



Construction of Science Attitude Scale

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Abstract

Modern age is an age of science. Many inventions of science have taken place in the present age. They have made our life easy and comfortable. Science has made its way almost in every walk of life. The blessings of science are many. Wherever we look we find the wonders of science. Electricity, railways, bus, telephone, computer etc. all are the gifts of science. We are living in an age when science has completely changed our everyday life. Man's landing on the moon or sending a spacecraft to Mars are remarkable events. Science has transformed human life beyond all imaginations.

At the secondary level science education has become one of the core subjects. Science education in the schools help in establishing a scientific and literate society that is innovative and forward looking, one that is not only a consumer of technology, but also contributor to the scientific and technological civilizations of the future.

Since the very dawn of civilization, man was curious to know about the things around him. This curiosity led the genius persons to the establishment of certain knowledge based upon facts. Knowledge, skill and other aspects acquired through science education has been considered essential for all the categories of learners at secondary stage. It has been realized that science education is essential for the learners right from the beginning of school education in this modern world based on science and technology. So, our children must be aware of the scientific and technological inventions. Hence, it is essential to know the attitude of the students towards science education. Indian Education Commission (1964-66) has pleaded for science education.

Looking into the importance of science education at secondary level, it is pertinent to raise certain issues such as - what type of attitude the students are having towards science learning?

Thus, the present science education caters the needs of the students to develop scientific temperament and attitude. To find out the answer of these questions the present study has been designed.

Key words: Attitude, science, education

Introduction: Einstein says, "Science is an organized and ordered way of investigating and understanding the world which is essentially practical in nature." Science has been defined in many ways. Science is a way of thinking, a way of understanding the world. Science is the system of knowing the universe through data collected by observation and controlled experimentation. As data are collected, theories are advanced to explain and account what has been observed. The true test of a theory of science is three fold: (i) Its ability to explain what has been observed (ii) Ability to predict what has not yet been observed and, (iii) Its ability to be tested by further experimentation and to be modified as required by acquisition of new data. If we re-read this definition of science we will see three major elements – processes, products and human attitude.

Elements of science can be visualized in this way.

Processes – certain ways as in investigating problem, observing for example making hypothesis, designing and carrying out experiments, evaluating data, measuring and so on.

Products – Facts, principles, laws and theories.

Human attitudes – Certain belief, opinions for example suspending judgments until enough data have been collected.

Today, science is considered to possess dual nature which emphasizes that science is a cumulative and an endless series of empirical observations which result in the formulation of concepts and theories being subject to modification in the light of further empirical observations.

The word 'attitude' is derived from the Latin word 'aptus' which means 'fitness' or 'adapted ness'.

The word 'scientific attitude' includes curiosity towards the surrounding environment, belief in cause effect relationship, patience, truthfulness, impartiality and open-mindedness etc.

The modern civilization is a scientific civilization. This is an age when the modern society is completely drawn into the scientific environment and science has become an integral part of our life and living. Now we cannot think a world without science. The wonderful achievements of science have glorified in the modern world. A citizen of a modern world sees the countless manifestations of science all around him. There is no aspect of man's life today which has not been influenced by science one-way or the other. We are living in an age of scientific culture. Science has shrunk the world and totally changed the human outlook. In fact, science now has an all prevailing influence on every sphere of human activity. Further, modern science is no longer confined to the surface of this globe. Its sphere of achievement reaches beyond the earth.

In recent times, there has been rapid addition of knowledge to the world of science. Great achievement of science and technology and the use of this scientific achievement in promoting the well being of mankind through their application in the field of industry, communication, engineering etc. has made science more important than ever before. Science has infact radically transformed the material environment of the citizens of modern world. Thanks to the achievements of science. We see around us an outstanding array of labour and time saving gadgets and appliances, streams of scientific information, dispelling the darkness of ignorance and tens of thousands of new products ensuring a healthier and more comfortable life.

