



RESEARCH ARTICLE

A Study of Reasoning Ability and Problem Solving Ability in Relation to the Attitude Towards Mathematics of Secondary School Students

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ABSTRACT

An attempt has been made by the investigator to study the reasoning ability and problem solving Ability in relation to the Attitude towards Mathematics of secondary school students. Descriptive cum survey method was used in the study. For the study, 4 schools were selected through random sampling technique. Tools of attitude, reasoning ability and problem solving ability was selected and given to the students. Statistical analysis has been carried out on the gathered data by using the different tools mentioned above. Mean, SD, t- test test were applied. After calculation it was found that attitude does not play a role in defining reasoning ability and problem solving ability at .01 level of significance and also at .05 level of significance.

Key words: Reasoning Ability, Problem Solving Ability, Secondary School Students

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INTRODUCTION

Education is a never ending process of inner growth and development and its period stretches from cradle to grave. Education in the real sense is to humanize humanity and to make life progressive, cultured and civilized. It is through education that man develops his thinking and reasoning, problem solving and creativity, intelligence and aptitude, positive sentiments and skills, good values and attitudes. Man learns something every day and every moment and education is concerned with ever growing man in an every growing society.

Education helps man in the modification of instincts by utilizing his instinctive energy in constructive channels. We are living in the age of science and technology. There is an undue emphasis on knowledge oriented education which pays attention to the intellectual development of the pupils. Education is a sub-system of the wider social system. Our social set up is totally governed by scientific and technological knowledge which can only be attained by study of mathematics. Mathematics is responsible for giving us a system, organization of essential abilities for leading a successful life. Mathematics leads a man to correct analysis, correct reasoning and correct decision making power."Mathematics as an expression of the human mind reflects the active will, the contemplative reason and the desire for aesthetic perfection. Its basic elements are logic and intuition, analysis and construction, generally and individually."(Courabt, Richard and Robbins Herbert)

Mathematics should be visualized as the vehicle to train a child to think reason and articulate logically. Mathematics is a subject of great educational values and makes an important contribution in achieving aims of education. Mathematics plays a predominant role in almost every walk of life. From the very beginning, mathematics has been a living and growing intellectual pursuit. It has its roots in everyday activities and forms the basic structure of our highly advanced technological developments. Mathematical knowledge is all prevailing in nature as it permeates every branch of knowledge. Now-a-days, the knowledge of mathematics has become much indispensable in almost every walk of life. Right from cradle to grave all human activities are controlled and fashioned by mathematics. Mathematics has entered in our life and daily activities so much that or existence would impossible without it. Its achievement in almost all spheres is marvelous. There is not any field where mathematical aid is not called for.

Etymologically the word “mathematics” owes its origin to the root word “Mathenien” which implies to learn. Generally, mathematics involves two distinct and different processes i.e. one as a method used to solve the problems of quantity, space, order etc. and second as a set of laws or generalizations of truths that are discovered. Webster’s dictionary defines mathematics as a science of number and their operations, interrelations, combinations, generations and abstraction and of space configuration, and their structure, measurement, transformation and generalizations, whereas Benjamin Franklin is of the view that no other science can be more noble, more excellent, more useful, more admirable and more demonstrative for men as that of mathematics. Marshall H. Stone is of the view that mathematics is the study of abstract system build up from abstract element and Locke says that mathematics is a way to settle in the mind of children a habit of reasoning.

Different mathematicians have described the nature of mathematics differently. The various points which highlight the nature of mathematics are as follow:

1. Mathematics has its own language and symbols.
2. Mathematics is the science of logical reasoning.
3. Mathematics is also the science of inductive and deductive reasoning.
4. Mathematics is a systematic, organized and exact branch of science.
5. Mathematics involves study of space, magnitude and measurements.
6. Mathematics knowledge is applied in the study of the branch of science.
7. Mathematics has two branches –pure and applied Mathematics.

The main aim of education is to develop the individual in such a way that he becomes a contributing member of society. The three main considerations for sending a child to school are as under:

1. To acquire knowledge and skill.
2. To develop intellectual habits and powers.
3. To develop desirable attitude and ideals.

