for building reasonable and efficient tests are followed, several items may go into students' impression of the test and cause mistakes in the appraisal. Item discrimination consequently assists the examiner in deciding what is inaccurate with the items. It is consequently clear that discrimination analysis offers empirical statistics which in turn shows how items and the entire tests are performing in genuine circumstances. Barakat (2019) accepted that achievement tests administered at national level asserts pressure and difficulty in the livers of test-takers. He encouraged that so as to cope with the question of fairness, it is crucial to really define and balance the construct of the items that affect the student's choice. Yazar and Nakiboglu (2019) built up a substantial and dependable test concerning the content of 'nature and chemistry' for Class IX. They proposed that achievement test can be utilised by instructors or the specialists to decide the learners' understanding levels or level of achievement. Khanum and Dange (2018) developed a solid and substantial achievement test in social science, which was institutionalised on the sample of 50 pupils from Class IX. They uncovered that achievement test can be utilised

by the educators to evaluate learners achievement in mindfulness about the essential 'Duties of Constitution' of Class IX. Kunwar (2018) uncovered that achievement test can be a useful instrument to quantify students' performance in Class X mathematics and an institutionalised achievement test can be prepared by setting up difficulty value, discrimination index, reliability, validity and norms. Parekh (2018) mentioned that achievement test assists with measuring the learners knowledge in science subject of Class VIII. Sener and Tas (2017) found that achievement test can assist students with organising their learning exercises as per their strength and weakness in the fifth grade biology subject. Anandharaja, Balakrishnan and Lawrence (2016) revealed that institutionalised and legitimate achievement test is a critical research device that assists with estimating the scholarly achievement of Class X students in social science. Kara and Çelikler (2015) reported that a powerful and dependable test including 32 inquiries with transitional difficulty level and differentiation quality were prepared in science subject. Bichi, Embong and Mamat (2015) found a noteworthy positive relationship between item difficulty and discrimination index of the achievement test in their study.

While reviewing the literature, it was found that studies related with achievement test with were carried out with Class V (Sener and Tas, 2017; Kara and Çelikler, 2015); Class VI (Inel, 2010); Class VII (Yildirim, 2012), Class VIII (Parekh, 2018); Class IX (Khanum and Dange, 2018; Yazar and Nakiboglu, 2019) and Class X (Kunwar, 2018; Anandharaja, Balakrishnan and Lawrence, 2016) and with the senior secondary stage (Bichi, Embong and Mamat, 2015). Achievement test is an important requirement for most of the educational research. Hence, it has to be important that a researcher is well acquainted with the procedure of conducting achievement test for any given grade of any given curriculum. Thus, this article details the way a test can be constructed and standardised in any given grade and subject or topic by taking a topic of Class VIII geography textbook.

Research Question

How to construct a reliable and valid achievement test for Class VIII students in geography subject for the topic 'Inside and Outside of the Earth'?

Objective of the Study

To construct a reliable and valid achievement test for Class VIII students in geography subject for the topic 'Inside and Outside of the Earth'.

Construction of Achievement Test

The investigators adopted the following steps to construct a genuine and appropriate achievement test in the present study:

1. Planning of the test
2. Preparation of the test items

3. Preparation of guidelines regarding the achievement test items
4. Preparation of guidelines for scoring and administration of the achievement test
5. Administration of the test (item analysis)
6. Standardisation of the achievement test

(1) Planning of the Test

In this stage, the investigator desires to priorities what actually needs to be measured, what are the indicators of fulfilment and which circumstantial factors may influence the consequences of the measurement. It is particularly imperative to characterise the reason behind the test since that expands the likelihood for accomplishing high validity. The investigator based on the review finding and experience, priorities the form of items to be used in the achievement. True or false, fill in the blanks, multiple choice questions were used for achievement test in the present investigation.

Following points are required to develop an achievement test:

- Purpose of the test
- Content of the test
- Development of the blueprint

(a) Purposes of the Test

In the present investigation, for the purpose of constructing achievement test, objectives were defined in behavioural terms focusing on knowledge, understanding, application and skill, from the selected sub-units of the chapter 'Inside and Outside of the Earth' of the Social Science textbook of Class VIII prescribed by West Bengal Board of Secondary Education.

