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A Study of Problem Solving Ability Among High and Low Achiever Boys in the Subject of Mathematics

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Abstract: *Problem solving is an individual phenomenon and involves the exercise of cognitive abilities of a high order and continuous and persistent struggling on the conscious as well unconscious levels. It is the ability to think and reason on given levels of complexity. This study aims to quantitatively assess the problem solving ability among high and low achiever boys in the subject of mathematics. Total of 164 students boys from 6 different Kendriya Vidyalaya schools of Jammu district were taken for the study. A standardised tool i.e., Garg's Problem Solving Ability Test was used to collect the data and find out the achievement of the students. Q1 and Q3 was computed for the categorization of the data. Bartlett's test and ANOVA is employed for the analysis of data. The findings of the study shows that the high achiever boys have better problem solving ability than the low achiever boys.*

Keywords: Problem solving, Complexity, standardised, Q1, Q3, Bartlett's test, ANOVA,

1. INTRODUCTION

Research is as old as the academic consciousness of the human mind. Man has all along tried to look back at his history for better understanding of the evolution process leading to the present stage of mankind. This urge for human brain to re-examine and to re-understand things may rightly be called research. Research, therefore has been an integral part of academic pursuits in the past. Research is always expected to be something original or a piece of work that advances and enhances human knowledge. This may be done in several ways such as re-interpretation of an existing theory, investigation of unexpected area or development of a new theory etc.

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 9 Issue 05
May 2022

Research may be defined as the application of the scientific method in the study of problems. It is a systematic attempt to obtain answers to meaningful questions about phenomena or events through the application of scientific procedures. It is an objective, impartial, empirical and logical analysis and recording of controlled observations that may lead to the development of generalizations, principles or theories, resulting, to some extent in prediction and control of events that may be consequences or cause of specific phenomena.

This research was done on problem solving ability. “Problem solving is defined as finding new answers, going beyond the simple applications of previously learned principles or rules to create a solution to a novel problem.” Intelligence is the principal factor in problem solving. The brighter the person the greater the problem solving ability. Motivation gives direction to thought. Otherwise one tends to be aimless. Motivation is important in the early stages of problem solving. When people gain satisfaction from their solutions of problems they develop a general motivation for problem solving. This is the case with intelligent people or great thinkers such as scientists, artists, writers and inventors. They develop a life long interest in solving problems just for the sake of solving them.

Here a research study is done on problem solving ability among students of mathematics. The investigator was interested to find out the influence of academic achievement on the problem solving ability among the boys. In this study different boys were taken from different Kendriya Vidyalaya schools of Jammu district. A sample of 164 students was taken and the Problem Solving Ability Test prepared by Roop Rekha Garg was distributed to the students. Then after assessing the tests of the students marks were given and then it was revealed that whether the students of Kendriya Vidyalaya schools were having the problem solving ability or not.

1.1 PROBLEM SOLVING

With the advancement in socio-economic and technological fields, the life of the individual is becoming more and more complex fraught with a number of problems

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Vol. 9 Issue 05
May 2022

which the individual and the society have to face in near future. There are needs and motives that are to be satisfied. For this purpose, definite goals or aims are set. In an attempt for their realization one experiences obstacles and inferences in one's attempt to achieve them. This creates problems and serious and deliberate efforts have to be made to overcome these impediments. One of the major responsibilities of schools is to develop scientific attitude in students so that they may solve their problems independently for better adjustment in the future complex society. If students merely apply a rule no real problem solving takes place. If students are given step by step instructions about how to reach an answer no real problem is necessary. Problem solving involves combining previously learned rules into a new, never-before-used higher order rule. Thus problem-solving leads to permanent change in a student's capabilities.

Problem solving is an individual phenomenon and involves the exercise of cognitive abilities of a high order and continuous and persistent struggling on the conscious as well unconscious levels. Problem solving is the framework or pattern within which creative thinking and reasoning takes place. It is the ability to think and reason on given levels of complexity.

According to Skinner (1968), "Problem solving is the process of overcoming difficulties that appear to interfere with the attainment of a goal. It is a procedure of making adjustment in spite of interferences."

In the words of Woodworth and Marquis (1948), "Problem solving behaviour occurs in novel or difficult situations in which a solution is not obtainable by the habitual methods of applying concepts and principles derived from past experiences in every similar situation."

Maltzman (1955) emphasized problem solving as the occurrence of a response that initially had a low probability of happening.