These are known as utilitarian, disciplinary and cultural values of education respectively. To acquire knowledge and skill is the practical or utilitarian value. Development of intellectual habits and powers is the disciplinary values and development of training in desirable attitudes and ideals in the cultural values.

Some of the people are not in favour of making mathematics a compulsory subject upto high school stage. They believe that the study of mathematics requires special ability. As it is not everybody’s cup of tea, therefore everybody should not be compelled to study the subject. Also Bacon has remarked, “Neglect of mathematics works injury to all knowledge since, he who is ignorant of it, can’t know other sciences or thing of the world”.

The term ‘ability’ is a label, which is used to designate the trait or characteristic that a test measures. The trait measured may be broadly defined to include cognitive abilities, basic competencies and personality characteristic.

Each person varies in his abilities from the other person. Some persons may be able, some may be bright or some may not so bright. Ability is something that increases during years and this increase may be furthered or hindered by various agencies including the school. Several abilities like memory, reasoning, problem solving, imagination etc. constitute the mental capacities of any person. Ability may be defined as a level of skill or intelligence.

MATHEMATICS AND REASONING ABILITY

Reasoning plays a significant role in one’s adjustment to one’s environment. Not only it controls one’s cognitive activities but also the total behavior and personality is influenced by proper or improper development of one’s reasoning ability. One makes use of one’s previous knowledge and experience in reasoning all our past experiences or the knowledge of the rules, principles and techniques are closely analyzed. In reasoning ,we try to explore mentally the reason or the cause of an event or happening .the attempt to find out the solution of the questions like “why it is so?”.Reasoning ability helps us to find out the relationship between the cause and effect relationship. Not only we are engaged in finding the causes but we are also interested to know the possible effects of actions and stimuli.

In thinking, what will happen if this or that is done, one is apt to make use of one's reasoning ability. Reasoning also helps us to arrive at certain conclusions concerning the future finding or a solution concerning the problem without actually engaging in any motor exploration. Reasoning is highly symbolic function. The ability to interpret various symbols, development of concepts and linguistic ability help much in reasoning.

For proper reasoning it is essential to have adequate insight into the problems in hand of requires adequate knowledge and experiences. Therefore children should be stimulated to enrich their experiences and to make efforts to increase the span of their knowledge. In the beginning, children should be encouraged to imply induction for their reasoning process so that they may acquire the ability to reason independently. Later on they may be trained in making use of deduction but in no case they should blindly follow the deduced results. They should be acquainted with the process of deriving these results so that they may apply them intelligently. Since reasoning consists of systematic steps, so children should be given proper knowledge of these steps and encouraged to proceed systematically in their reasoning.

MATHEMATICS AND PROBLEM SOLVING ABILITY

Life is full of problems and solution to these problems is not readily available unless we have training in the art of problem solving. Problem means a situation for which no readymade solution exists or in other words problem exists when there is a goal to achieve and there is a barrier. Another variable thought to be related with achievement in school is reasoning ability. Piaget states that children go through various developmental stages throughout their life. They do not only undergo physical changes, but also development with respect to cognitive abilities. Knowledge into the developmental stages enables instructional designers to implement activities or learning tasks suitable for the particular capabilities of that age group. Part of this mental development is attributed to alterations in brain structure and formation of 28 new connections between nerve cells. Therefore, there are some developmental patterns that are common to all children. However, they may show differences in physical and cognitive properties depending on their unique life experiences, the environment they come from and inherited characteristics (Parsons, Hinson & Brown, 2001). This may result in variation between children's decision making and reasoning abilities, which may account for differences in science achievement. This connection seems reasonable taking into consideration the fact that high levels of reasoning abilities are required for science process skills like Hypothesizing, controlling variables and collecting and analyzing data used in science courses (Valanides, 1997).

The main reason for learning all about mathematics is to become better problem solvers in all aspects of life. Many problems are multi-step and require some type of systematic approach. Most of all, there are a couple of things which are needed in solving problems.

