REVIEW OF RESEARCH

A STUDY ON THE RELATIONSHIP BETWEEN SCIENTIFIC REASONING AND SCIENTIFIC INTEREST OF SECONDARY SCHOOL STUDENTS

ISSN: 2249-894X
IMPACT FACTOR : 5.7631(UIF)
UGC APPROVED JOURNAL NO. 48514
VOLUME - 8 | ISSUE - 8 | MAY - 2019

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ABSTRACT:

Reasoning helps us to generate new knowledge and to organize existing knowledge making it more usable for future mental work. Reasoning therefore becomes central to many forms of thought such as scientific, critical, and creative thinking, argumentation, problem solving, and decision making. Students can explore in the field of Science and Technology only through the development of scientific reasoning power. Measuring scientific interest includes the ability of the students to appreciate and recognize the scientific aspects related to the content area and its related implications such as Technological applications, Industry, environmental issues, health and Nutritional values and other daily life applications. In the present study, the investigator tried to find out whether there exists any significant relationship between scientific reasoning and scientific interest of secondary school students for the total sample and subsamples based on Gender and Type of Management of School. The investigator also tried to find out whether there exists any significant difference in the scientific reasoning and scientific interest of secondary school students based on their Gender and Type of Management of school.

KEYWORDS: *Scientific reasoning, scientific interest, secondary school students.*

1.1 INTRODUCTION

Kuhn & Franklin (2006) defines scientific reasoning as involving both conceptual understanding and inquiry skills. Scientific reasoning differs from other types of information seeking in that it requires additional cognitive resources as well as an integration of cultural tools. Scientific reasoning is a specific type of intentional information seeking, which shares basic reasoning mechanisms and motivation with other types of information seeking (Kuhn, 2011).

Scientific reasoning assesses students' abilities in six dimensions including conservation of matter and volume, proportional reasoning, control of variables, probability reasoning, correlation reasoning and hypothetical-deductive reasoning (Lawson, 2000). Problem identification is built from an analysis of the situation. Exact identification of the problem requires proper scientific reasoning ability among the students. Inductive reasoning is the process in which it is believed that the premises of an argument support the truth of the conclusion. It is true even for a good argument, where it is quite possible that there will be false conclusion even if the premise is true (Lipton, 1998; Popper, 1998). Deductive reasoning or deduction consists of arguments where if the premises are assumed to be true, then it is impossible for the conclusion to be false. Using deduction, there is a formulation of specific conclusion from a general truth (Lipton, 1998). Interpretation of results obtained from data must be scientific in the sense that the interpretations must have a clear scientific base and should be the result of proper scientific reasoning. Students make

valuable suggestions and conclusions based on findings from study or experiment. They critically analyze each aspect of the findings based on certain criteria and makes critical judgements regarding the phenomenon based on proper reasoning.

Hidi & Renninger (2006) and Silvia (2006) stated that interest is mostly understood as a phenomenon that emerges from an individual's with his or her environment. Schiefele (2009) explained that the most important characteristics in interest is an individual's values and feelings. According to Dewey (1986), there is a strong connection between Interest and effort, i.e. the more a person becomes interested in a subject, the more effort he will put in it. Dewey (1979) described an interesting person as one being engaged, engrossed or entirely taken up with some activity because of its recognized worth. The content area for an Interest are either characterized in a general way by referring to a broad area of knowledge or possibilities of Interaction with the environment, or by describing specific topics or activities in which a person is actually interested. The content area of science Interest would comprise the whole body of science – related subjects and topics of which a person is aware. This is known as Interest in Science at a concrete or generalized level. In abstract level, an Individual's Science Interest can be limited to a particular School subject or to particular topics and activities within a subject domain, a discipline or a research field. Every young child tend to observe their environment in a systematic manner; since they enjoy new experiences and are ready to learn more about natural phenomena with which they are confronted. A critical phase for the development of Science Interest is adolescence, when students start to clarify their personal aims and ambitions.

1.2 NEED AND SIGNIFICANCE OF THE STUDY

Inhelder & Piaget (1958) assumed that scientific rationality was a model for ideal human reasoning, that is, a person who reflects on theories, builds hypothetical models of reality, critically and exhaustively tests for all possible major and interaction effects between variables and objectively and systematically evaluates evidence with respect to a claim. Jaleel & Premachandran (2017) found out that scientific reasoning is positively related to Achievement in chemistry and that the learning activities and written assignments in the classroom all should be designed in such a manner to arouse and promote scientific reasoning in students. This will leads to learning the scientific concepts at a greater rate and thereby better achievement in the content area. The study result stresses the importance of developing scientific reasoning in students for making the Science learning more creative and reflective.

Measuring scientific interest includes the ability of the students to appreciate and recognize the scientific aspects related to the content area and its related implications such as Technological applications, Industry, environmental issues, health and Nutritional values and other daily life applications. The content area of Science interest would comprise the whole body of science related subjects and topics of which a person is aware. A critical phase for the development of Science interest is adolescence, when students start to clarify their personal aims and ambitions. Premachandran & Jaleel (2017) have found out that Scientific Interest and Achievement in Chemistry are positively correlated and that the Teaching and learning activities in Science classrooms should focus on the ways for arousing Interest in the minds of students who are the budding scientists for the future scenario. Moreover the concepts and principles learning in the class rooms must be properly interconnected with the practical life situations in daily life.