Hayes (1989) & **Bransford & Stein (1993)** has described the process of problem solving as a cycle of seven steps of events i.e., first a problem is recognised and identified

in the environment. Then the problem is defined and represented mentally. Within the mental representation generated, a solution strategy is developed. To solve the problem, relevant knowledge about the problem is organised. The physical and mental resources needed to solve the problem are distributed. The solution is evaluated for meeting the goal of solving the problem.

Problem solving has the following characteristics

1. Problem solving is usually of a challenging nature.
2. Problem solving is the highest level of reasoning.
3. Problem solving is always within the capacity of pupil.
4. Problem solving is a sort of higher mental ability.
5. Problem solving requires special education and training.
6. Problem solving is directed by the goal.
7. Problem solving is usually related to life-problems.
8. Problem solving occurs when there is obstacle to reach the goal.

Steps in problem solving

It is possible to identify the following four steps in solving a problem:

1. Preparation
2. Incubation
3. Illumination
4. Verification

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 9 Issue 05
May 2022

- In the stage of **preparation** the problem is analysed, and all available information is assembled and studied intensively. Preliminary attempts are made to reach a solution, but if these fail the matter is laid aside.
- In the stage of **incubation** no serious work is done on problem though it may came to mind at odd moments like on awaking in the morning, or while day dreaming, or while out for a walk etc.
- **Illumination** comes in the form of an idea that looks so promising that it immediately engrosses the thinker's attention and leads to the most intense concentration.
- If the idea is good it must then be worked over in detail so as to produce **verification**.

1.2 PROBLEM SOLVING IN MATHEMATICS

A mathematical problem is a problem that is amenable to being represented, analyzed, and possibly solved, with the methods of mathematics. This can be a real-world problem, such as computing the orbits of the planets in the solar system, or a problem of a more abstract nature, such as Hilbert's problems. It can also be a problem referring to the nature of mathematics itself, such as Russell's Paradox.

1.3 STATEMENT OF THE PROBLEM

In the light of all above discussion, the investigator was inspired to conduct a study of this important theme which is stated as, **A study of Problem Solving Ability Among High and Low Achiever Boys in the Subject of Mathematics.**

1.4 OBJECTIVES OF THE STUDY

i. To find out the high and low achievers among the boys in the subject of Mathematics in the secondary classes of Kendriya Vidyalaya Schools and the problem solving ability among boys of Kendriya Vidyalaya Schools.

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 9 Issue 05
May 2022

ii. To study the differences in the low achiever boys in context of the problem solving ability in the subject of Mathematics.

iii. To study the differences in the high achiever boys in context of the problem solving ability in the subject of Mathematics.

iv. To suggest some educational implications based on the result.

1.5 EXPLANATION OF OPERATIONAL TERMS

The following terms are explained in brief:

1.5 (a) PROBLEM SOLVING

Problem solving can best be defined as a process of removing obstacles that appear to interfere with the attainment of goals. It is the framework or pattern within which creative thinking and reasoning takes place in any performance test as measured by Roop Rekha Garg. In other words, the procedure of overcoming difficulties is called program solving.

1.5 (b) ACADEMIC ACHIEVEMENT

Academic achievement in the present study means the grade and the marks obtained by the 6^{th}, 7^{th} and 8^{th} class students in their Summative Assessment (SA) and Formative Assessment (FA) tests of the present class. In this manner, the academic achievements score was calculated for each student. In the present study the effect of academic achievement was studied in order to know which group whether high or low of academic achievers show problem solving ability behaviour.

(i) High Academic Achievement: In the present study, the boys whose score would fall at and above the value Q_3 were considered as belonging to high academic achievement group.

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 9 Issue 05
May 2022

(ii) **Low Academic Achievement:** In the present study, the boys whose score would fall at and below the value Q_1 were considered as belonging to low academic achievement group.

1.6 HYPOTHESIS

i. There may be significant differences in problem-solving ability among high and low achiever boys.

ii. There will be no joint significant differences in problem-solving ability among boys of Kendriya Vidyalaya Schools.

1.7 DELIMATIONS OF THE STUDY

The study was limited to the following aspects:

i. The present study was limited to 6th, 7th, 8th class students only.

ii. The present study was limited to K.V. Schools only.

iii. The present study was limited to 164 students only.

iv. The present study was limited to different K.V. schools of Jammu district only.

v. The present study was limited to high and low achievers only.

