Construction and Validation of Scientific Aptitude Scale (SAS) for Higher Secondary Students

A. Balasundaram
Research Scholar

Dr. I. Muthuchamy,
Professor and Head,
Department of Educational Technology, Bharathidasan University, Khajamalai Campus, Tiruchirappalli - 620 023, Tamilnadu, India, Email: angabala@gmail.com,
Mobile No: +91 999476118

Abstract

Many factors influence the achievement of science, one of which is scientific aptitude. To excel in science teaching and learning identification and inculcation of these factors is necessary. Hence, the present study was attempted to construct and validate the scientific aptitude of higher secondary school students of Tamilnadu through a Scientific Aptitude Scale (SAS). The tool comprised of 30 items on the dimensions Reasoning, Numerical Ability, Scientific Information and Scientific Vocabulary. The tool was administered to 50 higher secondary students. It was validated through statistical analysis.
Keywords: Scientific Aptitude Scale, Higher Secondary School Students, Construction, Validation and Scientific Aptitude.

Introduction

The term "scientific aptitude" refers to congenital and environmental factors of a person which predict the scientific capacity of a person to perform any act. This capacity leads a person to comprehend the situation scientifically to solve the problem with the help of emergent attitude. So for scientific aptitude we need desirable habits, sound character, potential skills and readiness for the application of ideas to solve problems. It includes characteristics include mental activity, creative abilities and capacity for critical thinking, ability to see relationship, suspended judgement and open-mindedness (Stanly, 2016). These factors may be immensely responsible for achievement in science which will helps in tracing out the problems concerned in study (Yalo Gao and Hangsing, 2019). One may observe that in schools, some students outperform others in scientific studies and skills related to it. Such students having a specific ability or aptitude for science studies in addition to their general intelligence are recognised as possessing scientific aptitude (Lalmuanzuali et al.,2019).A child is curious in nature. It is an innate ability.

According to Psychological belief, every child has different capacities in him. It is possible to develop the desired capacities in a child at the stage of upper primary level. But it is noticed that there is a lack of proper tests for evaluating these kinds of aptitudes in child (Bhumika Subhashchandra Joshi and Somabhai Patel, 2016).A student having scientific aptitude should be encouraged and nurtured to develop and enhance their potential so as to be able to ensure that they have success in their pursuit of scientific research and careers in science.

In these days number of students offer for stream based education. Though various commissions and curricular reforms have taken place in India. There is lack of initiatives to develop the scientific aptitude of the students. Scientific aptitude leads to increased achievement in science. Research in this field should be intensified. A national policy to foster scientific aptitude is needed. Proper assessment of scientific aptitude will result in strategy development, means of enhancing scientific aptitude and evaluation procedures to be adopted. In order to achieve this goal investigator made an attempt to develop and validate a scientific aptitude tool based on a pilot survey.

Review of Related Literature

Deblina Talukdar and Deepa Roy (2019) conducted a study of scientific attitude and aptitude among schedule tribe students at secondary education. The study has expressed how one can create a positive feelings, tendency, and potentialities within the low strata of society of individuals who are coming to school to secure education.

Leo Stanley (2016) investigated the Influence of Scientific Aptitude on Achievement in Science of IX Standard Boys and Girls. The mean score indicates that the students' scientific aptitude was low.

Yalo Gao and Hangsing (2019) examined Scientific Aptitude and Academic Achievement in Tribal Students. Finding showed that except for the science vocabulary, all other dimensions of scientific aptitude such as reasoning, numerical ability and scientific vocabulary shows moderate positive correlation with academic achievement in science.

Bhumika Subhashchandra Joshi and Somabhai Patel (2016) constructed and Standardized Scientific Aptitude Test for 12+ Age-Group Students. The 12+ age-group students studying in urban area schools have the more scientific aptitude number. Thus it can be said that the scientific aptitude of the students studying in urban area schools is higher.

Lalmuanzuali et al.,(2019) undertook a study on Aptitude and achievement in science: a comparative study of higher secondary school students in Mizoram and Meghalaya.