From these studies, it was found that both scientific reasoning and scientific interest have a significant relationship with achievement of students related to science domain. So it was assumed that the scientific reasoning power and scientific interest of students may have a significant relationship between them. For developing proper reasoning ability in science concepts, an interest for the scientific concepts is a prerequisite. Then only students can go deep into the theoretical aspects related to each concept and apply them in practical situations using proper reasoning power. Hence the investigator decided to check whether there exists any significant relationship between the scientific reasoning and scientific interest of secondary school students for the total sample and subsamples.

1.3 HYPOTHESES OF THE STUDY

- There will be significant positive relationship between scientific reasoning and scientific interest of secondary school students for the total sample and subsamples Gender and Type of Management of School
- There will be significant difference in the scientific reasoning of secondary school students based on Gender and Type of Management of School
- There will be significant difference in the scientific interest of secondary school students based on Gender and Type of Management of School

1.4 OBJECTIVES OF THE STUDY

- To find out whether there exist any significant relationship between scientific reasoning and scientific interest of secondary school students for the total sample and subsamples Gender and Type of Management of School
- To find out whether there exist any significant difference in the scientific reasoning of secondary school students based on Gender and Type of Management of School
- To find out whether there exist any significant difference in the scientific interest of secondary school students based on Gender and Type of Management of School

1.5 POPULATION AND SAMPLE FOR THE STUDY

The population selected for the present study consists of students of standard IX in the Secondary Schools of Kerala, under the Department of General Education. The sample selected for the study consists of 176 secondary school students studying in standard IX from various schools of Kottayam district. Out of the 176 secondary school students, 94 were boys, 82 were girls, 77 from Government school and 99 from Aided schools. The sample was selected using stratified random sampling technique.

1.6 TOOLS USED FOR THE STUDY

1.6.1 Scientific Reasoning test: - The Investigator prepared a Scientific reasoning Test based on the five dimensions namely Problem Identification, Interpretation of Results/Data, Making logical conclusions, Deductive reasoning and Inductive reasoning. The initial draft consisted of 70 items with a total of 75 Marks. After Standardization process, the number of items was reduced to 26 with a total mark of 45. Items with *t* value > 8.500 at .01 level were only considered for the final test. Reliability of Scientific reasoning test was ensured using Test – re test reliability. The Chronbach's α Coefficient for the whole test was found to be .994. The Chronbach's α Coefficient obtained for various components of Scientific Reasoning test are .943 for Problem Identification, .981 for Inductive Reasoning, .981 for Deductive Reasoning, .983 for Interpretation of results and .974 for Making Logical conclusions and Critical evaluations. Face validity, Content validity and Intrinsic validity were used to validate the test. For the whole test the Intrinsic validity coefficient was found to be .996. The validity coefficients obtained for the components of Scientific reasoning are .948 for Problem Identification, .983 for Inductive Reasoning, .981 for Deductive Reasoning, .984 for Interpretation of Results and .976 for Making logical conclusions and Critical evaluations.

1.6.2 Scientific Interest Inventory: - The investigator prepared and standardized a scientific interest inventory in the form of a Likert type scale following a five point scale. The Inventory was prepared based on six dimensions namely Interest towards Science in General and practical applications of Science, Interest towards influence of Science in daily life, Interest towards Chemistry as a Science subject and Practical applications of chemistry, Interest towards the inter-relation between various branches of Science with Chemistry, interest towards the values related to Science in General and Chemistry in specific and Interest towards the Career related to the Field of Chemistry. The initial draft consists of 90 items. After standardization, 30 items having t-value greater than 8.36 were selected for the final draft. The reliability of the Scale were found out as 0.878 by split half method. Intrinsic validity

was found out as 0.937 and content validity was also established. The maximum score of the scale was 150.

1.7 METHODOLOGY USED FOR THE STUDY

The investigator administered scientific reasoning test and scientific interest inventory among secondary school students of the selected sample. The answer sheets were collected; tabulated and suitable statistical techniques were used for analyzing the data obtained.

1.8 STATISTICAL TECHNIQUES USED

- ✓ Descriptive Statistics
- ✓ Significance of difference between Means
- ✓ Call Pearson Product moment Correlation

1.9 LIMITATIONS AND DELIMITATIONS OF THE STUDY

Limitations are those elements over which the researcher has no Control. The investigator could not fully rely upon the information given by the sample. This study could be conducted only in one district of Kerala state due to lack of time. Extraneous variables like lack of interest, fatigue, retention, and over learning might have influenced the performance of students. Delimitations are the characteristics selected by the researcher to define the boundaries of the study. The study was delimited to two schools in the Kottayam district only. Due to lack of time and other necessary facilities, the investigator could not conduct the study in more schools or districts. The sample was confined to the students of standard IX only. Finally only the Government and Aided secondary schools coming under Department of General Education, Government of Kerala were considered for the study.