2. REVIEW OF RELATED LITERATURE

"The competent physician must keep constantly abreast of the latest discoveries in the field of medicine. The successful doctor must be able to readily locate information of patient to the case at hand, obviously, the careful students, the research worker and investigator should become familiar with location and the use of sources of educational information."

"-Carter V. Good"

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 9 Issue 05
May 2022

Review of related literature allows the researches to be acquainted with the current knowledge in the field or an area in with the research is undertaken. The review of related literature shows and enables researches to define the limits of the study and gives the researcher and understanding of the research in which the study is to be conducted. It implies locating, studying evaluating reports of relevant researches, study of published articles, going through related portion of encyclopaedia & research abstracts, study of pertinent pages out of comprehensive books and subject going through related manuscripts if any.

A review of relative literature enables the investigator to know about the previous work, the means of getting to know about the previous work, the means of getting to the frontiers in the field of his/her problem. Until we learn what others have done and what still remains to be done in his/her area the work is incomplete.

A survey of the literature would develop the insight of the investigator. Investigator is alert for finding the researches approaching in his/her area that have proved to be sterile.

A survey of the literature is worthwhile for an investigator to have comprehensive survey of what has already been done on the problem and its related studies. Survey of the related studies avoid the risk of duplication, provides theories, ideas, explanation or is valuable finding in formulating the problem and contributor to the general scholarship of the investigator. There are so many researches related to problem solving ability. Some of them are given below:-

2.1 REVIEW OF RELATED LITERATURE IN INDIA

SABAR (2006) conducted a study on problem solving ability in relation to family stress and sex of higher secondary school students. This study revealed that there is no significant difference between boys and girls in problem solving ability. There is no significant difference among students having low and high stress in their problem solving ability. There is no interactional difference on the basis of sex and family stress in

problem solving ability.

DEEVYA MAHAJAN (2008) conducted a research on Problem Solving Ability among high and low achievers. The findings of this study were:

i. There are significant differences in Problem Solving Ability among high and low achievers.

ii. The high achievers possess higher level of problem solving ability in comparison to the low achievers.

iii. There are significant sex differences in the problem solving ability among high school students.

iv. The high school boys are more able to solve the problems than the girls.

v. The variables of age and sex are independent of each other with problem solving ability as the dependent variable.

NARITA DEVI (2008) conducted a study on problem solving ability secondary school students in relation to their mental health. This study reveals that F ratio for the main factor sex is found not significant in problem solving ability as criterion. The boys and girls do not differ significantly through each other. There is no interactional effect of sex and mental health on problem solving ability as criterion when the joint influence of the two is seen.

NAYMA MALIK (2010) conducted a study on problem solving ability among senior secondary students in relation to their emotional intelligence. The findings of this study reveal that the boys and the girls possessing high emotional intelligence do not differ significantly from each other when problem solving is taken as dependent variable. Hence, the mean of girls is slightly higher than that of boys indicating that girls are slightly better problem solvers than boys.

NATIONAL COUNCIL OF SUPERVISORS OF MATHEMATICS (2011)

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 9 Issue 05
May 2022

The research was conducted on mathematical problem solving. This research is conducted within a variety of constraints -isolation of variables, availability of subjects, limitations of research procedures, availability of resources, and balancing of priorities. Various research methodologies are used in mathematics education research including a clinical approach that is frequently used to study problem solving. Typically, mathematical tasks or problem situations are devised, and students are studied as they perform the tasks. Often they are asked to talk aloud while working or they are interviewed and asked to reflect on their experience and especially their thinking processes. Schoenfeld describes how a clinical approach may be used with pairs of students in an interview. He indicates that "dialog between students often serves to make managerial decisions overt, whereas such decisions are rarely overt in single student protocols."

2.2 REVIEW OF RELATED LITERATURE IN ABROAD

SELANGOR (2009)

The study was conducted on Attitudes and Problem-Solving Skills in Algebra among Malaysian Matriculation College Students in the year.

The purpose of this study was to determine the attitudes and problem solving skills of Malaysian matriculation college students. The study examined whether there were differences in attitudes towards solving algebra problems and problem solving skills in algebra based on gender and course of study.

The findings showed that matriculation students had moderately favourable attitudes towards algebra problem solving. There were no significant differences in attitudes and problem-solving skills based on gender. However, the findings indicate that there were significant differences in attitudes--specifically, with regard to self-confidence--and problem solving skills between students in different courses of study.

