REVIEW OF RELATED STUDIES

CHAPTER II

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2.1 Introduction

2.2 Studies conducted on the construction and standardization of scientific attitude scale.

2.2.1 Some observations and Implications.

2.3 Studies conducted on measurement of scientific attitude and its relationship with other variables.

2.3.1 Some observations and implications.

2.4 Implications of the reviewed studies for the present study.

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2.1 INTRODUCTION

Research in the area of scientific attitude has many vital and useful findings to report but scientific attitude as a construct has not been investigated conclusively. Though it is well recognised among the academicians that scientific attitude should spring from teaching in general and teaching of science in particular but research efforts in the endeavour have shown certain doubtful conclusions. The flood of research in the field of measuring attitudes and opinions and which are conducted mainly by sociologists and psychologists is indicative of the scant attention paid by educationists. Realising the importance of scientific attitude as a vital construct and its inculcation among the students, researchers are now making vigorous attempts in providing important findings to planners to make adequate policies and programmes. Since scholars with different ideological predilications and theoretical propensities are studying the construct scientific attitude and its relationship with other variables, one finds considerable diversity in substantive focus, theoretical and methodological

orientation and also the findings in the available literature. Therefore, a critical analysis of these studies would enable us to examine the strength and weakness of the methodological perspective, the theoretical soundness of the findings and the areas that have been given inadequate focus. Hence in this chapter an attempt has been made to review the studies on scientific attitude and its correlates on other variables.

Keeping in view the objectives and focus of the present undertaking a total of sixteen studies have been reviewed in this chapter to develop a wholistic perspective of the nature and findings of these studies and to arrive at the implications for the present study. In view of the variation in the focus of the studies reviewed they have been categories in terms of the following aspects :

I. Studies conducted on the construction and standardization of scientific attitude scale.

II. Studies conducted on measurement of scientific attitude and its relationship with other variables.

It may be mentioned here that the above classification is by no means an exhaustive one. Further, while reviewing, some studies may appear exclusively on any one

section and other may cut across both the sections. A detailed discussion of studies on both the sections is presented in what follows :

2.2 STUDIES CONDUCTED ON THE CONSTRUCTION AND STANDARDIZATION OF SCIENTIFIC ATTITUDE SCALE.

Studies reviewed in this section have mainly focused on two aspects viz., (a) operationalization of the construct scientific attitude and (b) construction and standardization of scientific attitude scale.

From the studies conducted by Jain (1967), Branganza (1970), Kozlow and Nay (1976), Golwalkar (1978), Srivastava (1980), Ramachary (1982), and Sanadhya (1996), it can be observed that different researchers have operationalised the construct scientific attitude differently resulting thereby no unanimous acceptance of the construct. However, while operationalizing the construct scientific attitude most of the researchers have adopted a uniform pattern i.e. identifying the components and then arriving at the meaning. Even in this uniform pattern a lot of variation exists. The studies conducted by Kozlow and Nay (1976), Srivastava (1980), and Sanadhya (1996), have identified the components of scientific attitude which are nearly similar.

The common components identified by those researchers are Rationality, Openmindedness, Intellectual Honesty, Suspended Judgment and Aversion to superstitions. Apart from these common components Kozlow and Nay (1976), also included criticalmindedness, willingness to change and Questioning attitude ; Srivastava (1980), included Superstitions and Curiosity and Sanadhya (1996), included Curiosity in the operationalization of the construct scientific attitude.

Branganza (1970), used ten components of scientific attitude, which were : Intellectual honesty, High Order of curiosity, Freedom from superstitions, Confidence intelligence of belief that one can solve problems, Belief in progress, Belief in caurse and effect relationship, Respect for evidence, Suspended judgment, Freedom from prejudices, and Modesty. Golwalkar (1978), also used ten components of scientific attitude but they are different from the components used by most of the researchers. They are : Examines statement critically, Is open-minded, Is sceptic in nature, Perceives inconstancies in views, Has a strong desire for explanation of factor, Is objective in approach, Follows systematic method, Neglects the immediate values of things, and Is precise. A close look at these components reveals nothing but the behavioural specification of

components like Rationality, Curiosity, Openmindedness and Objectivity.