(b) Content of the Test

In this level, the investigators need to decide the content area for achievement test. Following sub-units were used as content in the present investigation:

- Surface of the earth
- Seismic waves
- Layers in the earth's interior
- Earthquake
- Volcanism

(c) Development of the Blueprint

An objective-based achievement test with proper weightage to objectives, content area and forms of questions can be prepared by the investigators with the help of blueprint given in Table 1. Experts' views were taken into consideration to decide the weightage to be given to different content areas, objectives and different forms of questions.

Table 1
Blueprint of the Achievement Test

Objectives → Contents ↓	Cognitive Levels				Total
	Knowledge	***Understanding***	***Application***	***Skill***	
Surface of the earth	2	1	1	2	6
Seismic waves	1	2	2	1	6
Layers in the earth's interior	2	2	1	1	6
Earthquake	1	2	1	2	6
Volcanism	2	2	1	1	6
Total	8	9	6	7	30

(2) Preparation of the Test Items

The investigators prepared test items for achievement test after the development of blueprint. True or false, fill in the blanks, multiple choice questions were included as test items. Total 30 items were framed from the selected topic. Experts' opinion, subject teachers' views and literature reviews were taken into consideration to ensure satisfactory coverage in the test items to achieve the planned purpose. This permitted the investigators to create test items covering the entire topic. Test items were scrutinised by subject teachers and experts whose remarks about the content, construction and language of the items were taken into consideration and changes were made accordingly. Thus, the first draft of the achievement test was prepared.

Table 2
Number of Items in the First Draft of Achievement Test at Different Cognitive Levels of Objectives

Objectives → Contents ↓	Cognitive Levels				Total
	Knowledge	***Understanding***	***Application***	***Skill***	
Surface of the earth	1, 17 (2)	6 (1)	11 (1)	15, 28 (2)	6
Seismic waves	2, (1)	7, 18 (2)	14, 22 (2)	12 (1)	6
Layers in the earth's interior	3, 24 (2)	8, 19 (2)	13(1)	16 (1)	6
Earthquake	4 (1)	9, 20 (2)	29 (1)	23, 27 (2)	6
Volcanism	5, 26, (2)	10, 21 (2)	30 (1)	25 (1)	6
Total	8	9	6	7	30

Note: Figures in parenthesis shows number of questions.

(3) Preparation of Guidelines Regarding the Achievement Test Items

True or false, fill in the blanks and multiple choice questions are three sections used in this test. Pupils were required to write 'T' for true or 'F' for false in the first section. Pupils were asked to write the appropriate word in the blank in the second section. They were asked to tick (√) the right answer from the given options in the third section.

(4) Preparation of Guidelines for Scoring and Administration of the Achievement Test

Accurate guidelines were a given for administration of the test. scoring key was developed to facilitate the objectivity for the achievement test.

(5) Administration of the test (first try-out)

First try-out was administered on a sample of 40 pupils. This achievement test was administered to Class VIII pupils who had already studied the content. There was no time limit in the first try-out. After the first try-out the answer sheets were scored as per the scoring key and scoring guidelines already developed by the investigators. One mark was allotted for each right answer and zero for each wrong answer.

Item Analysis

An analysis was completed to find out the item difficulty value and discriminative index.

Item difficulty

According to Frank S. Freeman (1962), the following formula is used to determine the level for item difficulty:

$$DL = \frac{(Ru + Rl)}{(Nu + Nl)}$$

Where, DL= Difficulty Level

Ru= the number of students in the upper 27%, who answered the item correctly.

Rl= the number of students in the lower 27%, who answered the item correctly.

Nu= the number of students in the upper group

Nl= the number of students in the lower group

The maximum index of difficulty is 100 per cent. Nunnally (1972) recommended highest 25 per cent and lowest 25 per cent as difficult and easy, whereas SPSS (1999) used the highest and lowest 1/3rd as difficult and easy respectively. Items falling under 33 per cent and above 67 per cent were likely to be too difficult and too easy, respectively.

Table 3

Distribution of Difficulty Level of Items of First Draft of Achievement Test

Level of difficulty	Items	Total
High Difficult (<0.33)	3, 7, 9, 10, 14, 15, 16, 17, 19, 27	10
Medium (0.34-0.66)	1, 2,4, 5, 6, 8, 11, 12, 13, 18, 20, 21, 22, 23, 24, 25, 26, 28, 29	19
Easy (>0.67)	30	1

Discriminative Index

A genuine item has the ability to discriminate between those who score high (top 27% cases) and those who score low (bottom 27% cases) in the test. While there are several similar ways of measuring the discrimination index, the investigators followed the following steps in the present study to determine the discriminative index (Kelly, 1939):

- Scores obtained by different pupils were arranged in the 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:

Where, DI = Discrimination Index

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

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 groups i.e., highest test scores and lowest test scores

Discrimination index has the ability to determine the difference between the highest and lowest test scores. Ebel and Frisbie (1986) developed the following guidelines for determining the quality of the test items on the basis of discrimination index. Table 4 highlights the values of DI and their corresponding explanation.