THE SOLOMON R. GUGGENHEIM MUSEUM (2010)

The study was conducted on The Art of Problem Solving. This study examines how emotional intelligence (EI), personality, and social problem-solving skills were linked to depression and life dissatisfaction in 144 Chinese undergraduate students in Hong Kong. Factor analyses of questionnaire responses yielded 3 separate dimensions of depression (affective, psychomotor, and cognitive). Structural equation modelling showed that EI (self-emotions appraisal and use of emotion) was linked to somatic and cognitive symptoms of depression, after controlling for personality.

Also, social problem solving was linked to psychological distress, and moderated its links with personality and EI. These results underscore the differences among the links between the components of EI and of psychological health, and support the possibility of promoting people's psychological health through EI and social problem-solving interventions.

WILSON, FERNANDEZ AND HADAWAY (2011)

The study was conducted on Mathematical Problem Solving Ability. The study reveals that your problem may be modest; but if it challenges your curiosity and brings into play your inventive faculties, and if you solve it by your own means, you may experience the tension and enjoy the triumph of discovery. Such experiences at a susceptible age may create a taste for mental work and leave their imprint on mind and character for a lifetime

Problem solving has a special importance in the study of mathematics. A primary goal of mathematics teaching and learning is to develop the ability to solve a wide variety of complex mathematics problems. Stannic and Kilpatrick traced the role of problem solving in school mathematics and illustrated that to many mathematically literate people, mathematics is synonymous with solving problems - doing word problems, creating patterns, interpreting figures, developing geometric constructions, proving theorems, etc. On the other hand, persons not enthralled with mathematics may describe any mathematics activity as problem solving.

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 9 Issue 05
May 2022

3. METHODOLOGY

This chapter includes the information about sample which has been the basis of research and provides a picture of the instruments used, collection of data and statistical techniques employed.

3.1 SAMPLING

Sampling is fundamental to all statistical methodology of research. Foundation of research depends on sampling. Sampling is soul of research. A good sample will produce a result very much approaching the population and generalization would be effective. The sampling is essential and advantageous as it saves time and energy.

Sampling is the process by which a relatively small number of individuals, objects or events is selected and analysed in order to find out something about the entire population from which it was selected.

Sampling has great utility in research to estimate an accurate guess about population. In the limited time, the investigator can never collect data from the whole population in any investigation. He/she has to take selected group of individuals who would represent the whole population and from the basis for making references for certain population facts.

For the present study it was decided by the investigator to choose Jammu district as the field of her investigation. The study was limited to 6th, 7th and 8th class students. The investigator adopted the technique of random sampling in selecting the boys from various Kendriya Vidyalaya schools. The number of subjects selected for the study is 164 boys in total. The list of boys selected from different Kendriya Vidyalaya schools is given in Table 3.1.

TABLE 3.1 SHOWING NUMBERS OF STUDENTS SELECTED FROM DIFFERENT INSTITUTIONS

S.NO.	Name of Institution	Boys
1	Kendriya Vidyalaya No. 1, Gandhi Nagar, Jammu	33
2	Kendriya Vidyalaya No. 2 Jammu Cantt., Jammu	23
3	Kendriya Vidyalaya Nagrota, Jammu	36
4	Kendriya Vidyalaya Sunjuwan, Jammu	24
5	Kendriya Vidyalaya Ban Talab, Jammu	25
6	Kendriya Vidyalaya, Miran Sahib, Jammu	23
	Total	**164**

3.2 VARIABLES TO BE STUDIED

In the present study variables studied have been classified under two heads:

i) Independent variable

(a) Boys

(b) Academic Achievement

ii) Dependent variable

Problem solving ability

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 9 Issue 05
May 2022

3.3 TOOL USED AND ITS DESCRIPTION

For collecting new unknown data required for study of any problem, one may use various instruments to derive new facts or to explore new fields. The selection of new suitable instruments is of vital importance for various purposes. In the present study, the investigator selected the following tool to be used to collect the requisite data.

3.3.1 GARG'S PROBLEM SOLVING ABILITY TEST

The problem solving ability test used by the researchers in the present investigation has been prepared and standardized by Dr. Roop Rekha Garg. The inventory is in English and contains 22 unsolved questions. Every question has four given responses out of which only one answer is correct. The given speed test of 45 minutes durations has been prescribed to access the level of intelligence of the students. A student has to answer a series of questions which have been set in ascending order starting from the simplest ones to avoid monotony and fatigue of the subject.