Similarly, Vyas (1981), used the following ten components; Scepticism, Faith in the possibility of solving problems, Precision and respect for quantification, A liking for new things, Willingness to change opinion, Humility and suspended judgment, Loyalty to truth, Aversion to superstitions, Liking for scientific explanations, and Acceptance of probabilities. These are also the behavioural specifications of components of scientific attitude like Criticalmindedness, Openmindedness, Rationality, and Intellectual honesty.

Instead of either identifying the components and listing the behaviours under identified components or simply specifying the behaviours, Jain (1967), classified the behaviours into the following four domains: intellectual Domain; Affective Domain; Cognitive Domain; and Metaphysical and Mythological Domain. The classification of behaviours under the four domains was: Intellectual Domain Belief in Cause and effect relationship, Looking for sufficiency of data in coming to certain conclusions, Arousing intellectual curiosity; Affective Domain Respecting others production of data with a view to verify it, Preparedness to share his

findings with others, Believing that scientific inventions are not bad in themselves ; Cognitive Domain - Showing intellectual honesty, Doing a task to its logical conclusion, Withholding Judgment; and Metaphysical and Mythological Domain - Freedom from superstitions, Freedom from prejudices, and Disbelieving fatalism or Avoiding bigotry and fanaticism. Though this classification is according to the different domains, the behaviours under the domains can be ultimately clubbed into the components like Rationality, Curiosity, Openmindedness, Intellectual honesty, Objectivity, and Humility.

On the basis of the analysis presented so far it can be inferred here that most of the researchers have operationalised scientific attitude as a combination of certain components which are described with the help of specification of behaviours that an individual manifests. However, Ramachary (1982), has operationalised it very broadly as "an opinion or position taken with respect to psychological object in the field of Science".

For the purpose of measurement of scientific attitude, most of the researchers have developed a scale based on the identified component and/or specification of behaviours under the identified components. While Srivastava (1980), used the the scale developed by Billechy and Zakharidas (1975), and Ramachary (1982),

used a scale prepared by Moore and Sutmen (1970). Kozlow and Nay (1976), adopted a multidimensional approach i.e. the researchers took into account the opinion of groups of students by their teachers along with the data collected by administering scientific attitude scale developed by them.

With respect to the technique of scientific attitude scale construction most of the researchers have adopted either Thurstone's equal appearing interval technique or Likerts summated rating technique except Srivastava (1980), who selected the items by the technique of Thurstone's equal appearing interval and modified the items by the technique of Likert's summated ratings.

Most of the scientific attitude scales were developed to measure scientific attitude of secondary and higher secondary school students except Jain (1967), Srivastava (1980), and Sanandhya (1996). Jain (1967), developed it for second year students of Delhi, Srivastava (1980) developed it for science and non-science teachers and students, and Sanandhya (1996), developed it for Pre-service and In-service Science and Humanities teachers of Rajasthan. The size of sample was minimum of 150 in the study of Golwalkar (1978), and was maximum of 950 in the study of Sanandhya (1996).

The number of items or statements in the scientific attitude scale was ranging from thirty to forty. The nature of items was multiple choice type in the study of Jain (1967), whereas, in the rest of the studies it was in the form of statements representing hypothetical situations.

Jain (1967), computed the reliability coefficient of the developed scale by using KR-20 formula the value of which was 0.63. Kozlow and Nay (1976), classified the components of scientific attitude into three categories, viz.: 'Cognitive,' 'Intent', and 'Action' component. The reliability coefficient of these three groups components as estimated by KR-20 formula was 0.55, 0.45, and 0.39 respectively. However, the test - retest stability coefficients for these groups were 0.71, 0.68, and 0.64 respectively. Whereas, Sanadhya (1996), Computed the reliability coefficient by split-half method and it was found to be 0.88. The correlation coefficients between the total attitude scores and the scores on various dimensions taken separately ranged from 0.62 to 0.82.

2.2.1 Some observations and Implication

The review of studies on construction and standardisation of scientific attitude scale reveals, that though the teachers and the teacher educators are

aware of the importance of scientific attitude and its measurement, in nearly three decades time (from 1967 to 1996) only a few standardized scientific attitude scales have been developed by researchers. Again, out of the available studies most of them have concentrated upon the development of scientific attitude scale for secondary and/or higher secondary school students. For other groups of students a very scant attention has been paid by the researchers. While on the one hand adequate attention should be paid for the development of scientific attitude scale for different age group of students, higher emphasis should be laid upon the development of scientific attitude scale for secondary and/or higher secondary school students. This is because at the end of secondary and/or higher secondary school education, most of the objectives specified for that stage are supposed to have been achieved. In such situation, it would be essential to measure the scientific attitude of the target students and compare it with specified objectives. Such comparison would throw light on the attainment of the specific objectives. Based on such comparison, required modifications can be made in the curriculum, teaching methods and educational policies and programmes. For this more number of valid and reliable scientific attitude scale would be required.

