

Prediction of Achievement in Science through Scientific Creativity and Mathematical Creativity among English Medium Secondary Class Students of Sagar City

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Abstract

The traditional system of instruction assumes that all the students need the same information at the same place and at the same time. This education system does not achieve the whole targets for qualitative teaching and learning, so that students may be able to think critically, act creatively and solve their problems individually and collectively. In this manner we can say that the traditional educational teaching methods are not more suitable in current situation. Today's classrooms are portrayed by predominant part of the instructor and students considered as detached recipient of chose content issue, learning strategy and assessment procedures. The points and targets of training change every one in a while with the way of thinking of life, need of the general public and topic. The education system should be more practical at upper primary and secondary level and avoid the workloads which enhance rote method in students to increase their percentage or grade points. In case if we talk about creative and innovative work in field of science at secondary level students, the result is negligible. Now the question arises, why this ratio of students has a large difference in it? Therefore, the investigators tried through this study to explore the impact of scientific creativity and mathematical creativity on achievement in science among English medium secondary class students of Sagar city. The main objectives of this study were to investigate the relationship among scientific creativity, mathematical creativity & achievement in science and the combined impact of scientific creativity and mathematical creativity on achievement in science among secondary students of English medium secondary class of Sagar city.

Keywords: Scientific Creativity, Mathematical Creativity, Achievement in Science, English Medium students and Secondary Class Students.

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I. INTRODUCTION

The study of science and mathematics are basic components of school education and are being taught at all the levels of study including primary to senior secondary levels. The science and mathematics are being taught as two separate disciplines in all over the countries including India. The science subjects and mathematics are considered as tough and requires more attention and hard work at school level. Therefore, the achievement in science plays a very much crucial role, to evaluate the students' hard work during their school education. An important and un-separable part of science curriculum is creativity. Our traditional classroom setting provides very little to make the students creative. As Piaget (1950) considered, "The principal goal of education is to create men who are capable of doing new things, not simply repeating what other generations have done." In the 21st century, the whole world is going to digitalize day to day. Today's digital world is full of information and the students are able to receive information in many different ways in the present digital era. In this regard of current situation, the role of schools must have changed and now it is basic requirement that the environment of school made creative to all the students. It is more beneficial if it did in a scientific way, because it will help to open broad and divergent thinking power to all the students. Some special project works, brain storming method and some other tasks help to develop creative minds of secondary class students. Mathematics is

considered as tough subject at secondary level of study and requires more efforts to understand the subject matter. But creative ideas in mathematics make it simpler and easily understandable matter of study.

The Kothari Commission (1964-66) recommended to promote science in higher education and it is possible when we establish a solid base at secondary level of study and help them to develop broad and creative thinking. In order to make each child to be an inventor rather than a mere follower, a proper planning of educational activities mainly including scientific and mathematically creativity is needed. The science that we see (as a process or things) in daily life must have creativity, foresight and vision in itself to be the centre of technology that we develop tomorrow (near future) for the competitive world, and in every school, there are certain students who may become creative scientists in future. The achievement in science is also based on creativity possessing in the student because scientific creativity and mathematically creativity help secondary class students to achieve small certain goals so that some special small goals can help students to do some special or innovative in future reference.

The fast extension of information in various parts of science and its ensuing effect on the everyday life of individuals have set educationists of the apparent multitude of cutting-edge

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nations to consider the situation of science education in schools. Brown (1976), a distinguished scientist and humanist defines science as the organisation of our knowledge in such a way that it commands or makes possible the explanation of more of the hidden potential or strength found in the individual and in the surrounding. So, the unique potentialities of the child should be preserved and enriched by science education. In every school, there are certain students who may become creative scientists. An important objective of science education is to locate and nurture these talented learners so that they may be directed to intellectually stimulating researchers and thus provide the nation with future scientists. The reflective thinking capabilities of children must be sharpened through the learning strategies of science. Thus, science education becomes one of the best vehicles to foster intellectual potentialities and independent thinking of individuals.

The term scientific creativity stands for various aspects of divergent thinking ability in science (as defined by Guilford and his associates), estimated through its accepted characteristics, viz., measures of fluency, flexibility and originality and obtained using standardised test of scientific creativity. Scientific creativity may be considered as specific creative expression, unique production in science and technology, it may be a unique scientific process responsible some creative contribution in the field of science, technology and otherwise (Simonton, 2003). Scientific creativity considered from the following point of view-

- Logical inventiveness can be thought as logical technique or logical cycle principally engaged with creation of strange and unique logical commitment.
- Logical inventiveness likewise manages the strange and unique greatness in the field of science and logical profitability.
- The strange logical reasoning capacities described by deliberate methodology for all substance whether from science or humanities or in any case could be considered as the fundamental quality of logical innovativeness.