First of all, it is needed to find what type of information is being asked for. Then all the information that is being given in the question is to be determined. When one clearly understands the answers to these two questions, he is then ready to devise his plan instruction in problem solving skills than in other strands. Problem solving calls on all of a student's mental capacities including logical thinking, reasoning and creativity. Problem solving activities require students to go beyond strictly using algorithmic or other routine processes. Instead, students must recall previously learned mathematical skills and knowledge and think about how to apply them successfully to solve the problem. To be a successful problem solver, students need both the right attitude and the necessary skills. Problem solving is a complex process and is often met with a variety of affective responses. These beliefs, attitudes, and emotions are significant because they influence how a student will approach the solution. It has been found that students approach problem solving differently, and these differences can't always be explained by academic variables.

ATTITUDE TOWARDS MATHEMATICS

One of the determinants of behavior is attitude. Family ,friends, peer groups, develop attitudes in growing children toward people ,things , places, home, school friends, these acquired tendencies make the child to behave in a certain way towards specific objects or situations. Attitude can held about the physical world around us, about other people and about phenomena. Attitudes reflect a

person's tendency to think or behave in a positive or negative manner towards the object or person or situation. In practice the term 'attitude' is usually taken to mean the cognitive and /or affective components. Behaviour is not often constructed as an outcome of attitudes. A student may have favourable attitude towards school but believes that school has few unattractive elements. Thus, one may hold two different attitudes simultaneously towards school or anything or person.

A teacher has a greater responsibility in developing appropriate attitude in the growing and developing children toward right diet, exercise studies by discussing with them in realistic terms. Developing positive attitude toward mathematics is must nowadays as most of the competitive exams have some reasoning ability part, problem solving part. If the students are scared of studying mathematics it is the duty of teacher to make the subject interesting.

According to Robert M.W. Travers (1973) an attitude is a readiness to respond in such a way behavior is given a certain direction."

No one is born with any attitude. The kind of environment in which he grows, experience in life, attitudes of parents, peer group have indelible impact on the growing child. Thus he acquires attitudes towards various things and people out of direct experiences of indirect influences.

Attitudinal change is the need of the day. Attitudes are no doubt uniquely organized in each person. Though certain attitudes may be held by many, each usually gives his own slant in expressing them. They are tinged with emotion and are personal and complex in character. Attitudes and their organization are the products of individual's own reactions to his own experiences studies show that younger children of low socio economic status have similar attitudes as and parents due to similarity of experience to which both the children and parents were exposed. Attitudes tend to decrease with increasing age of the child. Greater diversity of influences operates on older children and on adolescents causing divergence in attitudes. Hence there may be the need to change the attitudes of young children towards education especially mathematics. Most of the students are scared of it and don't want to study it at all. They want it to get removed this subject from the curriculum. They are not aware that mathematics plays very important role in our life. We cannot think of our daily work to be done without mathematics. It is required in each and every field

Loving teachers, lively classroom interaction, more participation and learning through play can change young learner's unfavourable attitudes towards school and studies. A teacher greater responsibility in developing appropriate attitudes in the growing and developing children towards right diet exercise, studies and peers irrespective of caste creed ,religion ,class by discussing with them in realistic terms.

By summarizing, we can say that

1. Mathematics is indispensably required in modern age. It is very difficult to imagine world without mathematics. All our daily activities are based on mathematics. We can't take a single step without it. So mathematics is essential for the existence and progress of modern world.
2. Mathematics develops reasoning and problem solving ability. So it must for every student to understand the concepts clearly and properly for solid base.
3. Hardly there is any competitive exams that are without reasoning questions. So it also becomes necessary for us to develop reasoning and problem solving ability in students, and this is possible if we develop the positive attitude towards mathematics among students.
4. So I thought of studying this topic in detail to study whether attitude plays a role in developing reasoning and problem solving ability among students.

OBJECTIVES

A broad interpretation of the objectives of educational research could be so comprehensive that it would become meaningless. Therefore, our concern will be limited to three goals of educational researchers. These goals are as follows:

1. **Theoretical objectives:** Formulation of new theory and establishing new results.
2. **Factual objectives:** To find out new facts.
3. **Practical objectives:** To provide new application which has some practical value but does not contribute in the funds of human knowledge.