The foregoing discussion makes it evident that "we live in a world of accelerated change produced, to a large extent, by science and its applications in technology". In such a world, all of us knowingly or unknowingly, are constantly affected by science. The temper of the age demands that man learns to adjust to this tremendous all pervading change. He has to have a clear understanding of the impact of science on human affairs. And this is possible through a sound process of training in science. Grounding in the basic principles of science can help men to adjust to the changes of modern life. For this reason, the basic sciences belong in the curriculum of general education as well as in scientific and technological training.

It is usually seen that modern technology (e.g. in agriculture, medicine and engineering) requires manpower with fundamental training in the basic sciences (mathematics, physics, chemistry, biology and the sciences of earth and space). The economic and social development of a country also requires a climate of wide spread and popular acceptance of science and technology, in part adult education. Science has also had such a profound effect on modern life at the practical and philosophical levels that no man can consider himself in the main stream of modern thought if he remains a "scientific illiterate".

Thus it can be said that science and modernity are synonymous. A country desiring to join the community of modern nations has to embrace science in all its dimensions. Jawaharlal Nehru, the first prime minister of India, had the same conviction. Science education is an integral part of education at school level and the main aim of science education is to develop scientific attitude among the students. If scientific attitude is developed, children will live, think and work accordingly. It makes the people live as effective citizens in the present scientific society. It also helps the people live up to their satisfaction and expectation.

Objectives of the present study: The present study purports to meet the following objectives:

- (a) General objective: To know the attitude of class X students towards science education.
- (b) Specific objectives:
 - (i) Whether the science teacher has been successful in making pupil understand the basic idea of science?
 - (ii) What is the relation between science and other subjects?
 - (iii) What is the position of laboratory in the schools?
 - (iv) Whether boys are more interested towards science education than girls?
 - (v) Whether urban students are more interested towards science education than rural students?

Methodology: The effectiveness of any research depends mainly on the methodology and procedure adopted in the study. A sound and well organized methodology includes the appropriate strategy in stepwise execution of the investigation. It leads the investigator to the target he/ she aims at. A good research always follows a sound methodology and procedure otherwise the findings of the study will be of generalized facts. The data were collected with the help of a standardized science attitude scale. Sample of the study consists of 100 students of class X from two urban and two rural schools of Cachar district. The item wise analysis was carried out for the data obtained through the attitude scale. The obtained data were analyzed in terms of frequency and percentage.

In the following pages, an attempt has been made to provide a brief description of standardization of science attitude scale.

Standardized Test: A standardized test is an instrument of measurement, which measures what it aims to measure quite correctly with constant results. It is according to the standard of achievement of efficiency of the individual to be tested, neither too easy nor too difficult. It has standard norms and therefore its result give us true picture of individual test.

It is a test where fixed instruction is given. It is a universal type of test. Items should be analyzed. In every item, it should have reliability and validity.

The following relevance need to be followed in the standardization of a test.

- 1) Planning the test
- 2) Writing the items
- 3) Pre-testing items and item analysis
- 4) Preparing the final test
- 5) Collecting reliability and validity evidence
- 6) Developing normative and interpretative materials.

Construction of test – While constructing the test, the following areas is covered:

General science, biological sciences, physical sciences, laboratory and science teacher.

Among the different techniques available for the construction of attitude scale, Likert method is considered to be more appropriate for use in the construction of science attitude scale. Before preparing the SAS, the investigator reviewed the relevant literature and other descriptive material, dealing with the contribution of scientific thought.

Initially the number of items (statements) were chosen as sixty five and those sixty five items were administered on a sample of 50 students.

After scoring the items, item analysis was done. Difficulty value of an item is determined by the formula,

$$\text{Difficulty level} = \frac{R}{T} \times 100,$$

where, R = The no. of persons who get the items right (upper group and lower group)

T = No. of persons in total

$$\text{Discriminating index} = \frac{R_U - R_L}{\frac{1}{2} T}$$

Where, R_U = No. of persons who get the item right in the upper group.