Table 4
Guidelines of Discrimination Index of the Test Items

DI	Quality	Recommendations
>0.39	Excellent	Retain
0.30–0.39	Good	Possibilities for improvement
0.20–0.29	Mediocre	Need to check or review
0.00–0.19	Poor	Discard or review in depth
<–0.01	Worst	Definitely discard

Table 4.1
Distribution of Discrimination Index of Items of First Draft of Achievement Test

Discrimination Index	Items	Total
>0.39	1, 2, 4, 5, 6, 8, 11, 12, 13, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30	21
0.30–0.39	7, 9, 17	3
0.20–0.29	3, 10, 15	3
0.00–0.19	14, 16, 19	3
<–0.01	————	0
Total		30

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
>0.39	27	1, 2, 4, 5, 6, 8, 11, 12, 13, 18, 20, 21, 22, 23, 24, 25, 26, 28, 29	30	21
0.30–0.39	7, 9, 17	——	——	3
0.20–0.29	3,10,15	——	——	3
0.00–0.19	14, 16, 19	——	——	3
<–0.01	——	——	——	0
Total	10	19	1	30

Second Try-Out

Achievement test was revised and administered on another group of 40 pupils of Class VIII after the first try-out. Same procedure (as in the first try out) was used to find out the difficulty value and discriminating index.

Table 5
Item Analysis Chart (Final Draft)

Level of Difficulty → Discriminating Index ↓	Medium (0.34-0.66)	Easy (>0.67)	Remarks	Total
>0.39	1, 2, 4, 5, 6, 8, 11, 12, 13, 18, 20, 21, 22, 23, 24, 25, 26, 28, 29	30	Excellent Items	20
0.30-0.39	——	——	Good Items	0
0.20-0.29	——	——	Mediocre	0
Total	19	1	——	20

Table 6
Item Selection (Final Draft) for Achievement Test

Item Number	Difficulty Level	Discriminating Index	Remarks
1.	0.45	0.70	Accepted
2.	0.50	0.78	Accepted
*3.	0.18	0.20	Rejected
4.	0.55	0.83	Accepted
5.	0.45	0.70	Accepted
6.	0.50	0.78	Accepted
*7.	0.23	0.30	Rejected

8.	0.41	0.64	Accepted
*9.	0.23	0.30	Rejected
*10.	0.18	0.20	Rejected
11.	0.55	0.83	Accepted
12.	0.45	0.70	Accepted
13.	0.50	0.78	Accepted
*14.	0.14	0.17	Rejected
*15.	0.18	0.20	Rejected
*16.	0.14	0.17	Rejected
*17.	0.23	0.30	Rejected
18.	0.50	0.78	Accepted
*19.	0.14	0.17	Rejected
20.	0.55	0.83	Accepted
21.	0.41	0.64	Accepted
22.	0.45	0.70	Accepted
23.	0.41	0.64	Accepted
24.	0.55	0.83	Accepted
25.	0.50	0.78	Accepted
26.	0.50	0.78	Accepted
*27.	0.27	0.44	Rejected
28.	0.55	0.71	Accepted
29.	0.64	0.76	Accepted
30.	0.68	0.45	Accepted