It is observed from the review of the available studies that researchers agree on the complex nature of the construct "Scientific attitude". This is evident from the manner in which the researchers have operationalised scientific attitude in their studies. The researchers in their studies have included a combination of different components that constitute scientific attitude. However, a close analysis of the operationalization of scientific attitude reveals that very important components like Environmental awareness, and Courage to question were not included by any of the researchers. This implies that, as scientific attitude is complex in nature, thorough and detailed study of the available literature is essential and opinions of the experts in the field should be sought to properly operationalise it.

On the one side, it is found from the review of the studies that researchers agree to the problem of identifying behaviours under scientific attitude as its constituents are many and varied in nature and on the other side, there are only thirty to forty items or statements in the scientific attitude scale to measure it accurately. How can such a small number of items or statements have capacity to measure scientific attitude of individuals ? There is a need to develop and standardize more scientific attitude scales with adequate

number of items or statements capable of estimating the scientific attitude of an individual precisely. Moreover, the available scales were developed in different states of our country. They are either in Hindi or English. Owing to the fact that we have different regional languages in different states and more number of students at secondary and/or higher secondary stage are studying through the medium of regional language than through the medium of English, scales in regional language of the students would be required.

With respect to the examination of the methodology of the standardization of the developed scales, it reveals that there is no uniformity with respect to the estimation of coefficient of reliability of the scale.

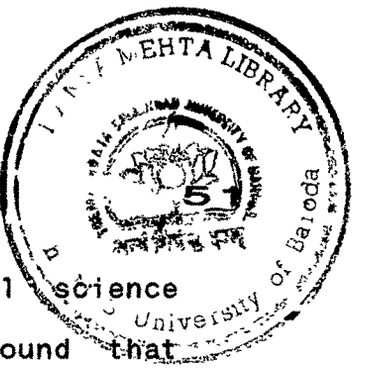
2.3 STUDIES CONDUCTED ON MEASUREMENT OF SCIENTIFIC ATTITUDE AND ITS RELATIONSHIP WITH OTHER VARIABLES.

In this section, studies related to measurement of scientific attitude of different group of individuals and finding its relationship with other variables have been reviewed. Studies on measurement of scientific attitude have been conducted by Branganza (1970), Billechy and Zakharidas (1975), Bhaskara Rao, et. al. (1986), and Bhaskara Rao (1996). The study of Branganza (1970), revealed that many of the high school students of Goa

have acquired the scientific attitude. Again the students of standard X have higher scientific attitude than the students of standard IX and Scientific attitude of the students of standard XI was highest among the three classes. However, the researcher concluded that the students have acquired the scientific attitude, but have not acquired all the characteristics of the scientific attitude. Similarly, Billechy and Zakharidas (1975), had studied the scientific attitude of 349 secondary school students, 121 University students and thirty one science teachers. The researchers found that all the groups demonstrated positive scientific attitude. Contrary to this Bhaskara Rao, et. al. (1986), in their study with experienced secondary school teachers found that sixty five per cent of the sample hold low scientific attitude. Only thirty five per cent of them hold an average scientific attitude and no one from the sample with high scientific attitude. In another study, Bhaskara Rao, et. al. (1989), found that the prospective science teachers were also holding low scientific attitude. In one more study on scientific attitude vis-a-vis scientific aptitude of secondary school students of Guntur district of Andhra Pradesh Bhaskara Rao (1996), found that secondary school students had an average scientific attitude.

The studies on the comparison of scientific attitude of different groups of individuals (the students and the teachers) have been carried out by Srivastava (1980), Vyas (1981), Sindhe (1982), Ghosh (1986), Dubey and Ghai (1993), Bhaskora Roa (1996), and Sanadhya (1996). With respect to the scientific attitude of boys and girls, Vyas (1981), Sindhe (1982), Ghosh (1986), and Bhaskara Rao (1996), found that the two groups do not differ significantly, but contrary to this Srivastava (1980), found that boys and girls differed in respect of their scientific attitude. About the scientific attitude of male and female teachers, Dubey and Ghai (1993), found that the male and female teachers did not differ significantly on their scientific attitude.