R_L = No. of persons who get the item right in the lower group.

T = total no. of persons in total in upper and lower group.

Items which are relatively easy that is difficulty level more than 95% were discarded. Items which have negative discriminating values were further modified. Items which have discriminating index Zero that is which have no discriminating power were also discarded. Finally after item analysis, fifty items were selected, and are arranged serially item easy to difficult in an ascending order manner.

The reliability of science attitude scale (SAS) was estimated by split half method. The coefficient of correlation is calculated by using the following formula:

$$r_{xy} = \frac{N \sum xy - (\sum X)(\sum Y)}{\sqrt{N \sum X^2 - (\sum X)^2} [N \sum y^2 - (\sum y)^2]}$$

Where, x and y are odd and even numbered scores.

The reliability of the whole test is calculated by using the Spearman Brown formula:

$$r_{11} = \frac{2 \text{ times correlation between half tests}}{1 + \text{correlation between half test}}$$

$$= \frac{2 r_{\frac{1}{2} \frac{1}{2}}}{1 + \frac{1}{2} \frac{1}{2}}$$

$$r_{11} = \text{Reliability coefficient of whole test}$$

$$r_{\frac{1}{2} \frac{1}{2}} = \text{Reliability coefficient of one half of the test}$$

The following table shows the calculation of coefficient of co-relation and reliability of the whole test:

Sl. No.	Odd No. Item x	Even No. Item y	X ²	y ²	xy
1	66	60	4356	3600	3960
2	84	73	7056	5329	6132
3	75	67	5625	4489	5025
4	71	63	5041	3969	4473
5	71	70	5041	4900	4970
6	83	81	6889	6561	6723
7	71	66	5041	4356	4686
8	86	62	4624	3844	4216
9	75	70	5625	4900	5250
10	70	70	4900	4900	4900
11	67	61	4489	3721	4087
12	77	70	5929	4900	5390
13	85	80	7225	6400	6800
14	80	76	6400	5776	6086
15	76	65	5776	4225	4940
16	74	67	5476	4489	4958
17	72	74	5184	5476	5328
18	73	73	5329	5329	5329
19	69	78	4761	6084	5382
20	78	73	6084	5329	5694
21	75	75	5625	5625	5625
22	86	78	7396	6084	6708
23	73	73	5329	5329	5329
24	72	71	5184	5041	5112
25	73	68	5329	4624	4964
26	78	70	6084	4900	5460
27	77	70	5929	4900	5390
28	67	72	4489	5184	4824
29	75	69	5625	4761	5175
30	82	73	6724	5329	5986
31	74	71	5476	5041	5254
32	79	73	6241	5329	5767
33	70	73	4900	5329	5110
34	73	68	5329	4624	4964
35	89	83	7921	6889	7387
36	85	78	7225	6084	6630
37	89	79	7921	6241	7031
38	86	70	5776	4900	5320
39	78	75	6084	5625	5850

