Relationship between Intelligence and Scientific Inquiry Skills among Secondary School Students

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Abstract: Robert Sternberg defines intelligence as "the mental abilities necessary for adaptation to, as well as shaping and selection of, any environmental context (1997, p. 1). In today's world of rapid change, along with sufficient intelligence, one has to acquire life skills also to meet the challenges of day to day life. Scientific Inquiry skills can help the learners to meet the challenges in their learning process. The term "Inquiry Skills" as applied to science stands for the intellectual skills needed for conducting scientific investigation attained by the student as a result or consequence of learning science. Hence Science teaching and learning in the classroom should be able to develop Scientific Inquiry Skills among students. The major objective of the study is to find out the relationship between Intelligence and Scientific Inquiry Skills among secondary school students of Kerala state. The study adopted survey method. The study showed that there is significant relationship between Intelligence and Scientific Inquiry Skills and (1983) & Tobin (1986) revealed strong correlation between acquisition of Inquiry Skills and achievement in science. The categories of scientific inquiry skills selected for the study are Observing, Sensing the problem, Classifying, Hypothesizing, Designing experiment and Inferring. This study revealed the fact that school curriculum should provide provisions to develop Scientific Inquiry Skills among students especially children belonging to secondary stage as it is the stage of full of energy and enthusiasm.

Keywords: Intelligence, Scientific Inquiry Skills, Observing, Sensing the problem, Classifying, Hypothesizing, Designing experiment and Inferring

1.Introduction

We live in the scientific era. Science has brought about drastic changes in the life of man. It is due to science that man is leading a comfortable and secured life. The rapid expansion of knowledge in different branches of science and its consequent impact in the daily life of people have set educationists all over the world to think about the position of science education in schools. The progress and prosperity of any nation is determined by the thinking of the youth which is definitely the outcome of education attained by them. Among the different levels of education, secondary stage is the most important because during that stage students generate more productive ideas by combining creative and critical thinking. Hence prime importance should be given to education at secondary level by restructuring the curricula to meet the needs and challenges of the time.

According to Fitz Patrick (1959) science is a cumulative and endless series of empirical observations, which result in the formation of concepts and theories, with both concepts and theories subject to further empirical observations. Science is both a body of knowledge and a process of acquiring it. The process of science demands different strategies and methods of teaching.

National Policy on Education (1992) remarked, "Science educators have the role of providing such scientifically literate citizens to the nation. To fulfil its expectations, citizens should have proper attitude towards science, scientifically literate and cultivate an appreciation for science.

Intelligence

Robert Sternberg defines intelligence as "the mental abilities necessary for adaptation to, as well as shaping and selection of, any environmental context (1997), p. 1

Thurston describes intelligence in terms of seven primary abilities or factors, namely:

- (1) Ability to deal with space,
- (2) Ability to solve problems,
- (3) Ability to understand ideas expressed in words,
- (4) Ability to write and talk easily,
- (5) Ability to perform numerical calculation,
- (6) Ability to recognize likeness and differences, and
- (7) Ability to recall past experiences.

The above classification highlights the importance of intelligence in problem solving, abstract thinking, discrimination etc. which are equally important in science learning also.

Significance of the study

Today with the emerging trends in science education, inquiry skills are given more emphasis. Curricula are framed and text books are written with a view to developing Scientific Inquiry Skills. But the extent to which teaching and learning is effective in imparting training n in the development of skills and acquisition of knowledge is a questionable matter. In this context science instruction at secondary level should be in such a way as to foster Scientific Inquiry Skills among the learners. Joseph (1998) under took a study on process outcomes in Physics in relation to some selected cognitive, affective, social and environmental variables. The study revealed that all the cognitive, affective social and environmental variables correlated significantly with process outcomes in Physics.

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Scientific Inquiry Skills were studied by many researchers from 1970's onwards. For example, the results of the experimental studies (Argaw, Haile, Ayalew and Kuma, 2017; Tomera, 1974; Champagne and Klopfer, 1981) showed that acquisition of science Process Skills enabled secondary school students to solve daily life problems. Intelligence also contributes in solving problems. This motivated the researcher to study the relationship between Intelligence and Scientific Inquiry Skills among Secondary School students.

Objective of the study

1. To study the relationship between Intelligence and Scientific Inquiry Skills among secondary school students.

Hypothesis of the study

1. There is significant relationship between Intelligence and Scientific Inquiry Skills among secondary school students.

2.Methodology:

Design of the study

The investigator used survey method to find out the relationship between Intelligence and Scientific Inquiry Skills among secondary school students.

Sample of the study

The sample consisted of 225 9thstandard students belonging to 8 schools from three districts-Alappuzha, Kollam and Pathanamthitta districts of Kerala sate which follow the syllabus prescribed by Department of Public Instruction, Kerala State. Details given in Table 1.

 Table 1: Details regarding the districts number of schools and students selected for the administration of the Test on Scientific Inquiry Skills

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Serial No	Name of District	Number of schools	Number of students	Total number of students
1	Alappuzha	2	76	
2	Kollam	2	74	225
3	Pathanamthitta	2	75	

Tools and Techniques

For the present study, the following tools were used.

a) Test on Scientific Inquiry Skills

Test on Scientific Inquiry skills was developed by the investigators based on the components of Scientific Inquiry Skills, Observing, Sensing the problem, Classifying, Hypothesizing, Designing experiment and Inferring.

b) Raven's Standard Progressive Matrices (RPM, 1996) to measure Intelligence of students of standard Nine

Selection of the components of Scientific Inquiry Skills

The term "Inquiry Skills" as applied to science stands for the intellectual skills needed for conducting scientific investigation attained by the student as a result or consequence of learning science. There are different classifications of Inquiry Skills. From among the classifications the investigator selected six components of Scientific Inquiry Skills namely, Observing, Sensing the problem, Classifying, Hypothesizing, Designing Experiment and Inferring which were relevant for the present study. Thus the tool titled "Test on Scientific Inquiry Skills" was intended to measure the components of Scientific Inquiry Skills namely Observing, Sensing the problem, Classifying, Hypothesizing, Designing Experiment and Inferring.