Sonali N. and Channawar (2018) conducted a study of Scientific Aptitude Among Government High School Students of Raipur. Finding of the study shows that the level of scientific aptitude is more in boys compare to girls of high school and the study also shows that there is significant difference in different area/part of scientific aptitude like Reasoning Test, Numerical ability and there is no significant difference between boys and girls in Scientific Information and science vocabulary test.

Moshahid (2016) scrutinized the Scientific Aptitude among English and Urdu Medium Secondary Level Students. The result revealed that English medium secondary level students possess better scientific aptitude than Urdu medium secondary level students. There is no significant difference in the level of scientific aptitude among the English and Urdu medium female secondary level students.

Manickavasagan(2019) identified the Correlation among Higher Secondary Students' Achievement in Chemistry, Scientific Aptitude and Chemistry Learning Environment.There existed a positive relationship between the Scientific Aptitude & Chemistry Learning Environment of higher secondary students.

Arati Pravinkumar Patel (2019) conducted a study of scientific aptitude of secondary school students in context of certain variables. The author says that identification of scientific aptitude at secondary school will guide the students to choose the stream of study.

Objectives of the study

1. To construct scientific aptitude scale for Higher Secondary School Students
2. To standardize scientific aptitude scale for Higher Secondary School Students
3. To establish norms for scientific aptitude scale for Higher Secondary School Students.

Construction and Validation of Scientific Aptitude Scale (SAS)

The construction of the Scientific Aptitude Scale in science subjects was done by the investigator. The investigator undertook a literature survey to conceptualize the variable Scientific Aptitude. Various literature sources were verified, reviewed on the constructs that constitute the variable Scientific Aptitude. In this way the standardization of tool and its items were done. Finally, the dimensions that constitute Scientific Aptitude were considered as Reasoning ability, Numerical ability, Scientific information, Scientific

vocabulary, The ability and the level of the content taken for Scientific Aptitude Test were taken as Higher Secondary Level and the questions were set up as age appropriate for the Higher Secondary Students. Objective type questions were prepared to maintain the objectivity of the evaluation. The student has to put a tick mark to mark the correct answer in the four options given. The correct response will get a score of 1 and the wrong response will get a score of 0. Total numbers of questions in the tool were 40. The maximum score is 40 and the minimum score is 0.

Standardization of Scientific Aptitude Scale

After development of the Scientific Aptitude Scale, the validity of the test and the reliability of the test were established by item analysis and test re-test method respectively.

Validity

To find out the fitness of each item in the Scientific Aptitude Scale, item analysis was done by the investigator. The responses of each test item were scored '1' for correct answer and '0' for wrong answer responses. The Scientific Aptitude Scale was administered on a small group of 50 students. The investigator was with the students at the time of administering the test. The doubts raised by the students were clarified and the items concerned were noted down, the items found ambiguous were also corrected. From the responses, the total numbers of 'Right answer' and 'Wrong answer' were calculated. Initially the scale contained 40 items out which after careful analysis, 30 items were selected.

Item Validity

The pilot study was conducted to establish the item validity of the Scientific Aptitude Scale in science subjects. The test was administered with 50 higher secondary students randomly selected. In order to have the items in the test valid, item analysis was carried out by the investigator. Thus the difficulty level and item discriminating power of each item were found out. The scores were arranged in the descending order. The upper 27% of the scores were selected.

Item Difficulty Level

Difficulty level of an item is the percentage of students who answer the items correctly in a tool.

$$\text{Item difficulty level} = \frac{R \times 100}{T}$$

R = The number of examinees got the items correct

T = Total number of examinees tried the item

Item Discriminating Power

The discriminating power of a item is a measure of an item's ability to discriminate best those who scored high on the total test and those who scored low.

$$\text{Discriminating Power} = \frac{RU - RL}{\frac{1}{2}T}$$

RU – The number of examinees in the upper group got the item right

RL – The number of examinees in the lower group got the item right

T – The number of examinees included in the item analysis

Selection Criteria

The items are selected according to Anderson (2008) criteria. In the difficulty level, the items with difficulty level 40 to 80 and in the discriminating power, the items with discriminating power greater than 0.4 were selected for the tool.