Note: *Items are rejected in the final draft of Achievement Test

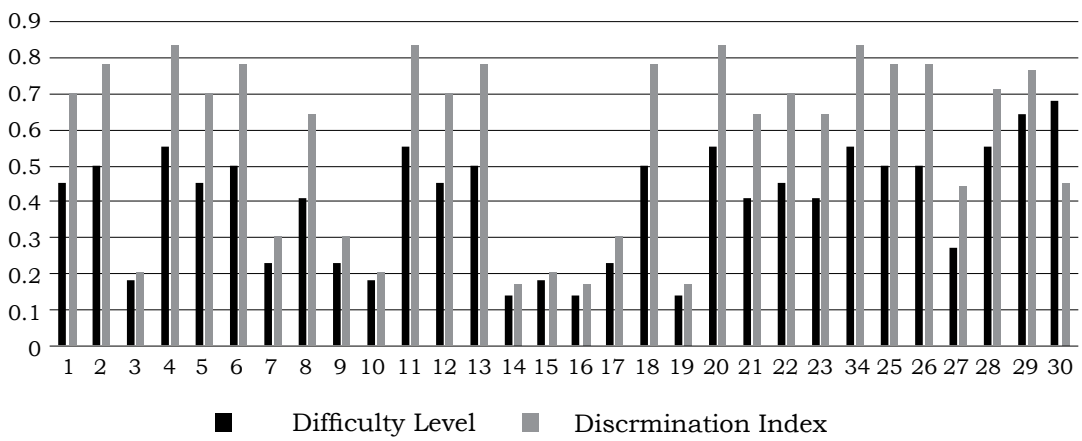

Figure 1: Item Difficulty Level and Discrimination Index

Figure 1 highlights the numerical values of difficulty level and discrimination index of all the 30 items in the achievement test. With the help of these values, accepted and rejected items for the final achievement test can be identified. Thus, 10 items were suggested to be rejected for the final drafting the of achievement test after the completion of item analysis.

Table 7 points out that there is a significant positive correlation [r (28) = 0.892, P=0.000, (P<0.05)] between Item Difficulty Level and Discrimination Index. This indicates that the test items on average have 0.40 Difficulty Level and 0.57 Discrimination Index. On the basis of this result, it can be mentioned that there is a significant positive correlation between two variables, with an increasing value of 'Difficulty Level', there is also an increase in the 'Discrimination Index'.

Figure 2 indicates scatter plot showing correlation between the Difficulty Level and Discrimination Index of items. The scatter plot shows that there is a significant positive correlation among the two variables.

Table 7
Correlation between Item Difficulty Level and Discrimination Index

Item Statistics	N	Mean	SD	r-cal	df	Sig. (2 tailed)
Difficulty Level	30	0.40	0.16	0.892**	28	0.000
Discrimination Index	30	0.57	0.25			

** Significant correlation at the 0.01 level (2 tailed)

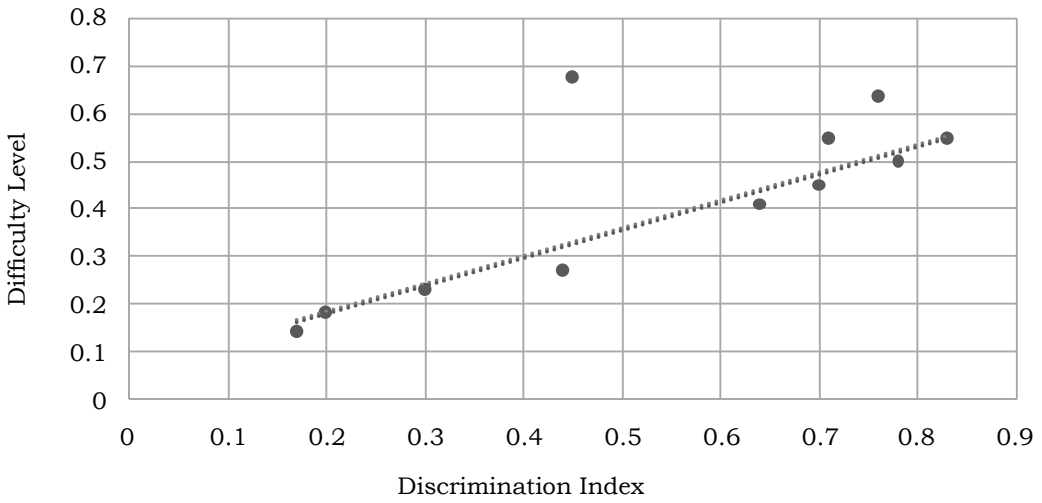

Figure 2: Scatter Plot Showing Relationship between Difficulty Level and Discrimination Index of Items

Table 8
Number of Items in the Final Draft of Achievement Test at Different Cognitive Levels of Objectives

Objectives → Contents ↓	Cognitive Levels				Total
	Knowledge	***Understanding***	***Application***	***Skill***	
Surface of the earth	1 (1)	6 (1)	11 (1)	28 (1)	4
Seismic waves	2 (1)	18 (1)	22 (1)	12 (1)	4
Layers in the earth's Interior	24 (1)	8 (1)	13(1)	------	3
Earthquake	4 (1)	20 (1)	29 (1)	23 (1)	4
Volcanism	5, 26 (2)	21 (1)	30 (1)	25 (1)	5
Total	6	5	5	4	20

Note: Figures in parenthesis shows the number of questions.