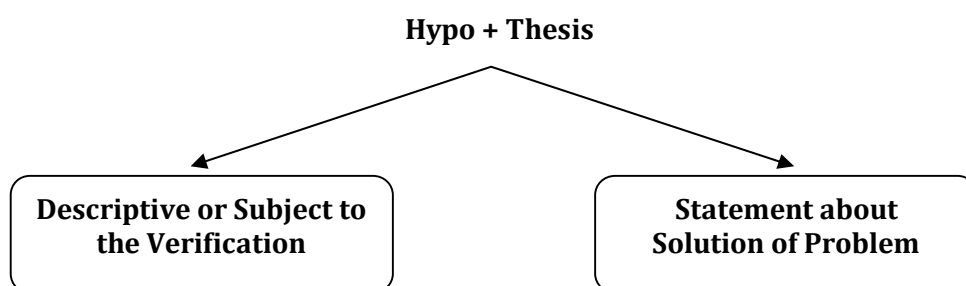
In any type of study, objectives are very necessary. By selecting the objectives we can easily make our study in better way, and effective. Objectives must be cleared and related to the literature.

1. To study the reasoning ability of secondary school students.
2. To study the problem solving ability of secondary school students.
3. To find out the attitude of secondary school students towards mathematics.
4. To study the relationship between attitude towards mathematics and reasoning ability of secondary school students.
5. To study the relationship between attitude towards mathematics and the problem solving ability of secondary school students.

HYPOTHESIS

The hypothesis is a powerful tool in research process to achieve dependable knowledge. It helps the researcher to relate theory to observation and observation to theory.

The word hypothesis is made up of two Greek roots which means that it is some sort of 'sub statements', for it is the presumptive statement of a preposition, which the investigation seek to prove. The word hypothesis consists of two words:



- 1: There is no significant relationship between attitude towards mathematics and reasoning ability of secondary school students.
- 2: There is no significant relationship between attitude towards mathematics and problem solving ability of secondary school students

RESEARCH METHODOLOGY

It is not frequent to find the term Method and procedure used interchangeably in research literature. It is so because both the terms are generally understood to denote tool and techniques adopted in research study. Research studies are distinguished on the basis of their different purposes and approaches and that is what technically be called difference in method. Research studies adopting different methods, however ,do not as rule differ significantly in their procedure,selection,formulation and definition of a problem, survey of related literature ,collection ,analysis and interpretation of new data and reporting of the work done are step of procedure, common to all types of method of research. Hence it can be held that steps of procedure in research are elements common to all educational investigation Selection of the research methods depends upon the nature of the study and objective to be achieved. Methods of the study or methodology are the sheet anchor of any research proposal. It is the procedure that has to be decided upon before starting work on it.

Firstly the nature of research is analyzed and the type of research .in all there are two broad categories of research based on nature i.e.

Quantitative: Research in which data can be analyzed in terms of number.

Qualitative: Research in which description of event and person scientifically is involved without the use of numerical data.

In wider scope of research can be categorized into three methods.

Here are many methods of collecting, analyzing, reporting research data. There are basically three different types of methods.

Descriptive Method: It provides a method to investigation to study describe and interpret what exist at present.

Historical Method: It provides a method of investigation to discover, describe and interpret existed in the past.

Experimental Method: It provides a method of investigation to describe basis relationship among phenomena under controlled condition.

Here we used the descriptive cum survey method for our research. This method is one of the important methods in education because it describes the current position of the present research. The term survey suggests the gathering of the evidence relating to current conditions. The term descriptive implies the determination of normal or typical condition or practice. The term descriptive survey is generally used for the type of research which purpose to ascertain, what is normal or typical condition or practice at the present time.

Descriptive survey method is one of the most common methods in research work. It is a method of collecting and analyzing data obtained from large number of respondents representing a specific population collected through highly structured and detailed questionnaire or interviews. It followed studying local as well as state, national and international aspects of education. It involves interpretation, comparison, measurement, classification, evaluation and generalization. All direct towards a paper understanding and solution of significant education problem.

Three types of information are collected are collected under this method:

1. Information of what exists by studying and analyzing important aspects of present situation.
2. Information of what we want by clarifying goal and objectives possible through study of conditions existing.
3. Information of how to get these discovering the possible means of achieves the goal on the basis of experience of others or the opinion.