It is hard to characterize inventiveness inside a branch of knowledge like science. All around, no single definition exists for numerical innovativeness. Often it is functionally defined and examined (Haylock, 1987; Jensen, 1973; Kozlowski et al., 2019). In spite of the neglect of the study of creativity specifically within the subject of school mathematics, the notion of creativity is apparently considered by many mathematical educators to be relevant and important in terms of children doing mathematics. Some of the research and literature associated with creativity in school mathematics, mainly from English speaking countries, is reviewed. Particular attention is given to attempts to assess creative ability in school mathematics. Two key aspects emerge: the ability to overcome fixations in mathematical problem-solving, and the ability for divergent production within mathematical situations. It is proposed that these might form the basis for a framework for fostering and rewarding mathematical creativity in schoolchildren. Jensen (1973) operationally defined mathematical creativity as the capability to provide numerous, different and appropriate comebacks when offered with a mathematical situation in written, symbolic, iconic, graphic, or chart form.

Russian psychologist Kozlowski (1976) stated that mathematical creativity can be manifested in five different ways: (a) through problem posing, (b) using alternative methods, (c) by inventing proofs, (d) by generating formulas and (e) creating unique methods to solve mathematical problems.

It is an emerging trend that young students choose Mathematics, Physics and Chemistry to study because of these subjects' potentialities for job opportunities. Kozlowski, Chamberlin and Mann, 2019 described that definite teaching methods should be in place to support advance students' creativity in mathematics. Just like best practice in reading, writing, or classroom supervision, there are specific instructional strategies that best care creative thinking and rational in mathematics. There are four specific teaching techniques conferred and recognized to encourage creative thinking (a) problem-solving and problem-posing tasks (PSPPT); (b) mathematical modelling (through MEAs); (c) multiple solution tasks (MST); (d) open-ended questions. Creativity encouraging tasks have certain characteristics which include constructions, connection to reality, self-assessing, documentation, multiple solutions, and justifications. Furthermore, in the context of mathematics, they support divergent thinking at times and convergent thinking at other times. These characteristics in mathematical teaching excel some recent and traditional complications (Kozlowski et al., 2019). As a prerequisite for attending entrance exams of many professions or other competitive exam in various field after higher secondary stage, students assume and feel that science is a mere collection of information. Rote memorisation of scientific facts devoid of meaningful understanding of it influences negatively on the thinking capacities of the learners. So, the science teaching especially physical science teaching in secondary classes has to be redefined with broader perspective under the characteristics of scientific creativity and mathematical creativity. Achievement in science is important at the secondary level since it provides a base for higher studies which is inevitable for admissions of various medical and engineering professions. So, achievement in science at this stage has to be scrutinised. Almost, all recently generated science teaching strategies insist the importance of developing the creative talents of the learners concerned. Review of some related literature shows that achievement in science depends mainly on learner character i.e. cognitive variables like intelligence, aptitude, creativity, and problem solving skills and so on. Psychologists, define achievement as performing up to internal standards of excellence or simply as, striving of success. The internal standards of excellence are playing an important supporting role in achievement in science. In the present study achievement in science refers to obtain the excellency under certain domains viz. knowledge, comprehension, application and skill in science and consideration is given to investigate the relationships between scientific creativity and mathematical creativity, scientific creativity and achievement in science, mathematical creativity and achievement in science and prediction of the contribution of scientific creativity and mathematical into achievement in science among English medium secondary class students.

II. OBJECTIVES OF THE STUDY

The major objectives of the study are enlisted as follows: -

- To find out the relationship between scientific creativity and mathematical creativity among English medium secondary class students of Sagar city.
- To find out the relationship between scientific creativity and achievement in science among English medium secondary class students of Sagar city.
- To find out the relationship between mathematical creativity and achievement in science among English medium secondary class students of Sagar city.
- To find out the combined impact of scientific creativity and mathematical creativity on achievement in science among English medium secondary class students of Sagar city.

III. HYPOTHESES OF THE STUDY

The study has been designed to test the following hypotheses -

- There is no significant relationship between scientific creativity and mathematical creativity among English medium secondary class students of Sagar city.
- There is no significant relationship between scientific creativity and achievement in science among English medium secondary class students of Sagar city.
- There is no significant relationship between mathematical creativity and achievement in science among English medium secondary class students of Sagar city.
- There is no significant contribution of scientific creativity and mathematical creativity in prediction of achievement in science among English medium secondary class students of Sagar city.

IV. DELIMITATIONS OF THE STUDY

The present study is delimited to the 10th standard students of CBSE board affiliated English medium private schools of Sagar city of Madhya Pradesh and the achievement in science refers to the achievement in Physics, Chemistry, Biology and Mathematics subjects taught at secondary class of 10th standard of CBSE board only.

V. RESEARCH METHODOLOGY

A. Method– In the present study survey and correlational method of descriptive research was followed.

B. Population – The present study was conducted on 13 CBSE affiliated English medium private secondary schools of Sagar city of Madhya Pradesh and the total number of 1399 students which were studying at these schools in 10th class of the study were constituted as population for this research work.

