SCIENTIFIC REASONING OF HIGHER SECONDARY SCHOOL STUDENTS

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ABSTRACT

The main objective of the study was to find out the significant difference in scientific reasoning among higher secondary students with respect to gender, locality of school and type of management of school. the investigator adopted survey method for the study. The sample consisted of 300 VIII standard students in Kottayam. The tool prepared and validated by Vishwanadhan Nair and Sobhana Devi, Kerala University, Thiruvananthapuram (1993) was used to measure the Scientific Reasoning of the sample. The statistical techniques used in the study were Mean, Median, and Standard Deviation and 't' test. The findings revealed that there was significant difference in scientific reasoning among higher secondary students with respect to gender, locality of school and type of management of school.

INTRODUCTION

"Science is built up of facts as a house is of stones, but a collection of facts is no more a science than a pile of stones is a house".

(Poincare, 1908)

Learning about science requires the coordination of a complex set of cognitive, affective, and motivational strategies and skills. Specifically, research from educational psychology can contribute greatly to our understanding of how adolescents acquire and process scientific knowledge; overcome misconceptions; learn the discourse of scientists; learn to think and reason like scientists; evaluate sources of scientific information; and reconcile personal beliefs (e.g., religious and political beliefs) with science content. The ability to think adaptively and reason

about complex problems requires weighing issues and arguments and considering alternative points of views (Dole & Sinatra, 1998). Adolescents generally have the capability to reason and think critically, but this ability must be fostered and scaffolded for most students to engage with information in a critical fashion. Teachers should play a vital role in supporting the development of learning and reasoning skills.

NEED AND SIGNIFICANCE OF THE STUDY

Scientific reasoning is a higher level intellectual activity employed in the learning process. The word 'Reasoning' is used to describe the mental recognition of cause and effect relationships. It is also called logical thinking. It may be the prediction of an event from an observed cause or the inference of a cause from an observed event. It is best defined as a problem solving activity. It is the organization of all relevant experiences/relationships with reference to a particular problem situation. Reasoning consists of making a new judgment on the basis of judgment or judgments already formed and as a commonly defined as perceiving relations among judgments or see agreement or disagreement among judgments already made (Bhatia, 1968). It helps the person to fit a problem or situation into familiar social, cultural or psychological patterns so that his decisions and actions have continuity and are understood by others. Scientific reasoning can be defined as domain of general abilities along several skill dimensions. A developing list of such skill dimensions includes Control of Variables, Proportions and Ratios, Probability, Co relational Reasoning, Basic Logical Reasoning, Inductive reasoning, Causal Reasoning and Hypothetical-Deductive Reasoning.

Reasoning does not occur unless a difficulty or a question has risen, for which there is no answer. It involves trial and error and also insight .Therefore reasoning is a variety of learning. After reasoning, the organism is left with new patterns of response in the face of situations where he or she had a different one before. But in reasoning, as contrasted with trial and error learning, one's past experiences play a much greater role. Previous experiences are recalled and organized into patterns that did not exist before. However an increasingly sophisticated knowledge base supports increasingly sophisticated forms of reasoning.

Many adolescents have the reasoning, metacognitive, and self-regulatory skills necessary for problem solving, but the motivation to approach difficult problems and persist toward solutions is rare among individuals of all ages. Today's world is a complex place and scientific

problems increasingly require abstract reasoning about systems to appreciate their intricacies (Goldstone & Sakamoto, 2003). Consider problems such as tornado forecasting, predicting the catastrophic effects of a pandemic, or understanding the reasons for the decline in the bee population: understanding each of these requires students to think about how multiple systems interact. The students can be motivated by improving the quality of education that they receive from the school. A creative teacher can provide ample opportunities for them to enhance their critical thinking skill.

Even if a teacher provides appropriate environment to support critical scientific thinking and reasoning, students often lack the requisite background knowledge to do so effectively. The ability to reason effectively and adapt to changing situations requires rich, interconnected, domain specific knowledge. Lack of sufficient domain and specific content knowledge limits the task of thinking critically. If tomorrow is to be a better and brighter one, today's children are to be focused; because they are the adults of tomorrow. It is their reasoning ability that design and determine the future. So the investigator felt the need to study the reasoning ability of higher secondary school students.

OBJECTIVES OF THE STUDY

1. To study the level of Scientific Reasoning of higher secondary school students.
2. To find out the significant difference in the means scores of Scientific Reasoning among higher secondary school students with respect to a. Gender b. Locality of school. c. Type of management of school

HYPOTHESIS OF THE STUDY

There is significant difference in the mean scores of Scientific Reasoning of higher secondary school students with respect to a. Gender b. Locality of school. c. Type of management of school

METHODOLOGY

The investigator used Normative Survey Method for the present study. The population of the study consisted of VIII standard students in Kottayam District and the sample consisted of 300 VIII standard students in Kottayam. The tool prepared and validated by Vishwanadhan Nair

and Sobhana Devi, Kerala University, Thiruvananthapuram (1993) was used to measure the Scientific Reasoning of the sample. The statistical techniques used in the study were Mean, Median, and Standard Deviation. The test of significance of difference between two means was also calculated for comparison.