40	82	79	6724	6241	6478
41	80	75	6400	5625	6000
42	78	73	6084	5329	5694
43	75	67	5625	4489	5025
44	75	70	5625	4900	5250
45	78	72	6084	5184	5616
46	79	74	6241	5476	5846
47	65	61	4225	3721	3965
48	74	70	5476	4900	5180
49	75	69	5625	4761	5175
50	76	71	5776	5041	5390
51	79	74	6241	5476	5846
52	68	60	4624	3600	4080
53	72	65	5184	4225	4680
54	74	66	5476	4356	4884
55	79	72	6241	5184	5688
Sl. No.	Odd No. Item x	Even No. Item y	X ²	y ²	xy
56	69	61	4761	3721	4209
57	69	62	4761	3844	4278
58	69	71	4761	5041	4899
59	73	67	5329	4489	4891
60	71	78	5041	6084	5538
61	71	66	5041	4356	4686
62	68	62	4624	3844	4216
63	77	68	5929	4624	5236
64	61	64	3721	4096	3904
65	75	66	5625	4356	4950
66	58	53	3364	2809	3074
67	62	66	3844	4356	4092
68	67	60	4489	3600	4020
69	70	61	4900	3721	4270
70	72	66	5184	4356	4752
71	72	69	5184	4761	4968
72	81	76	6561	5776	6156
73	85	78	7225	6084	6630
74	73	76	5329	5776	5548
75	69	62	4761	3844	4278
76	74	65	5476	4225	4810
77	55	59	3025	3481	3245
78	79	72	6224	5184	5688
79	73	69	5329	4762	5037
80	71	67	5041	4489	4757
81	66	67	4356	4489	4422
82	69	71	4761	5041	4899
83	80	73	6400	5329	5840
84	66	63	4356	3969	4158
85	68	65	4624	4225	4420
86	65	63	4225	3969	4095
87	72	68	5184	4624	4896
88	79	75	6241	5625	5925
89	69	66	4761	4356	4554
90	76	68	5776	4624	5168

91	72	69	5184	4761	4968
92	71	75	5041	5625	5325
93	64	63	4096	3969	4032
94	78	76	6084	5776	5928
95	63	57	3969	3249	3591
96	77	61	5929	3721	4697
97	75	81	5625	6561	6075
98	78	68	6084	4624	5304
99	74	73	5476	5329	5402
100	77	73	5929	5329	5621

Calculation of coefficient of correlation (r) from raw scores:

$$r_{xy} = \frac{N \sum xy - (\sum X)(\sum Y)}{\sqrt{N \sum X^2 - (\sum X)^2} [N \sum y^2 - (\sum y)^2]}$$

Here, $\sum X = 7268$, $\sum y = 6879$, $\sum xy = 514464$, $N = 100$

$$\begin{aligned} \therefore r_{xy} &= \frac{100 \times 514464 - (7268) \times (6879)}{\sqrt{[100(538958) - (7268)^2][100 \times 486421 - (6879)^2]}} \\ &= \frac{1443428}{1604678.644} \\ &= 0.8995 \\ &= 0.90 \end{aligned}$$

$$\begin{aligned} \therefore \text{reliability} &= \frac{2r}{1+r} \\ &= \frac{2 \times 0.90}{1+0.90} \\ &= 0.9473 \end{aligned}$$

Validity - The science attitude scale appears to have face validity, content validity and construct validity.

Limitations of the present study:

- 1) The present study has been confined to 100 class X students of two urban and two rural schools of Cachar District only.
- 2) The tool of the present study includes only one instrument namely attitude scale for class X students.

Analysis and Interpretation of data: The obtained data were analyzed in terms of frequency and percentage.

Major Findings: The major findings of the present study are summarized as follows:

- 1) Majority of the female students have strongly agreed that science is interesting.
- 2) About 25% of male students and 26% of female students have disagreed the statement. None of the science subject is hard.
- 3) Few male students have agreed to the statement science makes a man materialistic, while 23% of female students have undecided about the same statement.
- 4) 40% of male students and 45% of females have strongly agreed to the statement modern technological devices should be used in classroom; while 37% of rural students have strongly disagreed to the same statement.
- 5) Many students both male and female, from rural and urban areas have strongly agreed about the role of teacher in teaching science.
- 6) Most of the students both from rural and urban areas, male and female have agreed that science has relation with other subjects.
- 7) A number of male and female students, both from rural and urban areas have agreed that

- girls' feel nervous on studying science, while boys generally prefer science.
- 8) Many students, both male and female, from rural and urban areas have agreed that study of pure science is more interesting than bioscience
 - 9) A number of female students and urban students are curious about laboratory experiments.
 - 10) A lot of students have supported that science teaching should be such that it should be related to the real life situation.

