

# Effect of Gender, Attitude towards Science, Parental Education and Family Size on Science Achievement of Secondary School Students of Central U.P.

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## ABSTRACT

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This study explored the effects of gender, attitude towards science, parental education, and family size on science achievement. A convenience sample of 2006 students, 1080 males and 926 female from twenty one schools of central UP was used for study. The Science Attitude Scale, Science Achievement Test and Personal and Environmental background assessment Questionnaire were used for data collection, while t-test, f-test and correlation techniques were used for statistical analysis. The results revealed that there was a significant difference between science achievement of boys and girls. The results of analysis showed that there was positive co-relation between attitude towards science and achievement in science. The results of the analysis showed that the parental education is positively correlated with the science achievement of the students. The family size of the students was positively associated with the science achievement of the students.

**Keywords:** Science Achievement; Gender; Attitude towards Science; Parental Education and Family Size.

## 1 INTRODUCTION

EDUCATION on all accounts is accepted to be a systematic and applied discipline. It is systematic because it draws heavily upon other discipline. It is applied because educational ideas have to be practiced before they could gain proper acknowledgement and accuracy. It raises the status of the human beings and the community as a whole. It broadens the mental horizon of the human beings.

Education involves the transfer of communication of information knowledge and skills from one point (The source) to another (The Receiver). According to M.K. Gandhi "Education Means the all round drive out the best in child, man, body, Mind and Soul."

Education is universally recognized as the most effective tool of bringing about change towards the social and economic betterment and cultural transformation of a society. It raises the status of human being and the country as a whole. It broadens the mental horizon of the human being. In one hand education develops the total personality of the individual; on the other hand it contributes to growth and development of the society. It is only through education the moral ideas and spiritual values, the aspiration of the nation and its cultural heritage are transferred from one generation to another for preservation, purification and sublimation into higher and higher culture.

Education is the key to all processes of development especially-human development. Catalytic action of education in this complex and dynamic growth process needs to be planned meticulously and executed with great sensibility.

The nation that fails to make a genuine assessment of his human energy available in it is bound to lag behind others in the era of great competition in the national and international fields. An ideal system of education should enable individuals

to know and develop to the fullest their physical and intellectual potentialities and promote their awareness of societal and human values so that they can develop a strong character and live better lives and function as responsible members of society.

Science and Mathematics are the parts of educational system which play a pivotal role in making a man rational and develop his independent thinking and help in removing the superstitions, prevalent in the system in various forms. In view of the modern development and its importance in today's world, the Science and Mathematics education has assumed a significant place in the curricula of primary and secondary school education.

Science and Mathematics have become a substantial and integral part of an organized society. There is a close interaction between Science and Mathematics and the economic, social, political and educational issue of the society, therefore, there is hardly and need to justify the place of Science in a scheme of general education for school children. The objectives of Science teaching at secondary level as spelt out by the NCERT (1988), clearly indicates, "that the basic purpose of Science education at secondary level is to understand the nature of Science, its processes, methods and scope, so that the students can use scientific method to solve their problems and develop scientific attitude". Another important objective of secondary school Science is to provide a sound foundation for those seeking to continue the study of Science at higher level. According to Kothari (1966-68), "the aim of teaching Science in the primary school should be to develop proper understanding of facts, concepts, principles and processes in the physical and biological environment". In the words of Irawin L. Ramsay (1968) "We are living in a world of change and challenge a world

Filled with stocking and awe inspiring discoveries as well as world filled with crumbling of moral rot and decay." Such a time with its fast tempo has many implications for science education, unimagined higher to especially for a developing country like India.