2. ANALYSIS AND INTERPRETATION OF THE STUDY

2.1 Relationship between Scientific reasoning and Scientific interest of secondary school students for the total sample and subsamples based on Gender and Type of Management of school

The investigator collected the scores of students on scientific reasoning test and scientific interest inventory. The mean and standard deviation obtained for the total sample and subsamples based on Gender and Type of management of school on scientific reasoning and scientific interest were given in Table 1.1.

Table 1.1

Descriptive statistics for the Total sample and Relevant subsamples on Scientific reasoning and Scientific Interest

variables	Total sample		Boys		Girls		Government school		Aided school	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Scientific reasoning	24.31	11.23	25.5	10.92	22.95	11.49	25.77	12.5	23.18	10.1
Scientific interest	120.34	17.5	118.45	17.11	122.50	17.73	126.01	14.32	115.92	18.5

Table 1.1 shows that the scientific reasoning of Boys is slightly greater than Girls and also scientific reasoning of Government school students are slightly greater than that of aided school students. Similarly the scientific interest of Girls was found to be slightly greater than that of Boys and the scientific interest of Government school students was found to be slightly higher than that of aided school students.

The correlation between scientific reasoning and scientific interest were found out for the Total sample and subsamples based on Gender and Type of Management of school using Pearson Product moment correlation. The results obtained are given in Table 1.2.

Table 1.2

Correlation between Scientific Reasoning and Scientific Interest for the Total sample and Subsamples

No.	Variables Correlated	'r' value				
		Total sample (N = 176)	Boys (N = 94)	Girls (N = 82)	Government (N = 77)	Aided (N = 99)
1	Scientific reasoning and Scientific interest	0.457**	0.499**	0.506**	0.582**	0.378**

** - Significant at .01 level

Table 1.2 shows that the correlation coefficients obtained for the total sample, Boys, Girls, Government school students and Aided school students are all positive. This reveals that there exist a significant positive correlation between scientific reasoning and scientific interest for the Total sample and the subsamples Boys, Girls, Government school students and Aided school students. Hence Hypothesis I is accepted.

2.2 Comparison of Scientific reasoning and scientific interest of secondary school students based on subsamples Gender and Type of Management of school

The mean and standard deviations were calculated for the subsamples Boys, Girls, Government school students and Aided school students. Significance of difference between the mean scores of Boys and Girls and also between Government and Aided school students were found out for the variables scientific reasoning and scientific interest. The results obtained were given in Table 1.3.

Table 1.3

Comparison of Boys and Girls and Government and Aided school students on scientific reasoning and scientific interest

Variables	Subsample	Type	N	Mean	S.D	t - value
Scientific Reasoning	Gender	Boys	94	25.50	10.92	1.51
		Girls	82	22.95	11.5	
	Type of Management	Government	77	25.76	12.5	1.52
		Aided	99	23.18	10.1	
Scientific Interest	Gender	Boys	94	118.45	17.11	1.54
		Girls	82	122.50	17.73	
	Type of Management	Government	77	126.01	14.32	3.96*
		Aided	99	115.91	18.5	

* - Significant at .01 level

Table 1.3 shows that there is no significant difference between Boys and Girls and Government and Aided school students on scientific reasoning. Hence Hypothesis II is rejected. It was also found that there exists no significant difference between Boys and Girls on Scientific interest. But there exist significant difference in the scientific interest between Government and Aided school students. Hence Hypothesis III is partially substantiated.

2.3 MAJOR FINDINGS OF THE STUDY

- ✓ There exists significant positive relationship between Scientific reasoning and Scientific interest of secondary school students for the total sample and subsamples Gender and Type of Management of School
- ✓ There is no significant difference in the scientific reasoning of secondary school students based on subsamples Gender and Type of Management of School
- ✓ There is no significant difference in the Scientific interest of secondary school students based on subsample Gender
- ✓ There exists significant difference in the Scientific interest of secondary school students based on subsample Type of Management of School

2.4 EDUCATIONAL IMPLICATIONS OF THE STUDY

- ❖ The study shows that scientific reasoning and scientific interest of secondary school students are positively correlated. This means that the learning activities in the class rooms should be designed in such a manner so as to arouse proper scientific interest in students. Then it will gradually help them to solve scientific issues and apply the concepts in practical situations with the gradual development of scientific reasoning.
- ❖ The school curriculum should incorporate the teaching techniques and strategies that will arouse scientific interest and scientific reasoning among secondary school students.
- ❖ The science teacher education curriculum should be restructured in such a manner that it should include innovative instructional strategies, methods and learning models which can help the student teachers to practice and apply in regular classrooms to foster scientific interest and appropriate scientific reasoning ability.
- ❖ The infrastructural facilities of schools should be improved so as to ensure proper development of students so that the disparity in scientific interest of students based on Type of management should be dimnished as far as possible.

2.5 CONCLUSION

Scientific reasoning and scientific interest are positively related to each other. So it is the duty of teachers, curriculum planners and Educational administrators to provide methods, strategies and materials in the teaching learning process more constructive and thereby leads to the strengthening of relationship between scientific reasoning and scientific interest of secondary school students.

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