On the Similar line the comparison of scientific attitude of different groups of students have been studied by Billechy and Zakharidas (1975), Vyas (1981), Sindhe(1982), and Bhaskara Rao (1996) ;b and that of teachers have been studied by Dubey and Ghai (1993), and Sanadhya (1996). About the scientific attitude of science teachers, Billechy and Zakharidas (1975), in their study found that there was no significant difference between the university students and science teachers. Based on this findings the researchers have concluded that experience in secondary school does not seem to be an effective cause of scientific attitude. Vyas (1981),



studied the scientific attitude of optional science students and compulsory science students and found that the optional science students possess significantly higher scientific attitude than their counterpart. Sindhe (1982), found that students with high academic achievement had high scientific attitude, students with average academic achievement had average scientific attitude and the low achievers had a low scientific attitude. Bhaskara Rao (1996), found a significant difference in the level of scientific attitude possessed by the students of private and government schools and by the students of rural and urban secondary schools. Thus, it can be concluded that students of belonging to different groups like urban and rural, private and government schools, high, low and average academic achievement, and optional science and compulsory science differ with respect to their scientific attitude. Whereas, university students and experienced science teachers do not differ with respect to their scientific attitude.

The comparision of scientific attitude of different groups of teachers have been studied by Dabey and Ghai (1993), and Sanadhya (1996). In their study on comparision of scientific attitude of college teachers with teachers of Saraswati Bal Mandir, Dubey and Ghai (1993), found that there was no significant difference

between the mean scores of college teachers and Saraswati Bal Mandir Teachers on their scientific attitude. It was also found that the science teachers and the humanities teachers; and the teachers below thirty years and the teachers above thirty years did not differ significantly on their scientific attitude. Similarly, significant difference in the mean score of scientific attitude was not found between the in service and the pre-service science teachers and between the in-service science teachers and the in-service humanities teachers, in the study of Sanadhya (1996). Thus, it is observed that teachers of different groups from Bal Mandir to university, Pre-service to in-service, and Science to humanities subject do not differ significantly with respect to their scientific attitude.

The relationship of scientific attitude with other variables have been studied by Srivastava (1980), Ramachary (1982), Sindhe (1982), Vardhini (1983), Ghosh (1986), and Bhaskara Rao (1996). The study of Srivastava (1980), revealed that the amount of scientific knowledge or general exposure to science courses made an impact on scientific attitude. A similar kind of finding has been arrived at by Ramachary (1982), and Vardhini (1983). In their studies, a significant positive relationship between scientific attitude and achievement in Science subjects was found Ghosh (1986), and Bhaskara Rao (1996),

found a significant positive relationship between scientific attitude and scientific aptitude. While Sindhe (1982), found that the correlation between scientific attitude scores and non-formal science activity score was negligible and was not significant. Thus, it can be observed that scientific attitude is related to the knowledge of science and is also related to scientific aptitude i.e. the interest in and inclination for scientific knowledge.

2.3.1 Some Observations and Implications

Though a very few studies have been conducted on measurement of scientific attitude a cursory examination of the available studies reveals that most of the students and teachers possess scientific attitude. This is an indication of the attainment of one of the objectives of teaching science. However, a detailed examination of the studies which have been reviewed is a matter of concern for the teachers and teacher educators. This is so because the acquisition of scientific attitude by the secondary and higher secondary school students is either upto an average level or upto low level. Moreover, majority of the teachers possess the scientific attitude upto a low level. Even the prospective teachers who are comparatively younger than the teachers on job were also holding a low scientific attitude. Apart from this, it

is the team of this prospective teachers, on whom the future of any nations' educational progress depends. Now, if such teachers do not possess a high level of scientific attitude, it is very difficult to accept that they will be in position to inculcate the same in the students - the future citizens of any nation. So, it is implied that teacher educators should take care to make the prospective teachers aware about the importance of scientific attitude.