Science has responded to human concerns in several areas like medicine and agriculture. The technological developments have reduced drudgery for a considerable sector of the population. In future, however, the side effects of the developments and developmental activities which alienate human society from nature will have to be seriously responded to. Every individual will require training and preparedness in areas like disaster management. Need based knowledge would be valued by the society and the community

In the present social set-up, science is more important for the common man. A little reflection will show what predominant role science plays in our everyday life and how it has become an indispensable factor for the progress of our present day world. It is the pivot of all civilization. This is the subject which undisputed forms the very basis of entire world's commercial system. It is a contributory factor in the prosperity of human race. There is no mathematics, no art and no profession, where science does not held a key position. The accuracy and exactness of a thing is determined to a major extent by the amount of science utilized in it. Even social sciences like economics, psychology, geography etc. make abundant use of science. The gigantic work of construction of dams, bridges, building of ships, airplanes, bombs etc. are possible only because of the quantitative science. Even in medical area sciences is used to measure the doses, the blood pressure, the rate of the pulse, the body temperature etc.

Achievement is the end product of all educational endeavours. The main concern of all education efforts is to see that the learner achieves. Quality control, quality assurance and total quality management of achievement have increasingly gained the attention of research in education. After exploring the concept of achievement in the cognitive, affective and psychomotor aspects of human behaviour, researchers have probed further and have attempted to understand the 'black box' of achievement.

The world is becoming more and more competitive and quality of performance has become the key factor for personal progress. Parents desire that their children climb the ladder of performance to as high a level as possible. This desire of a high level of achievement put a lot of pressure on students, teachers and institutions, in general the educational system itself. In fact it appears as if the whole system of education revolves around the academic achievement of the students, through various other outcomes are also expected from the system. Thus a lot of time and efforts of the schools are helping students to achieve better in their scholastic endeavours. The importance of scholastic achievement has raised several important questions for educational researchers. What factors promote achievement in students? How far do the different factors contribute towards academic performance? Therefore many factors have been hypothesized and researched upon and researchers have come out with different results, at times, complementing each other but at times contradicting each other.

## 2 Conceptual Frame Work:

Derek Cheung (2009) examined the interaction effect between grade level and gender with respect to students' attitude toward chemistry lessons taught in secondary schools. The sample consisted of 954 chemistry students in grade Secondary 4-7 (approximately) 16-19 years of age) in Hong Kong. Students attitudes were surveyed using an attitude toward chemistry lessons scale (ATCLD), and subscale scores were produced on four dimensions: liking for chemistry theory lessons, liking for chemistry laboratory work; evaluative beliefs about school chemistry; and behavioral tendencies to learn chemistry. When the ATCLS data were subjected to two-way MANOVA, the interaction effect between grade level and gender on students attitudes toward chemistry. Lesson was statically significant. The interaction effect was attributable to scores on the theory-lessons subscale and laboratory work subscale. Male students in Secondary 4 and 5 liked chemistry theory lessons more than their female counterparts. However, male students liking for chemistry laboratory work declined when they progressed from Secondary 4 to Secondary 7; no such a significant decline in attitude toward chemistry laboratory work was found in females. Overall, both males and females were just marginally positive about chemistry lessons during the years of secondary schooling. Implications of these findings for curriculum design are discussed.

Tzuriel, David (2010) explored the barriers to children's achievement in the areas of science, math, and engineering. A gender difference in girls' spatial abilities emerges very early in development. Researcher studied more than 100 first graders, placing about half of them in a training program that focused on expanding working memory, perceiving spatial information from a holistic point of view rather than based on particular details, and thinking about spatial geometric pictures from different points of view. The other children were placed in a control group that took part in a substitute training program. After eight weekly sessions, initial gender differences in spatial ability disappeared for those who had been in the first group. This is the first study to find that training helps reduce the gender gap in spatial ability. Further work can follow up on these findings by determining whether eliminating the gender gap contributes to achievement in math and science. While the research doesn't yet show that the intervention leads to better achievement in science, math, and engineering for girls, this is a promising direction for supporting girls' achievement and eventual contributions in.

Every research project deals with the solution of a problem of human interest. Therefore, the researcher has a definite purpose in mind. He has certain specific goals to achieve through his research work. Such specific goals or purposes are technically formed as objectives. Every research study must have some objectives to achieves, without which no research can be conducted. The entire research process is guided by objectives which have been explicitly and precisely spelled out by the investigator in advance.