RESULTS AND DISCUSSION

1. Level of Scientific Reasoning of Secondary School Students

The statistical constants namely Mean, Median and Standard Deviation were computed for the Scientific Reasoning scores.

Table 1

MEAN, MEDIAN AND STANDARD DEVIATION (S.D) OF THE DISTRIBUTION OF SCORES ON SCIENTIFIC REASONING OF HIGHER SECONDARY SCHOOL STUDENTS

Variable	N	Mean	Median	SD
Scientific Reasoning	300	7.83	8	2.08

From table 1 it is understood that the value of the Arithmetic Mean for the total sample is 7.83. The value of Median obtained is 8 and the Standard Deviation of the distribution is 2.08.

2. Level of distribution of Scientific Reasoning among the sample

The investigator classified the students as below average, average and above average based on the formula X+σ and X-σ. The students who scored between X+σ and X-σ are average students and those above X+σ are above average students. Those below X-σ are below average students.

Table 2

CLASSIFICATION OF STUDENTS IN TERMS OF SCIENTIFIC REASONING

Below Average	Average	Above Average

11.67%	67.67%	20.67%

Table 2 indicates that 11.67% are in below average level of Scientific Reasoning, 67.67% are in average level and 20.67% falls in above average levels of Scientific Reasoning.

Hypothesis 1

There is significant difference in the mean scores of Scientific Reasoning of higher secondary school students with respect to a. Gender b. Locality of School c. Type of Management of School

Table 3

SIGNIFICANT DIFFERENCE IN THE SCIENTIFIC REASONING OF STUDENTS BASED ON GENDER, LOCALITY AND TYPE OF MANAGEMENT OF SCHOOLS

No:	Group		Sample Size	Mean	SD	CR	Level of significance
1	Gender	Boys	150	8.17	1.95	2.89	P<0.01
		Girls	150	7.49	2.15		
2	Locality	Urban	150	8.19	2.18	3.07	P<0.01
		Rural	150	7.47	1.91		
3	Type of Management	Aided	150	7.46	1.97	2.08	P<0.05
		Unaided	150	7.96	2.18		

The mean and Standard Deviation of Scientific Reasoning scores of boys are 8.17 and 1.95 respectively and means score and Standard Deviation of girls are7.49 and 2.15 respectively. The difference in their mean was tested for significance. The t-value obtained is 2.89, which is greater than the table value of significance at 0.01 level. Thus it can be inferred that there is significant difference in the mean scores of students in Scientific Reasoning with respect to gender.

Critical ratio of Scientific Reasoning of students according to locality is 3.07, which is higher than the table level of significance at 0.01 level (3.07, $P<0.01$). It shows that there is significant difference in the mean scores of students in Scientific Reasoning with respect to locality. It is interpreted that students from schools in urban area exhibit high Scientific Reasoning than rural area. Because the students in schools of urban area got high exposure in academic activities, social activities and also they got up-to-date information regarding each and every aspect of information and knowledge management in education, technological and economic progress of the country.

The students from Government and Unaided schools were compared on the basis of their Scientific Reasoning. Critical ratio obtained for Scientific Reasoning of students according to type of management of schools is 2.08 and which is higher than the table value of significance at 0.05 (2.08, $P < 0.05$). This leads to the conclusion that there is significant difference in the mean scores of students in Scientific Reasoning with respect to the type of management of schools.

CONCLUSION AND IMPLICATIONS OF THE STUDY

The study has thrown light on the present status of Scientific Reasoning of students in the secondary schools. Findings of the study revealed that Scientific Reasoning ability of majority of the students are in average level only. Hence innovative strategies and techniques should be incorporated in the curriculum transactions in order to enhance the Scientific Reasoning of students. The major findings of the study and the conclusion drawn from the findings helped the investigator to frame some measures to develop the Scientific Reasoning of students.

1. Creative spirit and reasoning power of children should be identified and stimulated.
2. The curiosity of children should be nourished and diverted to fruitful means.
3. Provide a class room environment that encourages and nourishes the creative spirit and reasoning ability in the child.
4. The beginning of reasoning /logical thinking starts when we confront a problem before the children, which has been properly developed. So education must be correlated with the problems of the daily life.

5. Encourage more student involvement in activities related to Science, through learning by doing.
6. Train students to find solutions to problems in their daily life through logical thinking and promote better understanding.

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