

Challenges in Measurement of Scientific Attitude

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Development of scientific attitude is considered as an important objective of science learning all over the world. Many teaching techniques are evolved and suggested to develop scientific attitude. Some out of them are the outcome of elaborate efforts of researchers. The challenge remains with the measurement of effects of these techniques. In other words it is a challenge of measurement of learning of scientific attitude, which is discussed at length in this write up. During the course of my work in the area of scientific attitude for the last 25 years, I have come across these challenges and tried to face them. This paper is aimed at making teacher educators, teachers, research students and also NGOs in the field aware of these challenges.

Following are some of the major challenges in measurement of scientific attitude

- 1) Conceptualizing
- 2) Domain decision
- 3) Content validity
- 4) Selection of right type of measuring instrument
- 5) Objectivity
- 6) Teachers training

The challenge of conceptualizing

Scientific attitude comprises of many complex factors. Only some of them are listed below after detailed study of related literature.

- a) Belief on cause and effect relationship.
- b) Suspend the judgment till enough data is gathered.
- c) Emphasis on empirical evidence.
- d) Open mindedness.
- e) Accuracy in thought and action.
- f) Intellectual honesty.
- g) Objectivity.
- h) Criticality.
- i) Unbiased decision making ability.
- j) Ability to identify difference between hypothesis and facts.

- k) Habit of reviewing the data.
- l) To keep away oneself from blind beliefs.
- m) Curiosity.
- n) Ability to think logically.
- o) Faith in development.
- p) Faith in problem solving.
- q) Ability to recognize self limitations.
- r) Interest in newness.

Apart from above sub-factors of scientific attitude, scientific temper and scientific outlook are the concepts having a very close relationship with scientific attitude. Under such circumstances, it is mandatory for test constructor –

- ♦ To understand and define each factor of the above list by dictionary meaning and also by some examples.
- ♦ To identify some similarities and differences in these factors.
- ♦ To classify them into sub-categories.
- ♦ To limit to some of these factors for the purpose of measurement so as to make the measuring instrument usable.
- ♦ To make operational definition of scientific attitude.

In the process of limiting to few factors and converting those into operational definitions, the totality of the concept and as a consequence the totality of measuring instrument is likely to be threatened.

Apart from this, the selected factors (which will define scientific attitude) may not be easily convertible in the test items in spite of best efforts of defining them operationally.

The challenge of domain decision

Psychological variables are generally categorized into three domains. These are cognitive, affective and psychomotor. The domain of the variable which is to be measured needs to be fixed for two reasons.

- a) It helps in deciding right type of measuring instrument.
- b) It also helps in writing appropriate test items.

The test constructor faces the challenge in making this decision as attitude is generally categorized as a factor of the affective domain. But if we look at the factors given above, which comprise scientific attitude, we realize that only one single domain is not sufficient to encompass all the factors. Categorization of each factor under some single domain will also be artificial. Still if tried, factors like objectivity, criticality, unbiased decision making ability, ability to identify difference between hypothesis and facts will have to be categorized under cognitive domain. Where as factors like intellectual honesty, habit of reviewing the data, faith in development, faith in problem solving will occupy space in affective domain. A factor like accuracy in action will go under the psychomotor domain.

The challenge of content validity

A decision of content validity is the next challenge for the test constructor. The development of scientific attitude starts from learning of science. But later on, it is expected to exhibit its presence in all walks of life. So the content is too vast for the test or it can be said that it will not be limited to the specific content. To select the sample content for construction of scientific attitude test items from general experiences is not an easy task.

Another issue in this is how one can guarantee transfer of scientific attitude from one area to another, i.e. the person having scientific attitude in health related issues may not have it in issues related to religion.

Challenge of selection of right type of measuring instrument

Witnessing concrete evidence of scientific attitude through objective measuring instrument is extremely difficult. Attitude is defined as a stable predisposition to respond. This stability is understood either

- (a) As a consistency across modes of responding to an attitude object.

Or

- (b) As a consistency in individual responses across time.

Such an analysis suggests the inadequacy of the usual procedure of measuring attitude at a single time by attitude scales and calling these responses attitude.

Scientific attitude cannot involve only a measure of final product. The process also becomes important with the use of word scientific, as this word refers to the way attitude is developed. If an attitude scale is con-

structed and the test item asks to give favorable or unfavorable response to the statements then this response alone may not provide enough information about scientific attitude because the process involved in reaching to this response cannot be revealed.

The test items for measuring scientific attitude need to measure cognitive, psychomotor and affective aspects. So varied types of test items need to be constructed. A routine type of attitude scale will not serve the purpose. Multiple types of tests and test items need to be thought.

Challenge of objectivity

Whichever is the tool chosen for measurement of scientific attitude, it will carry along with it numerous problems of objective measurement because of the complexity of the phenomenon. It is observed that experts in the field hardly come to a unanimous opinion about scientific attitude as a procedure and also as a product. It affects adversely on inter-examiners' objectivity.

Challenge of teacher training

Teachers hardly get any training of construction of scientific attitude measurement test at pre-service or in-service training programs. This training is essential as the standardized tools are rarely available and even if they are available they may not serve local purposes. Teachers training institutes need to think in this direction. It is seen that this major objective of science teaching is neglected in evaluation, measurement process and so as a consequence of this it is neglected in teaching too. At S.N.D.T. Women's University, we have done some efforts at pre-service teachers training programs, at M.Ed. and at doctoral research level to orient and to provide some experiences to our students regarding measurement of scientific attitude and have tried to overcome some of the above said challenges.