The present study is aimed at achieving the following objectives:

1. To compare the science achievement of secondary

school students on gender basis.

2. To study the relationship of attitude towards science with science achievement of secondary school students.
3. To study the effect of parental education on science achievement of secondary school students.
4. To study the effect of family size on science achievement of secondary school students.

### 3 Methods:

The present work is a descriptive study investigating if students' science achievement differed significantly to a group of variables such as gender, attitude towards science and participation in sports activities. The sample consisted of 2006 students of class IX, selected from 21 schools of central UP in which 1080 were male and 926 were female students. In this study, schools were categorized on the basis of their medium of instructions. For instance, English Medium schools, where pupils in IX are from all socio-economic strata and are admitted through competitions and Hindi Medium schools, where pupils in IX are from all socio-economic strata and are admitted through competitions.

### 3.1 TOOLS USED

#### 3.1.1 Science Attitude Scale:

The science attitude has operationally defined as a generalized attitude towards the universe of science content and being measured in terms of its favourableness or unfavourableness estimate d from the scores obtained by the subjects on an attitude scale toward science comprising of the four categories from the universe of content 'Science Attitude', (i) Positive intellectual (ii) negative intellectual, (iii) positive emotional and (iv) negative emotional attitudes.

The Science Attitude Scale is a dependable tool for measuring student's attitude towards science. It appears to be useful for teachers of science, guidance workers and research scholars. It can be used by the curriculum specialists to measure the outcomes of teaching science. The students of Psychology and Education can also use it to study the development of their attitude towards attitudes.

The attitude score of a subject is the sum total of scores on all the twenty items of the scale. For each student a total score on the scale can be obtained by summing his scores for the individual items. Thus a maximum of 80 scores can be obtained by a subject. However, the administration of the test reveals that the scores ranged from 25 to 70.

The summation of score earned by a student on all statements was taken as his attitude score. The total scores indicate favourableness or unfavourableness of the attitude of students towards science. The higher is the score the more favourable is the attitude towards science and lower is the score the more unfavourable is the attitude towards science of the students.

#### 3.1.2 Science Achievement Test:

The achievement test in science for class IX students that is used in the present study was constructed by the investigator. This is a very comprehensive test based on 16 chapters of class VIII science text book (NCERT). The test consists of 75

items of multiple choice type representing achievement at various areas of science such as physics, chemistry and biology of eighth class of U.P. Board and C.B.S.E. Board. Physics have 35 items, chemistry have 20 items and biology having 20 items. The total score on the test as a whole was used as a measure of achievement in science. All the items in the test were the easy items in the test were arranged in order of difficulty, the easy items being placed in the beginning and this was done to motivate the students. The difficulty values of items in the test between the range of .25 to .85 similarly, each item had a discriminating power greater than 0.30. The test was based on the latest syllabus prescribed by the directorate of education, U.P. & NCERT. This test had a fairly high content validity and its reliability is found to be 0.87.

#### 3.1.3 A Personal and Environmental background assessment Questionnaire:

The personal and environmental information sheet is prepared by the investigator. This sheet contains such questions requiring the subjects to give information on their parental educational, science resources available at home ,father occupation , gender, family size and time spent on watching T.V. etc.

### 4 Results and Analysis

Table 1: Comparison of mean science achievement scores of male and female students.

Gender	N	Mean	SD	df	t-value	Sig./ Not sig.
Male	1080	31.20	12.34	2004	4.51**	Sig. at 0.01 level
Female	926	28.75	11.88			

\*\* Significant at 0.01 level

Data analysis is performed on computer with SPSS 17 software package. When data was analyzed to make a comparative study of the achievement in Science of male and female students (Table 1) the result shows a significant difference between achievement in science of males and females (df=2004, t=4.51).