Difficulty level and Discriminating power of items in the Scientific Aptitude Test Scale

Table: 01

Item No.	Difficulty Level	Discriminating Power	Remarks
1	64.29	0.571	S
2	60.71	0.643	S
3	64.29	0.571	S
4	**53.57**	**0.343**	**NS**
5	50.00	0.429	S
6	57.14	0.571	S
7	67.86	0.500	S
8	**89.29**	**0.214**	**NS**
9	42.86	0.571	S
10	46.43	0.429	S

11	53.57	0.643	S
12	60.71	0.78	S
13	53.57	0.500	S
14	57.14	0.571	S
15	**85.71**	**0.286**	**NS**
16	46.43	0.643	S
17	57.14	0.571	S
18	71.43	0.571	S
19	42.86	0.429	S
20	46.43	0.643	S
21	**32.14**	**0.214**	**NS**
22	53.57	0.643	S
23	57.14	0.429	S
24	46.13	0.643	S
25	57.14	0.429	S
26	53.57	0.500	S
27	**54.41**	**0.132**	**NS**
28	**31.19**	**0.323**	**NS**
29	45.43	0.449	S
30	54.29	0.531	S
31	**32.86**	**0.429**	**NS**
32	47.43	0.516	S
33	59.43	0.476	S
34	48.79	0.512	S
35	**69.29**	**0.214**	**NS**
36	71.18	0.632	S
37	**26.73**	**0.526**	**NS**
38	45.98	0.623	S
39	56.73	0.529	S
40	**62.63**	**0.146**	**NS**

The questions were again shown to senior science subject teachers. All the suggestions proposed by the experts were incorporated and the tool is thus found to be valid.

Reliability

Before administering the Scientific Aptitude Scale, a pilot study was conducted to a set of 50 students. The investigator administered the test with 50 higher secondary science students and the scores were noted down. After a period of 15 days the same test was administered to the same set of students. The scores were noted down. Correlation coefficient between these two scores was found as 0.87. Thus the reliability of the test was established.

Administration of Scientific Aptitude Scale

After careful preparation, the test was administered personally by the investigator on the higher secondary science students in their respective places. After getting the permission from the heads of the institutions, instructions were carefully read out and explained to the higher secondary science students. Students were instructed to choose the correct answer out of the four given and mark it as A, B, C or D in the box provided. For answering the questions, they were given 30 minutes time.

Quantification of Scientific Aptitude Scale

The Scientific Aptitude Scale designed by the investigator is an objective type test. This test intends to find the Scientific Aptitude level of higher secondary science students. It contains objective type questions. After getting the responses from higher secondary science students the score is quantified as per the table given below.The maximum score in this test is '30" and the minimum is '0'.The Final tool consists of items in the following dimensions

Dimensions and Number of Items in each dimension of the Scientific Aptitude Test
Table:02

S.No	Dimension	No. of Items
1.	Reasoning	7
2.	Numerical Ability	7
3.	Scientific Information	7

4.	Scientific Vocabulary	9
Total		**30**

Conclusions

The term scientific aptitude is related to different factor like scientific knowledge (this knowledge significantly correlate with the student learning), Science skill (ability to learn the new concept and knowldge of science), motivation and satisfaction (come from school environment and teacher learning),socio-economic and aesthetic factor(influence by parental background and care, science is innovation and beauty of world so, it is possible when student can learn the aesthetic value),Scientific temper(comes from soul of the student when the student has cognitive, affective and psychomotor domain and process to analyse itself) are most important valuable factor for a scientific aptitude (Sonali N. and Channawar,2018). In this way scientific aptitude encompasses the physical and mental aspects of the child. Care should be taken in assessing the domain of scientific aptitude. In this way the present study will help in proper identification of the dimensions of scientific aptitude of the higher secondary students using the tool developed and validated in this study.

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