The item have been selected careful examination of available test of problem-solving inventories, reasoning test, intelligence test, etc. including mathematical puzzles, problems concerned with general knowledge and series test. A copy of the test is enclosed in Appendix.

Reliability

With the help of following methods the reliability coefficient has been calculated:

1. Split – Half Method (Spearman-Brown formula)

   R=0.683

2. Rational Equivalence Method (Kudar – Richardson formula)

R=0.791(N=280 students)

International Journal of Research (IJR)

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 9 Issue 05
May 2022

Name : ……... Age : ……..……

Caste : General / SC / ST / OBC ……... Class : ……..…

School : ……..…….

Grade in Maths in this year : ……..

Grade in previous class : ……..……

INSTRUCTIONS

1. This test intends to know your ability. Hence read the problems carefully and understand it before giving the response.
2. Each problem is followed by a number of possible responses among which only one is correct. Write the serial no. of only that response which you think is correct in the given space.
3. You have to complete the test within **45 minutes**. If you do so before time then check your answers.

Example:

In a figure 2 is added and then subtracted. The left over is again multiplied by the same resulting into 18. What will be the figure?

(a) 3 (b) 6 (c) 9 (d) 12

Answer (c)

AGRA PSYCHOLOGICAL RESEARCH CELL TIWARI KOTHI.

BELANDGANI, AGRA 282004.

1. If 3 clothes get dry in 2 hours, then how much time will it take for 9 clothes to get dry?

   (a) 2 hours (b) 6 hours

   (c) 4 hours (d) 3 hours

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 9 Issue 05
May 2022

Answer ( )

2. There are 6 oranges in a basket and without pealing them they are distributed in 6 children in such a way that each child gets a whole orange and one while orange is left in the basket. How is it possible?

   Answer ……

   …….

3. Ram has a bundle of 70 rupees note. If the number of first note is 1418 then what will be the number of the last note?

   (a) 1486 (b) 1387

   (c) 1488 (d) 1489

Answer ( )

4. A cat eats a rat in a minute. How much time will it take for 100cats to eat 100 rats?

   (a) 100 minutes (b) 1 minute (c) 10 minutes

Answer ( )

5. A student needs 25% marks for passing the exams. He got 35% marks and failed by 15 marks. Calculate the maximum marks.

   (a) 50 (b) 200

   (c) 100 (d) 400

Answer ( )

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 9 Issue 05
May 2022

6. If a figure is added by its double and then subtracted leaving 25 then what will be the number?

   (a) 25 (b) 15

   (c) 10 (d) 50

Answer ( )

7. Ram finishes a work in 5 days and shyam finishes the same work in 20 days. If both of them work together, then in how many days will they finish?

   (a) 8 days (b) 5 days

   (c) 6 days (d) 4 days

Answer ( )

8. There are two taps in a drum. One fills it in 12 hours and other empties it in 9 hours. If both the taps are opened together then how much time will it take to fill the drum?

   (a) 8 hours (b) 10 hours

   (c) 18 hours (d) It will never fill up

Answer ( )

9. A figure is added by the same figure and the same is subtracted. The left over is multiplied by the same resulting into 25. What will be the figure?

   (a) 25 (b) 15

   (c) 10 (d) 5

Answer ( )

10. The sides of a triangle are 42, 12 and 18 inches respectively then what will be its area.

(a) 14112 (b) 1764

(c) 84 (d) nothing

Answer ( )

11. A man is 5 years elder than his wife who is 10 times elder than her son. If the boy becomes 8 years old after 3 years ten what is the present age of man?

(a) 60years (b) 45years

(c) 55years (d) 50years

Answer ( )

12. Mohan earns 20% profit than Sohan in a business. How much less Sohan does suffer on account of Mohan.

(a) 20% loss (b) neither profit nor loss

(c) 10% loss (d) 40% loss

Answer ( )

13. What are those 2 figures that result in sum of 10 and have the difference of 2?

(a) 8:2 (b) 5:5

(c) 10:2 (d) 6:4

Answer ( )

14. Toofan Express starts from Bombay to Delhi at a speed of 180kms/h. on the other hand passenger train moves from Delhi to Bombay at a speed of

120kms/h. the junction where both these trains meet which train will be more nearer to Delhi?