The total numbers of male and female students were 1080 & 926 respectively as indicated by the table 1. Out of 75 scores, the mean achievement scores in Science of male student is 31.20 and standard deviation (SD=12.34). In case of female students, the mean Science achievement score is 28.75 and standard deviation (SD=11.88). The statistically calculated t-value is 4.51; which is significant at 0.01 level with 2004 df. The result clearly indicates that there is significant difference between mean science achievement score of male and female secondary school students. Both are not equally good they differ in their Science achievement. Thus the hypothesis of the study that "there is no significant difference between male and female students in Science achievement" is rejected at 0.01 level of significance.

Table 2: Relationship of attitude towards science and mean science achievement scores of secondary school students

Variables	N	Mean	SD	Correlation coefficient (r)
ATS	2006	41.66	13.59	0.338**
SAT	2006	30.07	12.19	

\*\* Significant at 0.01 level

The correlation was employed to find out the relationship of attitude towards science and achievement in science. The Total Sample was 2006. The mean scores of attitude towards science and achievement in science of secondary schools students were found to be 41.66 and 30.07 where as the standard deviation of attitude towards science and achievement in science of secondary schools students were found to be 13.59 and 12.19 respectively. The calculated correlation coefficient (r) is 0.338, which is significant at 0.01 level. The mean score, standard deviation (SD) and correlation coefficient (r) values are given in table 2.

The analysis does not confirm the prediction hypothesized in this study for the present sample. A strong relationship between student's attitude towards science and achievement in science has been demonstrated by this finding. Hence, the hypothesis stating that, "there is no significant relationship between attitude towards science and achievement in science of secondary school students" was rejected at 0.01 level of significance.

Table 3 Comparison of science achievement scores among the three categories of father's Education (E1= illiterate, E2= up to 12, E3= degree level and above) of secondary school students

illiterate E1 (N=262)		up to 12 E2 (N=1109)		degree level and above E3 (N=635)		Significant pairs (*)	F- value
Mean	SD	Mean	SD	Mean	SD		
24.54	10.09	27.27	10.24	37.22	12.09	E1 Vs E2 E1 Vs E3 E2 Vs E3	197.94**

\*\* Significant at 0.01 level

For studying relationship between father's education and their children's achievement in science the data was categorized into three groups, i.e., illiterate, educated up to class 12th, and degree levels & above, on the basis of their fathers education. The mean science scores of their children of these groups are 24.54, 27.27 and 37.22 respectively. The scores of these groups were put to analysis of variance. The results are given in table 3. Analysis of variance of the mean scores of the three groups give F value as 197.94\*\*, which is significant at 0.01 level. This implied that there is significant overall difference in the means of these three groups. Hence F-test was found significant; therefore Duncan's post hoc test was applied for further investigation.

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Further support to this conclusion, it is also provided by a test of significance of difference between science achievement scores of three type of father's educational level as given in the table 3.

The statistical method used in testing the major hypothesis was the Duncan's post hoc test for the difference between the means of three groups of father education. The significant pairs obtained by comparing each groups mean science achievement score with that of every other groups show that out of three possible paired comparison all three showed significant difference.

The result clearly indicates that as the father's education increases, the achievement in science score of their children also increases accordingly. The lowest mean scores in science is found of children whose fathers are illiterate and on the other hand the highest score in science achievement is found of the children whose fathers are highly educated.

Table 4 Comparison of science achievement scores among the three categories of mother's education (E1= illiterate, E2= up to 12, E3= degree level and above) of secondary school students

( Duncan's Mean Test )

illiterate E1 (N=502)		up to 12 E2 (N=1122)		degree level and above E3 (N=382)		Significant pairs (*)	F- value
Mean	SD	Mean	SD	Mean	SD		
25.06	10.12	29.43	11.46	38.52	12.45	E1 Vs E2 E1 Vs E3 E2 Vs E3	156.90**

\*\* Significant at 0.01 level

For studying relationship between mothers education and their children's achievement in science the data was categorized into three groups, i.e., illiterate, having received education up to class 12th, and degree levels & above, on the basis of their mothers education. The mean science scores of their children of these group are 25.06, 29.43 and 38.52 respectively. The scores of these groups were put to analysis of variance. The results are given in table 4. Analysis of variance of the mean scores of the three groups give F-value as 156.90\*\*, which is significant at 0.01 level. This implied that there is significant overall difference in the means of these three groups. Hence F-test was found significant, therefore Duncan's post hoc test was applied for further investigation.

