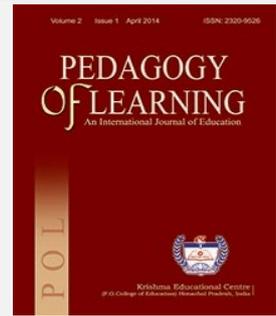


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Scientific Aptitude and Academic Achievement of Students in Mathematics

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ABSTRACT

Scientific Aptitude Test (SAT) is intended to measure the potential ability of a person to pursue as course of training in the field of Science related subjects. Academic Achievement in Mathematics helps to inculcate the skills of quantification of experiences around the learners. The concept of achievement involves the interaction of three factors like aptitude, readiness and opportunity of learning. The objective of the study was to determine the significant difference in the level of Scientific Aptitude with respect to variables like gender and locale. The Descriptive method of Normative Study type was adopted. A sample of 100 students was selected for the study from the Senior Secondary schools of West Bengal. Tool Used for the Study are Scientific Aptitude Test (SAT) tool developed by Shahapur and Rao (2006). Findings of the Study were that Boys possess more Scientific Aptitude than Girls and Scientific Aptitudes of Urban students are more than that of rural students.

KEYWORDS: Scientific Aptitude, Academic Achievement, Scientific interest, Accuracy of Observation.

INTRODUCTION

Scientific aptitude is complex of interacting hereditary and environmental determinants producing pre-dispositions or abilities. Miles (1954) defined, "Scientific Aptitude is another example of talent present in the gifted group so far greater extent than its probable realization in adult achievement." We can identify to an extent, certain, not all, characteristics possessed by individuals who succeed later in scientific endeavor. Scientific Aptitude Test (SAT) is intended to measure the potential ability of a person to pursue a course of training in the field of science and to seek special help who are found to be weak in the field of science related subjects. Scientific Aptitude Test (SAT) is intended to measure the potential ability of a person to pursue as course of training in the field of Science related subjects. Scientific Aptitude testing combined with the other relevant information received, would help to a greater extent in avoiding considerable wastage of human as well as

material resources by placement of individuals in places and lines of work in which they are most likely to be Productive.

Dimensions of Scientific Aptitude Test: The dimensions of the Scientific Aptitude Test are Experimental bent, Ability to reason, Logical conclusion, Ability to draw conclusion, Ability to interpret, Scientific interest, Ability to solve general problems and Accuracy of observation.

ACADEMIC ACHIEVEMENTS IN MATHEMATICS

Academic Achievement is of paramount importance, particularly in the modern days of educational scenario. Obviously, in the schools, great emphasis is placed on achievement right from beginning of formal education. Setting the stage for achievement of youth is thus a fundamental obligation of the educational system at the school stage. An achievement in Mathematics is considered as the yardstick in the field of Science and Technology. Mathematics is the father of all Sciences and it enjoys a unique status in the School Curriculum. Mathematics is visualized as the vehicle to train a child to think, reason, analyses and articulate logically, concomitant to any subject involving analysis and reasoning. Achievement in Mathematics helps to inculcate the skills of quantification of experiences around the learners who in turn carry out experiments with numbers and forms of Geometry, frame hypotheses and verify them, generalize the findings with proof, make decisions applying Mathematics, develop precision, rational and analytical thinking, reasoning, competence to solve problems, positive attitudes and aesthetic sense. The concept of achievement involves the interaction of three factors like aptitude, readiness and opportunity of learning. Mathematics is the bases of Science and Technical Education Pyramid, on which the entire edifice of development of technology is built on. Mathematics is the foundation stone of the massive super structure of Science and Technical education, which have the basic requirement for our economic development, modernization of the social structure and effective functioning of democratic institution. Scientific advancement and innovations on technology are the evergreen slogans of all times in all countries of the globe. Mathematics plays the prominent role in the above said regards. The Scientific Aptitude includes a spirit of enquiry, a disposition to reason logically and dispassionate the habit of judging beliefs and opinions on available evidences, the courage to admit facts, howsoever unsettling or disagreeable they might be and finally recognizing the limits of reasoning power itself. It is also expected that Scientific Aptitude and Achievement in Mathematics would help to equip individuals to participate in the creation of a society which is free from poverty, hunger, diseases and evils such as violence, exploitation, oppression etc. For improving the quality of life through economic and natural development, we depend on the knowledge of Mathematics.