(a) Toofan Express (b) Passenger

(c) None (d) Both

Answer ( )

15. A man is 10yrs elder from his wife and his wife is 20yrs elder from her daughter. What will be the wife's age when her daughter will be 8yrs old after 4yrs?

(a) 34 (b) 38

(c) 36 (d) 32

Answer ( )

16. Ram drives his scooter at a speed of 30 miles per hour and takes 10 minutes rest after 1 hour. If he has to cover 110 miles then how much time will he take if he starts at 10.30 a.m. from his house?

(a) 3.00 hours (b) 3.45 hours

(c) 3.15hours (d) 3.30 hours

Answer ( )

17. Ram, Sham and Mohan have invested RS.3000, Rs.25000 and Rs.1750 respectively in a business. After one year they gain RS.4930prifit. What amount will Mohan get from the profit?

(a) 1190 (b) 1240

(c) 1400 (d) 1700

Answer ( )

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 9 Issue 05
May 2022

18. The expenditure of a room is RS.40.if a room of double length. Height and width is to be whitewashed, what will be the expenditure?

(a) 120 (b) 80

(c) 200 (d) 160

Answer ( )

19. 1/4part of a electric pole was coloured red,1/5 part black, 1/3 part white leaving 1.3m length of the pole, then what will be the total length of the pole?

(a) 73m (b) 60m

(c) 52m (d) 37m

Answer ( )

20. Find out the former number of the series:

(a) 3, 5, 10, 12, 24, 26,……(52)

(b) 8,4,12,42,20,……..(66)

(c) 25, 27, 28, 30, 32,……..(28)

Answer ( )

21. A figure is added by the same figure and then same is subtracted. The left over is multiplied by the same result into 9. What will be the figure?

(a) 25 (b) 16

(c) 3 (d) 15

Answer ( )

22. Gita and Sita started walking in opposite directions. Gita walks 5mils and Sita walks 6 miles. After that both turns to their right and walks two miles each. Again they turn and walk 2 miles each. After walking so much, how far are they from each other?

(a) 2 miles (b) 4 miles

(c) 3 miles (d) 5 miles

Answer ( )

3.3.2 ACADEMIC ACHIEVEMENT

Examination marks of Class VI to VIII students obtained by them in FA-I examinations of their respective classes were noted down from the school record. The marks were converted into grades in order to make them comparable.

3.4 ADMINSTRATION OF TOOLS

The investigator visited various schools for the administration of tool. First of all permission was taken from the heads of the institutions and then the test copies were administered to the students. Initially, the investigator got herself acquainted with the problem-solving ability inventory, by carefully going through the test booklets. No item was restricted for the test. Before administering the test, the researcher carefully noted that the place for the administration of the test was such that the students worked comfortably and without disturbance. The pupils were properly motivated to take the test. The language used by the researcher in giving instruction to the students was very simple, so that the students understood what was to be done and then the test booklets were distributed among the students. The students were supposed to tick mark any one of the four alternatives against each item number after going through the question. After completion of the test, the booklets were taken back from the students. In the end, students were thanked for their co-operation. In this manner, the data was collected from all selected schools. Regarding the collection of marks, the investigator consulted the examination incharge of each respective school and noted down the marks of each student secured in FA-I examination. The examination incharge was kind enough to assist the investigator and in this way the researcher obtained the examination mark of students.

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Vol. 9 Issue 05
May 2022

3.5 SCORING OF TOOLS

Scoring of this tool i.e., Problem Solving Ability Test was done according to the scoring keys prescribed by the author of the test. The present test consists of 22 problems along with alternative answers (expect item No. 2 and 20) in which only one answer is correct. If the tester writes the correct answer, he should be awarded one mark and for the wrong answer zero should be given. The maximum marks will be 22. The scoring key of Problem-Solving Ability Test used in the study for the scoring of Problem-Solving Ability Test of students is given in the following Table.

TABLE 3.2 ANSWER KEY FOR THE PROBLEM SOLVING ABILITY TEST

S. No.	Answer	S. No.	Answer
1	a	12	b
2	One child get the orange with baskets	13	d
3	b	14	d
4	b	15	b
5	b	16	b
6	c	17	a
7	d	18	d
8	d	19	b
9	c	20	52, 62, 28
10	d	21	c
11	c	22	d

3.6 SELECTION OF STATISTICAL TECHNIQUE

In the present study the investigator employed One-Way ANOVA for finding out problem solving ability among high and low achiever boys.