Further support to this conclusion, it is also provided by a test of significance of difference between science achievement scores of three type of mothers educational level as given in the table 4.

The statistical method used in testing the major hypothesis was the Duncan's post hoc test for the difference between the means of three groups of mother education. The significant pairs obtained by comparing each groups mean science achievement score with that of every other groups show that out of three possible paired comparison all three showed significant difference.

The result clearly shows that as the mother's education increases, the achievement in science score of their children also increases accordingly. The lowest mean scores in science is found of children whose mothers are illiterate and on the other hand the highest score in science achievement is found of

the children whose mothers are highly educated.

Hence a significant difference between science achievement scores of students' parental qualification has been demonstrated by this finding.

Hence the hypothesis stating that "there is no significant difference among the categories of parental education and achievement in science of secondary schools students" is rejected at 0.01 level.

Table 5 Comparison of science achievement of students according to their family size

Family size	N	Mean achievement score	SD	df	t-value
Small	433	34.07	13.08	2004	7.842**
Large	1573	28.96	11.70		

\*\* Significant at 0.01 level

The total sample has been divided into two groups on the basis of their family size i.e. small family (up to 4 members) large size (more than 4 members). The number of students belongs to small size and large size was 433 & 1573 respectively as indicated by this table 5. The mean achievement of students of small family is 34.07 and SD=13.06. In case of large family, the mean achievement score of the students is 28.96 and SD=11.70. The graphical presentation of these mean scores is given in fig 5.8. The statistically calculated t-value is 7.842 which is significant at 0.01 level with 2004 df. The result clearly indicates that science achievement of students of small size of family have greater achievement than the students of large family size.

The analysis do not confirms the prediction hypothesized in this study for the present sample. A relationship between family size of the students and science achievement has been demonstrated by this findings. Hence the seventh hypothesis stating that "there is no significant difference between family size and achievement in science of students" was rejected.

## 5 DISCUSSION

The purpose of the present research was to determine the effect of Gender, attitude towards science, parental education and family size on science achievement of secondary school students of central U.P.. Data from a large contemporary sample of IX class students were analyzed.

F test followed by Duncan's mean test, Correlation coefficient and t-test were used to determine the effects of variables on Science achievement, while controlling for other relevant background influences.

The results of the analysis of data shows that the effect of gender, attitude towards science, parental education, and family size all had significant effect on science achievement scores.

There was significant difference in science achievement scores between boy and girls in the present study. The finding of this study in supported by linn C. Merle(1989) in-

vestigated that male have greater access to science and technical fields and greater earning power than females. The national assessment of educational progress and 'Every bad counts': reports that male were found to show higher motivation levels than females.

Hensley Clementine, Elizabeth Barber (1987) investigated that boys consistently scored lower than girls. Sarkar (1983), Singh (1984) are also supported that male scored higher than boys. Wing and Staver (1997) the study "An empirical study of gender Differences in Chinese students science achievement. found that boy scored higher than girls. Melkonion, Michael (1997) the study was conducted to know the effect of gender on science achievement level found that generally female student attained significantly higher grades than their male. Manning, M. Lee (1998) and Pinchas Tamir (1998) supported that boys like to study math and science that female and achieve hinge scored in sponce. Leader (1992) has also reported the existence of gender differences in science subjects in general as well as in math. According to same findings like Tzuriel David (2010) this study explored berriers to children's achievement in the areas of science, math and engineering. A gender difference in girls special abilities emerges very early in development. In that the two groups one is training program and other is controlled group , after eight weeks he found there are gender difference in the first group.

It generally believed that attitude towards subjects determines their success in that subject. In other words, favorable attitude results to good achievement in a subject. A Students constant failure in a school subject and science in particular can make him to believe that he can never do well on the subjects, thus accepting defeat. On the other hand, his successful experience can make him to develop a positive attitude towards learning the subject. This suggests that students attitude towards science could be enhanced through effective teaching strategies. It has in fact been confirmed that effective teaching strategies can create positive attitude on the students towards school subjects.