Observing: It refers to the process of gathering information with the help of fivesenses to fine details of objects or events.

Sensing the problem: This is the process of identifying problems and stating them in aprecise manner.

Classifying: It refers to the process of imposing order on collection of objects or events.

Hypothesizing: It is the process of applying concepts or knowledge gained in some situation to help understanding or solving problem in another situation. Designing experiment: It includes the process of identifying and controlling variables and designing the procedure for conducting the test.

Inferring: It refers to the process of making evaluation based on observed data(AAAS, 1968).

The blue print of the Test on Scientific Inquiry Skills is given in Table 2.

Componentsof Scientific Inquiry Skills	Subcomponents of Scientific Inquiry Skills	No ofItems	Total
Skill of Observing	Use the five senses to gather information (use of instruments also)	3	
8	(_	
	Identify difference between similar objects orevents	2	10
	Identify similarities between similar objects orevents.	2	
Skill of			
	Notice the fine details that are relevant to an investigation	3	
Sensing theproblem			10
	Recognize scientific problems in a new situation	5	

Table 2: Blueprint of the Test on Scientific Inquiry Skills (TSIS)

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Skill of Classifying			
	State problems as definite and concise question	5	
	Establish norm or commonality on collection of objects or events	6	10
	Identify commonalities in a group of objects or events and classify them.	4	10

	Suggest tentative solution to a problem Attempt to explain observations or relationships in terms of some principle or	3 4	10
Skill of Hypothesizing	concept		
	Recognize the need to test explanation bygathering more evidence	3	
	Pupils observe objects & phenomena	3	
	Identify & control variables	2	
Skill of Designing	Select equipment for experiment	3	10
Experiment	Design experiment	2	
01-11 - £ I£	Give explanation for an observation	3	
Skill of Inferring	Make evaluation based on the observed data	3	10
	Bring evidence to make a prediction	4	
Total			60

3.Selection of the Content

For this purpose the investigator thoroughly analyzed the text book of Physics for standard nine which follow the curriculum recommended by the Board of Secondary Education, Kerala State to select the topics. The investigator had discussions with the Supervisor and the Physics teachers teaching at secondary level in schools following the curriculum prescribed by the Board of Secondary Education, Kerala State. The investigator selected the content for the test from the following Physics topics of the Science text books prescribed for classes Seven to Nine by the Board of Secondary Education, Kerala State. The topics included are Force, Motion, Light, Magnetism, Static Electricity, Thrust and Pressure, Energy, Sound, Heat and Electricity.

3.6.1 Details regarding Raven's Standard Progressive Matrices (RPM, 1996)

The extraneous variable selected for the present study is intelligence. To measure intelligence of the students included in the sample, Raven's Standard Progressive Matrices was used. This is a standardized nonverbal group test of intelligence used in educational settings. It is one of the most common and popular test administered to groups ranging from 5-year-olds to the elderly. It consists of six sets of questions, namely set A, set B, set C, set D and set E. Each set contains 12 questions. These five sets or series of diagrammatic puzzles exhibit serial change in two dimensions simultaneously. Each puzzle has a portion missing, which the individual taking the test has to identify from among the options given. Thus there are all together 60 questions listed in the order of difficulty. A score of 1 is given to each correct answer and there is no negative mark. Therefore the maximum and minimum scores on this tool are 60 and 0 respectively. The five sets provide five opportunities to grasp the method of thought required to solve the problems and hence five progressive assessment of a person's intellectual ability. The items in each test have a progressively increasing order of diff the name "Progressive Matrices". The scoring is done according to the manual of the tool. The RPM has a test-retest reliability ranging from 0.80 to 0.93 and internal consistency ranging from 0.87 to 0.97.

An illustrative item is given below.



The Correct answer is 2.

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Statistical Techniques

i. The investigator used Test of significance of correlation to find out the significance of the relationship among the scores on Intelligence and the scores on Scientific Inquiry Skills.

4.Results

In order to test these null hypotheses, the investigator analyzed the data using Karl Pearson's Product Moment Coefficient of Correlation 'r' by fixing .05 as level of significance. The results of the analysis are presented in table 3.

Table 3: Correlation' r	among the Scores on Intelligence
and Scientific	Inquiry Skills (N-225)

and scientific inquiry skills (N=225)			
r an p values of the variables (N=225)			
Variables		Mean S.D	
Intelligence	1.00	38.68 6.49	
Scientific InquirySkills	.892*	27.12 5.19	

From the table 3 the investigator observes that r between Intelligence and Scientific Inquiry Skills (r = 0.892, p < .05). This indicates that there exists significant relationship among the scores on Intelligence and the scores on Scientific Inquiry Skills among the secondary school students.

Finding of the Study

There is a high positive correlation between Intelligence and Scientific Inquiry Skills among secondary school students.

5.Conclusion

Science teaching and learning in the classroom should be capable to develop Scientific Inquiry Skills among students. In order to meet this goal class room learning should progresses through collaborative social interaction and activities which results in social construction of knowledge. It develops cognitive competence as well as inquiry skills in learners by providing chances to work on real problems using scientific inquiry skills.

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