4. ANALYSIS AND INTERPRETATION OF DATA

Once the data has been collected the next task in front of the investigator was to categorize and analyze it so as to draw valid conclusion.

After the data have been collected it must be processed, categorized and analyzed to draw proper interferences. However, valid, reliable and adequate the data may be, it does not serve any worthwhile purpose unless it is carefully and systematically analyzed, intellectually and rationally concluded.

In the present study the investigator was concerned with computation of Q_1 and Q_3 for the categorization of data and for the testing of the significance of differences in the high and low achiever boys in the subject of Mathematics in the secondary classes of Kendriya Vidyalaya Schools and the problem solving ability among boys of Kendriya Vidyalaya Schools

4.1 CATEGORIZATION OF DATA

(i) Computation of Q_1 and Q_3

For categorization of the students on the basis of the marks obtained by them in the problem solving ability test Q_1 and Q_3 were computed. The values of Q_1 and Q_3 are given in the following Table.

TABLE 4.1 SHOWING THE QUARTILE VALUES (Q_1 AND Q_3) OF BOYS

Q_1	Q_3
7.13	**13.7**

After calculating Q_1 and Q_3 boys are divided into two categories. In one category the students who obtain below Q_1 were included and in the other category the students who obtain above Q_3 were included. Cases falling in between Q_1 and Q_3 were deleted to avoid overlapping.

(ii) Bartlett's Test

After the division of boys on the basis of Q_1 and Q_3 the homogeneity of sample was tested. For this purpose Bartlett's Test of homogeneity of variance was applied.

The value of Chi-square needed for significance for 1 *df* at .05 level 3.841. Since the obtained value 1.69 of Chi-square is less the needed value, the variance within the treatments may be treated as homogeneous.

4.2 TECHNIQUES EMPLOYED

After testing the homogeneity of variance, the data must be analyzed to draw proper inferences. However, valid, reliable and adequate, the data may not serve any worthwhile purpose, unless it is carefully and systematically analysed, intellectually interpreted and rationally concluded. It is therefore the investigator employed Analysis of Variance (ANOVA) for the analysis of data.

4.2.1 ANALYSIS OF VARIANCE

This technique of analysis of variance was first developed by R.A. Fisher in 1923.This method was widely used in the experiments of behavioral and social sciences to test the significance of differences of means in different groups of varied population. For this technique, Fisher is called the father of modern statistics. It is a powerful, robust

technique of overall test of several sample. In it data is treated compositely and a general null hypothesis is tested among various groups. Through this technique, it is possible to determine the significance of differences of different means in a single test rather than many. In this way ,it minimizes the Type 1 error unlike in case of t-test.

The value of F ratio is computed through.

$$F = \frac{\text{Variance between groups}}{\text{Variance within groups}}$$

Where the variance between groups refers to the variation or deviation that exist between group mean with respect to grand mean. Whereas the variance within groups refers to the variation or deviation that exist in each score from its mean value. In the test when the variance between is not greater than the variance within the group then it can be concluded that difference exists as a result of sampling error. When the ratio is greater than one it indicators that the result is greater to the sampling error. But in general case the variance between samples is greater than the variance within groups.

4.2.2 ASSUMPTIONS OF ANALYSIS OF VARIANCE

There were certain assumptions which should be taken into consideration before applying analysis of variance technique. These are given below:

1. Distribution should be normal:

It states that the distribution of the dependent variable in the population must be normally distributed unless the result will be different or more significant than the real result.

2. Variance should be homogenous:

It states that the variance in different sets of scores must not differ and the populations drawn from the sample must be equal or homogenous. Maximum variation from homogeneity may affect the result seriously.

3. Effect of factors should be additive:

It states that the effects of different factors on the total variation should be additive or multiplicative.

4. Sampling should be drawn from random process:

It states that sampling of different groups should be selected randomly where there is equal chance of selection of each item.

4.2.3 USES OF ANOVA

- Analysis of variance is suitable technique for the interpretation of multi-dimensional variables in researches of social sciences.
- It analyses various factors and their effects in the experimentation systematically.
- It interprets the test of means and their relative interactions.
- It is a sound and economical parametric test widely used by researches.