CHARACTERISTICS OF DESCRIPTIVE SURVEY METHOD

1. It provides more accurate data. It is relatively more scientific and accurate.
2. The data is subjected to parametric treatments.
3. The findings are authentic and accurate.
4. The sample of large size, the error is put to minimum.
5. The conclusions are realistic.
6. It provides deep insight to the psycho-metric method of test construction.

POPULATION AND SAMPLE

Population refers to any collection of specified group of human being or of non human entities such as object, educational institutions, time units and geographical area. The population of the sample was 120 secondary school students .It is not feasible to collect data of the whole population in any investigation. The investigation has to be contended with some individuals as objects which represent the whole population, otherwise approached as Sampling.

Sampling is a miniature picture of the entire group of aggregate fro it has taken. In other words, it is small representing of large whole."

Sampling is indispensable technique in behavioural research; the research work cannot be undertaken without the use of sampling. The study of total population is not possible and it is also impracticable. The practical limitation; cost, time and other factors which are usually operative in the situation, stands in the way of studying the total population.

Research findings are, of course dependent upon the sampling procedures followed. Ideally a representative or random sample would be desirable to provide maximum information about the generalizability of research data.

TOOLS AND TECHNIQUES

F.S. Freeman *"A psychological tool is a standardized instrument designed to measure objectively one or more aspects of the total personality by means of samples of verbal or non verbal response or by means of other behaviour."*

The following tools of research are employed for the investigations:

- a. **Tool of Reasoning ability :** " Reasoning Ability Test" ,(RAT-D) by L.N. Dubey
- b. **Tool of Problem Solving Ability:** "Problem Solving Ability Test ", (PSAT-D) by L.N. Dubey.
- c. **Tool of Attitude towards Mathematics:** "Attitude towards MathematicsScale.", (ATMS-GR) by S.C. Gakhar and Rajni.

1. Tool of Reasoning Ability: "Reasoning Ability test", (RAT) by L.N. Dubey.**Reliability:**

The reliability coefficient of the test was as below:

Method	Coefficient
Rational equivalence method	.89
Split half method	.91

Validity:

Validity coefficient of the test was calculated with the following tests:

Test	Coefficient
R.K.Tandon-group test of intelligence	.87
J.C.Raven's-progressive matrices	.83
L.N.Dube-problem solving ability test	.85

2. Tool of Problem Solving Ability: "Problem Solving Ability Test", (PSAT-D)**Reliability:**

The reliability coefficient of the test was calculated by the following methods:

Spearman brown formula(split half method)	.78
Kudar Richardson formula(rational equivalence method)	.76

Validity:

The coefficient of validity was calculated by correlation the scores with the following tests;

Group Intelligence test (R.K.Tandon)	.68
Test of reasoning ability	.85

3. Tool of Attitude towards mathematics "Attitude towards Mathematics" by Dr. S.C. Gakhar and Dr. Rajni:**Reliability of scale:**

The reliability of the scale was obtained by split half method. In order to make the two forms truly parallel; all the statements of the scale were arranged in the rank order according to the scale values.

Successive pairs were then marked off. Reliability of the scale was found to be .78.

Validity of the scale:

For finding the validity of the scale the scores of the attitude scale were compared with the actual behaviour of the students which were nearly comparable.

Procedure of Data collection:

Collection of data is a very essential in any behavioural research to provide a solid foundation for it. Any researcher who involves human sample subject in his research has certain responsibilities towards them. Since the activities of the sample subject are often closely associated with data collection process, it is appropriate to consider ethical consideration.

A brief description about the experiment is presented in the following steps:-

Step 1. Seeking Permission:

Before administering the test, the investigator took a letter of introduction from the principal of his college. With this letter; the researcher contacts the principal/headmaster of the respective school. After getting the permission, the investigator administers the test on students.

Step 2. Introduction to student:

There is a reasoning ability inventory, problem solving ability and attitude towards mathematics. In these questionnaires, some questions are given respectively, you have to read the each item

carefully and respond to it by making a tick on any one answer for in the given box, which you think describe you well.

Step 3. Administration of Test:

Tests were given to the students. Sitting arrangements were made in such a way that they could not copy from one another.

RESULTS

After the collection of data and organisation of data, different statistical techniques were used for calculation of results.