It becomes quite clear that attitude towards science and achievement in it are positively related in this study. The studies supported to this are H Broun (1965) found that male and female are significantly different achievement in science. Lowery (1967) found that girls generally have significantly more positive attitudes towards science than boys. Sharma (1967-68) conducted a study over 260 students of Class X in Delhi and found that the boys and girls shows nearly favorable attitude towards physics and there is no difference in attitude towards Physics between boy and girls. Thnhikom (1989) The study 'Attitude towards and achievement in science of secondary students in Kaset Sart Demonstration school, Bangkok, Thailand' Conducted on the population of 709 student in grades VII, VIX & IX & found that boys had more positive ATS than girls, girls attitude declined and boys attitude improved when grade level increased.

Khatoon (1998) the study investigated attitude towards science and its effect on science achievement at secondary school students. She find that the mean percentage of marks of Hindu & Muslims male students show that both differ significantly in their achievement. Derek Cheung (2009) has studied to examine the interaction effect between grade

level and gender with respect to student's attitude towards chemistry lesson taught in secondary schools. The sample consisted of 954 students, after investigation he found that both males and females were just marginally positive about chemistry lesson during the years of secondary schooling.

In this study parental education is found to be an important factor of children achievement in science. Children from highly educated parents are likely to have significantly higher science achievement scores as compared to the children of less educated parents. The study supported by Chatterji, Mukherji and Banerji (1971), the aim of this study was to investigate the effect of some important aspects of social class such as income, parental education, family size, general conditions of home etc. He found that parents education level was directly related to the achievement of their children. White (1982) studies the relationship between SES and academic achievement, the result shows that SES is correlated with academic achievement. Coldisand Bankstorne (1997) found that social status have significant and substantive independent effect in individual academic achievement. T.S Begum and Dr.(Mrs) M. Phukan (2000) found that type of family, number of siblings, education of parents and family income had significant impact on academic achievement of the students.

This study also explored the relationship between students achievement in science and their size of the family. Children of smaller family have got significantly higher achievement in science than the children of larger family. That is there is negative correlation between size of the family and achievement in science and as the family size increase the achievement decreases accordingly. The study supported to this are, Brown Harris (1997) found that larger families lent to score lower in reading achievement, language and math's than did student from small families and birth order was related to achievement. Chatterji, et. al. (1971) found that size of the family was not related to the academic achievement Krishnan & Nambuddin (1994) found that smaller family size has led to higher educational status.

## 5.1 DELIMITATIONS

It is not possible in a single research study to cover every aspect of variables associated with the problem under investigation. Although, the problem is very natural and is prevalent everywhere yet due to shortage of time & resources all the aspects variables could not be covered & the study is limited in several ways. It had to be determined in terms of population covered, sample selected, scope of variables studied, the scope of generalizability of finding & so on.

1. Due to the shortage of time & resources the study was carried out only on students of class 9th although problem of achievement is common to elementary classes yet the focus of the study has been on the secondary stage only.

2. The sample was restricted to rural and urban areas of central U.P. only so as to make an in-depth study of the factors that affect achievement in science in these schools.

3. The phenomenon of achievement has been studied on in relation to selected personal, environmental and institutional variables only.

4. The scope of study covers only a few districts of central U.P. as the investigator felt that no study had been conducted in this area. Hence the generalizability of the findings would be limited accordingly.

5. The tool for the assessment of the achievement in science is developed by investigator himself. Although attempt has been made for proper item selection, try out, estimation of reliability and validity of the tool, detailed norms still remain to be prepared.

6. It is desirable that the researcher reaches first hand or original sources for the study, but as access to some material was not possible materials taken from available secondary sources has been used.

7. Collecting of data in two sitting may be one more delimitation as a number of students are present only in one of the two sessions. Through a third visit is made to cover such students, some drop outs still remain beyond reach of the investigator and have been dropped from the study.

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