The analysis of scientific attitude possessed by different groups of students reveals that they differ significantly with respect to their scientific attitude. Regarding this, it can be concluded that due to the differences in the academic facilities available in the private and government schools and in the rural and urban schools, the difference in the possession in scientific attitude prevails. However it is observed that not even a single study has focused on the scientific attitude possessed by different socio-economic status groups of students. Hence, more studies should be conducted to measure scientific attitude of students who are differing with respect to location of school, socio-economic status, achievement in science and other school subjects, medium of instruction, parents qualification, the qualification and experience of teachers who are teaching them, and so on. Also there is a dearth of studies to

find out the reasons for different acquition of scientific attitude by different groups of students.

A detailed analysis of the studies on relationship of scientific attitude with other variables or vice versa reveals that scientific attitude is correlated with scientific knowledge and scientific aptitude. Whereas, the relationship of it was not found significant with non-formal science activity. keeping in mind the nature of scientific attitude, the involvement of a student in non-formal science activities should rather facilitate scientific attitude. Apart from this, there is a ongoing debate among teacher educators whether scientific attitude can be inculcated in student through the teaching of science only or through the teaching of other school subjects also ? To get adequate evidences to resolve the debate, more studies would be required to find out the correlation of scientific attitude with variables like achievement in science, achievement in other school subjects, participation in non-formal science activities, and so on.

2.4 IMPLICATIONS OF THE REVIEWED STUDIES FOR THE PRESENT STUDY.

From the review of studies under two sections in this chapter, it can be observed that there is a dearth of studies in the area of scientific attitude. Such an

observation can be made by the sheer presentation of certain facts from the educational surveys like the number of studies available in the area of science education (101) in general and scientific attitude (04) in particular. Further, it can be observed the studies have either concentrated on construction and standardization of scientific attitude scale or measurement of scientific attitude but both the aspects have not found a place together in most studies. On the basis of these observations it can be concluded that the focus of the available studies is limited.

With regard to the operationalization of the construct scientific attitude it was observed that researchers are not unanimous in their ideas. Such a situation has led to inconclusive findings. In such a situation adequate attempt should be made to come out with a comprehensive meaning which will pave the way for a proper policy planning and curriculum reform in teaching of science.

The review further reveals the inadequate attention paid by the researchers in developing scientific attitude scale for different age group of students and the limited number of scales available for the secondary and/or higher secondary school students. Furthermore, the availability of scientific attitude scale in regional languages is far too less to be desired. This is another

area which requires more work. While it is expected that the objectives of teaching of science are generally achieved at the end of school education, more number of studies are required at this stage to ascertain whether the objectives of teaching of science have been achieved or not. Such findings will help the curriculum designers to suitably modify the curriculum.

With regard to the studies on the measurement of scientific attitude, it can be observed that the degree of possession of scientific attitude by different group of students and teacher is just average or far too low. On the similar lines the comparision of the possession of scientific attitude by different groups of students and teachers also reveals the glaring differences. Though such findings are very disturbing but the scarcity of studies in this area withholds the researcher to seriously comment on this aspect. At most, it would be highly appreciated if more number of studies are conducted in finding out the reasons of such a dismal finding rather than simply pointing out the lacuna.

Furthermore the review reveals that a significant positive relationship exists between scientific attitude and scientific knowledge and between scientific attitude and scientific aptitude such a situation warrants to find out in what nature such relationship exists and how it

can be further nurtured. Such attempts would unreveal many subtle nuances of scientific attitude as a construct and thereby help the planners to formulate for better programmes and help teachers to take students to a very high level.

With regard to the methodology adopted by the studies reviewed in this chapter, it can be observed, that the sample taken to standardize the scientific attitude scale by most of the researchers in their studies is inadequate. Further, the items in the scientific attitude scale are for too less, the coverage of the components for operationalization of the construct have left out the areas like Environmental awareness and Courage to question. Such lacuna in the existing studies call for a more comprehensive work carefully taking into account most if not all the aspects of scientific attitude.

In the end it can be stated that so far, no study has been attempted which takes care of all the three major aspects viz., Operationalization of the construct scientific attitude, construction and standardization of scientific attitude scale, and measuring scientific attitude and finding it relationship with other variables like, achievement in science, general achievement and socio-economic status of students. In this direction, in the present study an attempt has been made to take care

of these lacuna found in the existing literature. In the following chapter, a detailed discription of the process of operationalization of scientific attitude and construction and standardization of scientific attitude scale has been given. Further, the methodology of finding out the relationship of scientific attitude with other variables have been discussed in greater detail.