Mean:

The value of mean is obtained by adding together all the items and by dividing this total by the number of items. In the present study mean value was obtained of reasoning ability and problem solving ability of secondary school students. The value of mean is obtained by adding together all the items and by dividing this total by the number of items.

“The mean of distribution of scores is the value on the scores scale corresponding to the sum of the scores divided by their number or size of sample.”

$$\text{Mean} = \frac{\sum X}{N}$$

Standard deviation:

Standard deviation measures the absolute dispersion of a distribution, the greater the amount of dispersion or variability, the greater the standard deviation the greater will be the magnitude of the values from their mean.

A small Standard deviation means, a high degree of the observation as well as homogeneity of series, a large deviation means just the opposite. In the present study standard deviation was calculated for reasoning ability and problem solving ability of secondary school students.

Standard deviation measures, the absolute dispersion of variability of a distribution, the greater the amount of dispersion or variability the greater the amount of dispersion or variability, the greater the standard deviation the greater will be magnitude of th deviation of the values from the mean.

A small standard deviation means, a high degree of uniformity of the observation as well as homogeneity of series, a large deviation means just the opposite. The S.D is represented by the Greek letter Sigma (σ)

$$\text{S.D} = \sqrt{\frac{\sum d^2}{N}}$$

Where:

d=sum of square of scores of X

N=no. of observations

Correlation Method:

The most widely used measure of correlation is the Pearson's *product moment correlation coefficient*. (r)

Definition of correlation

“Whenever two variables of the same group are related that the increase or decrease correspond to the increase or decrease to another or conversely, increase or decrease corresponds to the decrease or increase to another ,they are said to be correlated.”

Correlation:

$$r = \frac{\sum xy}{\sqrt{\sum x^2 + \sum y^2}}$$

Z test (Significance of Difference between two correlate coefficients):

This formula/method is used for converting r into z functions. This is useful for testing the significance of difference of two r 's by converting into z function:

The formula is :-

$$\sigma_{z_1, z_2} = \sqrt{\frac{1}{n_1 - 3} + \frac{1}{n_2 - 3}}$$

N_1 =Size of first sample.

N_2 = Size of second sample.

Formula of checking 't' value for z -test:

$$t = \frac{z_1 - z_2}{\sigma_{z_1 - z_2}}$$

After applying different techniques, we applied the correlation formula and calculated the result between reasoning ability and attitude towards mathematics .

In that we found no significant relationship between attitude towards mathematics and the problem solving ability of secondary school students at .05 levels and .01 levels. So our hypothesis is accepted at both the levels.

We applied the correlation formula and calculated the result between problem solving ability and attitude towards mathematics.

In that we found no significant relationship between attitude towards mathematics and the problem solving ability of secondary school students at .05 levels and .01 levels. So our hypothesis is accepted at both the levels.

DISCUSSION OF RESULT AND INTERPRETATION

The study was designed to find out the reasoning ability and problem solving ability in relation to the attitude towards mathematics of secondary school students. In this study we applied the tool of reasoning ability, problem solving ability and attitude towards mathematics on 120 students of government and private schools.

The above table showing the mean value of attitude towards mathematics and reasoning ability are 165.54 and 67.45 respectively. The value of S.D in case of attitude towards mathematics and reasoning ability is 15.55 and 7.66. In this case, the attitude has higher mean value than of reasoning ability. The calculated value of t is .21 which is very less than the table value at both the levels i.e. at .05 level and .01 level. These values are 1.96 and 2.58. So we find no relationship between the attitude and reasoning ability of secondary school students at .05 and at .01 levels. So hypothesis is accepted at both levels.

The above table showing the mean value of attitude towards mathematics and problem solving ability are 165.54 and 13.98 respectively. The value of S.D in case of attitude towards mathematics and problem solving ability is 15.55 and 3.16. In this case, the attitude has higher mean value and S.D. than that of reasoning ability. The calculated value of t is .18 which is very less than the table value at both the levels i.e. at .05 level and .01 level. These values are 1.96 and 2.58..So we found no significant relationship between the higher attitude and reasoning ability of secondary school students. So we can say that there is no relationship between attitude and problem solving ability of secondary school students. . So hypothesis is accepted at both levels.

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