Rao (2004) conducted research study on ‘Scientific Attitude, Scientific Aptitude and Achievement’, to identify the levels of these three present in secondary school students are with average scientific attitude, scientific aptitude and achievement in Biology. The Scientific Attitude, Scientific Aptitude and Achievement in Biology have a significant positive Inter relationship. Lawrence (2005) conducted the study on, ‘Show down at sex gap: women’s intrinsic Mathematics and Science aptitude divides Scientists’ and he found that, relatively low number of high-achieving women in Mathematics and Science partly reflects a lack of inherent aptitude for such pursuits. Elizabeth (2005) conducted a study, ‘Sex differences in intrinsic aptitude for Mathematics and Science: A critical Review’. The findings of the study were that males are more variable in their cognitive abilities and therefore pre-dominate at the upper reaches of Mathematical talent. Hyde and Linn (2006) conducted a study on Gender similarities’ in Mathematics and Science. The major findings of the study were that Boys and Girls have similar psychological traits and cognitive abilities; thus a focus on factors other than gender is needed to help girls in Mathematical and Scientific Career tracks. Zhuzheng (2007) studied gender differences in mathematical problem solving patterns and major findings were that, there are gender differences in mathematical problem solving favoring males. Strategy use, as a reflection of different patterns in mathematical problem solving between

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genders, is found to be related to cognitive abilities, together with Psychological characteristics and mediated by experience and education. Rationale of the study

Scientific Aptitude is a compound of abilities. These are developed through learning. These abilities include, suspended judgment, detection of fallacies and inconsistencies, reasoning logically and originally, drawing correct inductions and deductions. Mathematics being allied topic, demand much more Scientific Aptitude in students. In the context of an overhauling change in the system and demand for inculcation of cognitive abilities in the students, it is indispensable to promote mechanical reasoning, spatial relation and classification analogy, numerical, verbal, pictorial reasoning in students. Because of the high demands in this Science and Technological World, a learned society apt in Mathematics, is required. There has been a pressure on classroom teaching process, whereby the students can be encouraged to develop such abilities. Therefore, a research to identify and evaluate the teaching learning process in Mathematics in our schools has been obligatory. Whether our teaching - learning process is in tune with the inculcation of such abilities with the development of Scientific Aptitude of students are functioning or not, to ascertain this, the present attempt is an endeavour by the investigator.

Therefore, the study was aimed at measuring Scientific Aptitude of Science students offering Mathematics as subject of their study at Senior Secondary level. Because Mathematics incorporate development of reasoning power, draw correct inductions and deductions, detect fallacies and inconsistencies, suspended judgment etc., of students and Scientific aptitude test is based on the characteristics like Experimental bent, Ability to Reason, Detection of Illogical conclusion, Ability to draw conclusion from the given Data, Ability to interpret, Scientific interest, ability to solve general problems, accuracy of observation etc. So the investigator had been inclined to undertake the study to find out the relationship between Scientific Aptitude and Achievement in Mathematics. This was the strong rationale for the conduct of the present study.

OPERATIONAL DEFINITIONS OF THE TERMS USED

Scientific Aptitude: “The Scientific Aptitude here refers to experimental bent, ability to reason, detection of illogical conclusion, ability to draw conclusion from the given data, ability to interpret, scientific interest, ability to solve general problem, accuracy of observation,” as per the scale of measurement of scientific aptitude developed by Shahapur and Rao (2006).

Academic Achievement in Mathematics: “Academic Achievement in Mathematics is the attainments, accomplishments and proficiencies of performance in a given skill or body of knowledge. Here it refers to the performance of the students in summative evaluation at the yearend i.e. the marks obtained by the students on their previous summative test in mathematics”. The marks would be collected from the School tabulation register of the CBSE exam (X) result.

OBJECTIVES OF THE STUDY

The following objectives have been formulated in relation to the study.

1. To estimate the level of Scientific Aptitude of students studying Science Stream at Senior Secondary level.
2. To determine the significant difference in the level of Scientific Aptitude with respect to variables like gender and locale.
3. To ascertain relationship between Scientific Aptitude and Achievement in Mathematics at Senior Secondary level.
4. To compute the interaction effect of gender and locale on Scientific Aptitude and Achievement in Mathematics.

5. To predict scores of Achievement in Mathematics from the scores of Scientific Aptitude of the students.

HYPOTHESES

The following Hypotheses for the study have been formulated keeping in view of the above mentioned objective in null forms.

Ho₁: The levels of Scientific Aptitudes among Senior Secondary students studying Science are not normally distributed.

Ho₂: There does not exist significant difference in Scientific Aptitude in relation to gender and locale variations.

Ho₃: There does not exist significant difference in achievement in Mathematics at Senior Secondary Level in relation to gender and locale variations.

Ho₄: There does not exist the relationship between Scientific Aptitude and Achievement in Mathematics at Senior Secondary Level.

Ho₅: There does not exist significant difference between high and low Scientific Aptitude on Achievement in Mathematics.

Ho₆: There does not exist significant interaction effect of gender and locale on Scientific Aptitude.

Ho₇: Scientific Aptitude cannot be used as criterion for prediction Achieving scores in Mathematics.