Conclusion: In the present study an attitude scale is developed, by using Likert method to know the attitude of the students of class X, both male and female from rural and urban areas towards science education. The Science attitude scale has a reliability of 0.9 and sufficient validity. So, this attitude scale can be used to know the attitude of class X students of North-East India because the cultural context is mostly similar to all the state of North East. Thus, this scale has a practical implication for the policy decision of the science education.

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Appendix

The following science attitude scale is used in the present study:

SL.	NO.
STATEMENTS	
1. Science helps to develop creativity	SA A U D SD
2. Science makes a man materialistic	SA A U D SD
3. Science develops the objective outlook	SA A U D SD
4. Science makes a man dependent upon machine	SA A U D SD
5. I enjoy reading the science text book	SA A U D SD
6. Some students are very enthusiastic about science	SA A U D SD
7. Only reading the science textbook is not interesting	SA A U D SD
8. The laboratory experiments are very interesting	SA A U D SD
9. Problems in science content should be related to the real life situation	SA A U D SD
10. Science helps in getting knowledge	SA A U D SD
11. Scientists are persons without human consideration	SA A U D SD
12. Science cannot solve our all problems	SA A U D SD
13. Boys generally prefer science	SA A U D SD
14. Basic science helps us to develop positive attitude towards manual work	SA A U D SD
15. Science students have more employment opportunity than others	SA A U D SD
16. Science makes impossible things possible	SA A U D SD
17. Excessive emphasis on science brings down our moral standards	SA A U D SD
18. Science has become an integral part of our life	SA A U D SD
19. Study of science gives us basic knowledge about health and hygiene	SA A U D SD

20. Scientific knowledge sharpens our reasoning ability	SA	A	U	D	SD
21. Knowledge of science is necessary for understanding other subjects	SA	A	U	D	SD
22. Science is a blessing for human beings	SA	A	U	D	SD
23. Students should remain active in science classes	SA	A	U	D	SD
24. Science teacher should be very innovative in nature	SA	A	U	D	SD
25. Science makes people disciplined	SA	A	U	D	SD
26. Study of pure science is more interesting than bioscience	SA	A	U	D	SD
27. Laboratory should be fully equipped with necessary apparatus	SA	A	U	D	SD
28. Students should do the experiments independently	SA	A	U	D	SD
29. Apparatus should be handled very carefully	SA	A	U	D	SD
30. Diagrams should be neatly drawn	SA	A	U	D	SD
31. For studying science one should be good in mathematics	SA	A	U	D	SD
32. Bioscience is comparatively easy	SA	A	U	D	SD
33. Science teacher should be up to date in his/ her knowledge	SA	A	U	D	SD
34. Demonstration method is ideal for teaching science	SA	A	U	D	SD
35. Only teacher's talk in the classroom makes it dull and monotonous	SA	A	U	D	SD
36. Teachers play a greater role in motivating students	SA	A	U	D	SD
37. Scientists study phenomenon through observation and experimentation	SA	A	U	D	SD
38. There should be separate laboratory for biological sciences	SA	A	U	D	SD
39. Students should participate in science exhibition and science fairs	SA	A	U	D	SD
40. Students face problems while doing the experiments	SA	A	U	D	SD
41. All topics in science are not equally interesting	SA	A	U	D	SD
42. Scientific inventions make people idle	SA	A	U	D	SD
43. None of the science subject is hard	SA	A	U	D	SD
44. Modern technological devices should be used in class room	SA	A	U	D	SD
45. Teachers play a greater role in motivating students	SA	A	U	D	SD
46. Few girls feel nervous on studying science	SA	A	U	D	SD
47. Science is interesting	SA	A	U	D	SD
48. Science develops the objective outlook	SA	A	U	D	SD
49. Teachers play a greater role in motivating students	SA	A	U	D	SD
50. Study of pure science is more interesting than bioscience	SA	A	U	D	SD