(6) Standardisation of the Achievement Test

Twenty items were selected for the final achievement test after the item analysis. 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. Reliability coefficient of the present test was 0.892 (Pearson Correlation Coefficient). The general guideline for reliability coefficient value is given in Table 9.Based on the above table, the achievement test is highly reliable.

Table 9
General Guideline for Reliability Coefficient Value

Reliability Coefficient Value	Interpretation
0.90 and above	Very high
0.80-0.89	High
0.70–0.79	Adequate
Below 0.69	May have limited applicability

Validity of the Test

Content validity was measured by scrutiny of test items, views of subject expert(s) and critical analysis of the actual subject-matter and instructional objectives against the blueprint of the test in the present investigation. This displays that achievement test has its content validity.

Discussion

The achievement test is an important measurement instrument in the evaluation programme. It helps in estimating the measure of accomplishment of a person. In school condition, it is utilised as an

instrument to measure achievement of a person (Parekh, 2018). Many researchers have developed achievement tests in the literature to quantify the accomplishment of learners. Through the present study, the investigator has made an attempt to establish the consistency and accuracy of the achievement test constructed in the Geography subject. The standardised achievement test is an assessment tool that can quantify all the accomplishments with adequate questions beneficial for elementary level students. Some researchers (Parekh, 2018; Sener and Tas, 2017; Kara and Çelikler, 2015; Yildirim, 2012; Inel, 2010) viewed that achievement test with high reliability and validity must have more effectiveness to assess students' potentialities and understanding at elementary level. Khanum and Dange (2018) reported that continuous evaluation process with standardised achievement tests has an effective impact on students' cognitive development.

This exceptional study addressed that achievement test has accurate and consistent results. The steps used for constructing achievement test in the present study can serve as an example for other researches. This is an original work in respect to the construction and standardisation of achievement test and is equivalent to the outcomes of other scientific studies.

Educational Implications

Effective teaching-learning activities are controlled by a standardised achievement test. It can be helpful in assessing the effectiveness of instructions giving feedback to both the teachers and students. Content coverage or course selection is the most crucial part of an achievement test. Objectives in teaching and learning process are the main focus in the achievement test. Periodical behaviour of the learner can also be evaluated by achievement test. There are several research studies regarding the construction and standardisation of achievement test to measure learners' academic potentialities and understanding. It is assumed that the evaluation tool used in the study can be helpful in determining the readiness level of Class VIII pupils and their deficiency in the understanding of sub-topics. With the help of obtained outcomes in the present study, the following educational implications can be made.

The standardised achievement test can be helpful in determining the level and lack of understanding of 'Inside and Outside of the Earth' chapter of the Class VIII pupils. It is possible to understand the misconceptions of learners through an accurate and genuine achievement test. Different learning activities can be organised with the help of standardised achievement test. The standardised achievement test of this kind can be utilised as a data

collection tool for investigation in the area of research in social science education.

Item analysis plays an important role in the construction as well as validation of assessment tools like achievement test. The present study viewed that an ideal achievement test should have moderate difficulty level and good positive discrimination index. However, an item having zero or negative discrimination power with very low or high difficulty estimates should be completely revised, improved or rejected.

Conclusion

All the instructional objectives, i.e., knowledge, understanding, application and skill, were given equal priorities during the test construction of achievement test. The effectiveness of social science teaching is assessed based on the assessment and evaluation process. Achievement test is a widely used assessment tool in the field of educational research. This investigation helps to prepare a valid and reliable achievement test consisting of 20 questions with acceptable difficulty level and discrimination index for 'Inside and Outside of the Earth' chapter in geography subject. The present study prepared an assessment tool with the help of item analysis. Thus, it can be recommended that systematic item analysis process should be used during the preparation of consistent and accurate achievement test to minimise the measurement errors. The teacher-made achievement test in geography that is utilised to measure the learners' accomplishment. The final examination should also be made to pass through all the processes of standardisation and validation. Item difficulty and discrimination indices can be used to judge the quality of the items. Hence, training on the development of achievement test should be regularly organised for instructors, by which they can be more skilful in test construction, and marking and grading of students' scripts.

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