METHODOLOGY

- **Design:** The Descriptive method of Normative Study type was adopted.
- **Sample of the study:** A sample of 100 students was selected for the study from the Senior Secondary schools of West Bengal.
- **Tools Used for the Study:** Scientific Aptitude Test (SAT) tool developed by Shahapur and Rao (2006) was selected. The dimensions of SAT are Experimental Bent, Ability to reason, Logical conclusion, Ability to draw conclusion, Ability to interpret, Scientific interest, Ability to solve general problems and Accuracy of observation. School Achievement Record for taking scores on Achievement in Mathematics subject in CBSE(X) exam were considered for the study.

RESULTS AND DISCUSSION

The following statistical inferential measures on Scientific Aptitude Test (SAT) scores were adopted.

Differences between the mean scores on SAT of the sub-samples

Table1: Test of significant differences between the mean scores on SAT in relation to Gender and Locale variations

Variation		N	Mean	S.D	SE _D	't'	Remarks
Gender	Boys	50	50.4	7.38	1.295	3.24	Significant p <.01
	Girls	50	46.2	5.42			
Locale	Urban	75	50.13	5.96	1.565	4.68	Significant P <.01
	Rural	25	42.8	7.03			

The values of 't' for df= 98 at 0.05 level and 0.01 level of significances are 1.98 and 2.36 respectively obtained from the table of critical values of 't'.

On perusal of the above table, it is revealed that the calculated values of 't' are much greater than the tabular values as cited above t 98 degrees of freedom even at 0.01 level of significance. Hence, 't' ratios are significant on gender and locale variations. Therefore the null hypothesis, "There does not exist significance difference in Scientific Aptitude in relation to gender and locale variations" is rejected. This indicates that Boys possess more Scientific Aptitude than Girls and Urban students are having more Scientific Aptitude than Rural students. There are various factors which might have influenced the result like socio-economic status, various facilities availed, variation on getting the quality education on the basis of nature of management of schools and etc.

Differences between the mean scores on Achievement in Mathematics of the sub-sample

Table 2: Test of significant differences between the mean scores on Mathematics Achievement in relation to Gender and Locale variations

Variation	Sub-samples	N	Mean	S.D	SE _D	't'	Remarks
Gender	Boys	50	69.1	15.26	3.08	1.04	Not Significant p <.01
	Girls	50	65.9	15.62			
Locale	Urban	75	71.17	14.27	3.22	2.99	Significant P <.01
	Rural	25	55.5	13.86			

The values of 't' for df=98 at 0.05 level and 0.01 level and 0.01 level of significances are 1.98 and 2.36 respectively obtained from the table of critical values of 't' On perusal of this table, t is revealed that 't' ratio is significant on locale variation and not significant on gender variation of Mathematics Achievement Scores. The Achievement in Mathematics is more in case of urban students than rural students.

RELATIONSHIP BETWEEN THE SAT AND ACHIEVEMENT IN MATHEMATICS

Positive marked correlation exists between Scientific Aptitude and Achievement in Mathematics with $r_{12} = 0.413$.

Differences between High and Low Scientific Aptitudes in Achievement in Mathematics

On the basis of Q3 (53), the students secured above 53 marks in SAT were categorized as High Scientific Aptitude Achievers and on the basis of Q1 (44.4) value, the students secured below 44 marks in SAT were categorized as Low Scientific Aptitude Achievers.

Table 3: Test of significance between the mean scores on High Scientific Aptitude scorers with their corresponding Mathematics Achievement Scores (HSAM) and Low Scientific Aptitude Scorers with their corresponding Mathematics Achievement Scores (LSAM)

Variation	N	Mean	S.D.	SE _D	't'	Remarks
HSAM	31	76.11	13.935	3.865	4.25	Significant P <. 01
LSAM	25	59.7	14.72			

The values of 't' for df =54 at 0.05 level and 0.01 level of significances are 2.05 and 2.67 respectively obtained from the table of critical values of 't'.

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On pursuance of the above table, it is revealed that the ‘t’ ratio is significant. So the null hypothesis that, “There does not exist significant difference between high and low Scientific Aptitude in Mathematics” is rejected. Therefore students possessing High Scientific Aptitude achieved more in Mathematics Achievement compared to Low Scientific Aptitude Students.

Analysis of Interaction effect of gender and local variations on Scientific Aptitude

From the Scientific Aptitude Scores, Students were categorized on gender and locale variations and one way ANOVA analysis was performed and summary of ANOVA table was prepared. F-ratios were calculated.

Table 4: Test of significant interaction effect of Gender and Locale on Scientific Aptitude through the one way ANOVA Summary Table.