4.3 COMPUTATION AND SUMMARY OF ANALYSIS OF VARIANCE

For this study, the investigator was having Problem Solving Ability as the dependent variable and the boys and high and low academic achievement as the independent variables. The investigator was interested to study the problem solving ability among high and low achiever boys. With this aim in view the investigator used the technique of One-way Analysis of Variance.

The objective of the investigator in the study was to examine the problem solving ability among high and low achiever boys. The scores of students belonging to high and low achievement were calculated by applying One- Way ANOVA. The scores of the students have been subjected to computations through Table.

TABLE 4.2 SCORES OF HIGH AND LOW ACHIEVER BOYS IN PROLEM SOLVING ABILITY TEST

Low achievers A	High achievers B
5	16
5	15
4	15
4	19
6	18
5	15
5	14
4	18
6	17
5	14
ΣA = 49	**ΣA = 161**
N = 10	**N = 10**
M = 4.9	**M = 16.1**

After applying Analysis of Variance technique on the scores of high and low achiever boys given in Table 4.2 the investigator reached at the conclusion which is shown in the following Table.

TABLE 4.3 SUMMARY OF ANALYSIS OF VARIANCE FOR PROBLEM SOLVING ABILITY SCORES

Souces of Variance	Sum of Squares SS	*df*	Mean Square MS	F-Ratio	Significance
Between	627.2	1	627.2	333.6	Significant
Within	33.8	18	1.88		

Table Value 1/18 *df* at → 0.05 = 4.41
→ 0.01 = 8.28

INTERPRETATION

The value of F i.e. 333.6 has been found to be significant against *df* 1 and 18 at both levels of significance. The hypothesis of difference in problem solving ability among high and low achiever boys is therefore, accepted and it can be said that there is significant difference in academic achievement and the problem solving ability among the boys of different Kendriya Vidyalaya Schools of the Jammu district.

TABLE 4.4 SHOWING THE MEAN VALUES OF BOYS IN PROBLEM SOLVING ABILITY TEST

3	HIGH ACHIEVERS
4.9	16.1

INTERPRETATION

The mean value of the boys (high achievers and low achievers) is quite significant. The mean value of high achievers is 16.1 which is much higher and shows that high achiever boys have better problem solving ability than the low achiever boys.

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Vol. 9 Issue 05
May 2022

5. CONCLUSIONS, EDUCATIONAL IMPLICATIONS AND SUGGESTIONS FOR FURTHER RESEARCHES

5.1 CONCLUSIONS OF THE STUDY

After successfully completed the study the investigator reached at the conclusion that the high achiever boys have better problem solving ability than the low achiever boys. There is difference in problem solving ability among high achiever boys and low achiever boys.

5.2 EDUCATIONAL IMPLICATIONS

The problem solving is one of such an aspect which is a sort of God gifted factor. It is very rare to be of this kind. The problem solving is not the problem solving of a day's working riddle but it is something with which one has to grapple with the extraordinary mental faculties in order to crack up the problems which pertain to the higher order thinking.

As the practice makes a person perfect, so it is required that such students who have extraordinary mental faculties should be encouraged to be given the extra tasks which may require their extra mental faculties the schools should devise some extra time for such students by arranging extra classes and such material may be provided free of cost so that such students who have this talent even if may not afford to buy such material, may not feel to be of less talented than those who could do so.

Parents need to encourage their children in case if they find them to possess their talent of problem cracker. Such parents should help their children by giving them extra help both in academics as well as in financial terms, so that a pool of their talented children may be created, which is real human resource development.

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5.3 LIMATIONS OF THE STUDY

- The validity problem solving ability test couldn't be measured due to paucity of time.
- The causes of remedial measures were not taken.
- The study was carried out on the boys of Kendriya Vidyalaya Schools only.
- Convenient method of sampling was used for selection of the sample.

5.4 SUGGESTIONS FOR FURTHER RESEARCHES

1. The present study cannot be called final or comprehensive. More work can be done on different age groups.
2. A sample of 164 students was taken in the present study. Same study can be done on a large sample also.
3. Only boys were taken as sample in the present study. This study can be done on girls or both on boys and girls also.
4. This study was only done on students of schools of Jammu district only. It can be further undertaken in other district schools also.
5. Problem Solving Ability can also be studied in relation to adjustment, sex, neuroticism and security-insecurity feelings.
6. In addition to academic achievement, other variables could also be considered viz., socio-economic status, intelligence, risk-taking behaviour etc. with self-confidence as criterion.

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