Source of Variation	Sum of Squares (SS)	df	Mean Square (MS) Variance	F- ratio
Between Groups	SS _b =2005.95	03	MS _b =668.65	27.39
Within groups	SS _w =2343.81	96	MS _w = 24.41	
Total	SS _t =4349.76	99		

From the F-ratio table, the value of F-ratio (df for 3 and 97) at 0.05 level and 0.01 level of significances are 2.76 and 3.99 respectively.

By referring summary table of one way ANOVA, F- ratio is 27.39. But calculated value is more than that of tabular values of F-ratio is 27, 39, But calculated value is more than that of tabular values of F-ratio. So F ratio is significant. But it needs further testing of Scheffe’s test.

Table 5: Scheffe’s Test of Significance

Variations	N	Mean	F-ratio	Remarks
Urban Boys	32	56.03	20.03	Significant p< .01
Urban Girls	43	47.09		
Urban Girls	43	47.09	02.1	Not Significant
Rural Boys	18	43.6		
Urban Boys	32	56.03	24.3	Significant p< .01
Rural Boys	18	43.6		
Urban Girls	43	47.09	3.4	Significant p< .05
Rural Girls	07	40.7		

On pursuance of these tables, it is revealed that Urban Boys posses more Scientific Aptitude than Urban Girls as well as Rural Boys.

Prediction of Scores of Achievement in Mathematics from the Scientific Aptitude Scores

In order to predict the Achievement in mathematics Scores from the Scientific Aptitude Test scores, simple regression analysis is followed. The co-efficient of correlation (r²) between Scientific Aptitude and Achievement in Mathematics was already estimated as 0.413.

Table 6: Prediction of Mathematics Achievement Scores when Scientific Aptitude Scores are known through the Regression equation

Variation	N	Mean	S. D.	r_{12}
SAT Score (X)	100	47.36	6.69	0.41
Mathematics Achievement Scores (Y)	100	67.5	15.52	

By using simple regression analysis from the above data, it is revealed that, the regression equation is $Y=0.95X+ 22.45$. When the SAT Score (X) is known, we can predict the Mathematics Achievement Score of the students. When SAT Score = X = 50 (known), $Y = 0.95 (50) + 22.45 = 70$. Prediction of Mathematics Achievement Score =70.

SE (esty) = Standard Error (SE) of estimate (when Y scores are predicted from X scores). $SE_{(esty)} = 14.2$ (Our estimate will not miss the actual Mathematics Achievement Scores by more than 14 marks). At 0.01 level of significance Y (predicted Score) = $\pm 2.58 SE_y = \pm 36.4$. So Actual score in Mathematics Achievement will be the range of $Y \pm 36$.

MAJOR FINDINGS OF THE STUDY

- Boys possess more Scientific Aptitude than Girls.
- Scientific Aptitudes of Urban students are more than that of rural students.
- Gender variation does not play its importance in the Achievement of Mathematics.
- Positive Substantial of Marked Correlation exists between Scientific Aptitude and Achievement in Mathematics.
- Students possessing High Scientific Aptitude Achieved more in Mathematics Achievements compared to Low Scientific Aptitude students.
- Urban Boys Possess more Scientific Aptitude than Urban Girls and Rural Boys.
- Scientific Aptitude can be used to predict the Achievement in Mathematics.

RECOMMENDATIONS

Aptitude test can provide information that is useful in determining learning readiness, individualizing instruction, organizing classroom groups, identifying underachievers and high achievers, diagnosing learning problems and helping students with their educational and vocational plans. Although the results of Achievement tests are useful for these purposes, aptitude tests make a special contribution.

Standardized Aptitude Tests (like SAT) are designed to predict future performance in some activity, such as school learning. Like Achievement Tests, Aptitude Tests measure learned abilities. They differ from achievement tests, however, in that the test content is broader in scope, and test performance is less dependent on any specific set of learning experiences. This makes it possible to use the tests with students of varying educational backgrounds and to predict future performance over a wide range of learning activities. Therefore, the investigator has felt to recommend Scientific Aptitude Tests can be used to measure the potentialities of the students in school level.

REFERENCES

- Elizabeth, S.S. (2005). *Sex differences in intrinsic aptitude for mathematics and science: a critical review*. Washington, D.C.: American Psychological Association.
- Linn, C. M. (2006). Gender similarities in mathematics. *Science*, Vol. 314 (5799).

- Lawrence, S. (2005). *Show down at sex gap women's intrinsic mathematics and science aptitude divides scientists*. American Psychological Association.
- Rao, D. (2004). *Scientific aptitude and management: a comprehensive study*. www. google.co.in
- Shahapur, N. P. and Rao, C. R.(2006). *Manual for scientific aptitude test (SAT)*. Agra: National Psychological Corporation.
- Zhuzheng, Z. (2007). Gender differences in mathematics problem solving patterns. *International Education Journal*, 8 (2), 187-203.

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