Table – 1. List of Private English Medium Secondary Schools affiliated to CBSE in Sagar city

S. N.	Name of School	No. of Students in 10 th Class.
1.	St. Joseph's Convent Senior Secondary School, Near KV-1, Cantt. Area, Sagar.	225
2.	St. Mary's School, Gour Nagar, Makronia, Sagar.	186
3.	Vatsalya Senior Secondary School, Near Pili Kothi Civil Lines, Sagar.	168
4.	Delhi Public School, Bhopal Road, Lendra Naka, Sagar.	90
5.	Army Public School, Near Shahbaj Auditorium, Saugor.	70
6.	Joy And Campion Higher Secondary School, Ravidas Ward, Anand Nagar, Sagar.	120
7.	Mahar Children Academy, Near Pared Mandir Cantt. Area, Sagar.	70
8.	Maharshi Vidya Mandir School, NH 86, Lahdara Naka, Sagar.	120
9.	Greatmen International School, Near Deepali Hotel, Makronia, Sagar.	70
10.	Little Star Shailesh Memorial School, Near Paradise Hotel, Makronia, Sagar.	60
11.	Paras Vidya Vihar, Tilli Ward, Sagar.	96
12.	Deepak Memorial School, Adarsh Nagar, Makroniya, Sagar.	124
Total Number of Students		1399

C. Sample – In the present study, the researcher selected three schools among the population schools using random sampling technique, namely; (1) Vatsalya Senior Secondary School, (2) Little Stars Shailesh Memorial Senior Secondary School (3) Army Public Senior Secondary School; located at Sagar city of Madhya Pradesh. The research recollected data of 94 students (including Male & Female) from these senior secondary schools as sample.

D. Tool used – The researcher used the following tools for collection data which were significantly valid to measure the respected variables -

- Verbal Test of Scientific Creativity by V.P. Sharma and J. P. Shukla to measure scientific creativity among the secondary students. The reliability and validity of the tool were 0.73 and 0.98 respectively.
- Test of Mathematical Creativity by Hemlata N. Parasnin to measure mathematical creativity among secondary students. The split-half reliability for the test was not applicable and test-retest reliability was 0.79 respectively.
- For measuring achievement in science among secondary students, a self-made tool namely 'Achievement in Science Questionnaire' was administered. It was designed to measure the achievement in science subjects (physics, chemistry, biology and mathematics) under knowledge, comprehension, application and skill aspects of cognition domain of learning respectively.

E. Statistical technique – In the present study mean, standard deviation, Pearson's product moment coefficient of correlation and regression analysis statistical techniques were applied to analyse the data.

VI. ANALYSIS OF DATA AND INTERPRETATION

The data was organized, tabulated and analysed to find out the results by using different statistical techniques like correlation and regression were used according to the mode of objectives and hypothesis framed.

H0 1–There is no significant relationship between scientific creativity and mathematical creativity among English medium secondary class students of Sagar city.

Table – 2. Showing the coefficient of correlation between scientific creativity and mathematical creativity among English medium secondary class students of Sagar City

Variables	N	Mean	SD	R
Scientific Creativity	94	84.43	42.804	0.315*
Mathematical Creativity	94	33.67	12.107	

*Significant at .01 level

The table – 2 shows that the means for scientific creativity and mathematical creativity among English medium secondary class students of Sagar city are 84.43 and 33.67 respectively and their respective standard deviations are 42.804 and 12.107. The calculated value of product moment coefficient of correlation between scientific creativity and mathematical creativity among English medium secondary class students of Sagar city is .315 which is positive, low and significant at .01 level. Therefore, null hypothesis (H0 1) is rejected at .01 level of significance. It means there is significant relationship between scientific creativity and mathematical creativity among English medium secondary class students of Sagar city.

Since there is low positive correlation between scientific creativity and mathematical creativity among English medium secondary class students of Sagar city, this means if the degree of scientific creativity increases then mathematical creativity will also increase accordingly. Similarly, on decreasing the degree of scientific creativity there will be decrease in the mathematical creativity among English medium secondary class students of Sagar city.

H0 2– There is no significant relationship between scientific creativity and achievement in science among English medium secondary class students of Sagar city.

Table – 3. Showing the coefficient of correlation between scientific creativity and achievement in science among English medium secondary class students of Sagar city

Variables	N	Mean	SD	R
Scientific Creativity	94	84.43	42.804	0.154
Achievement in Science	94	23.05	7.959	

The table – 3 reveals that the means for scientific creativity and achievement in science among English medium secondary class students of Sagar city are 84.43 and 23.05 respectively and their respective standard deviations are 42.804 and 7.959. The calculated value of product moment coefficient of correlation between scientific creativity and achievement in science among English medium secondary class students of Sagar city is .154 which is positive and low but not significant. Therefore, null hypothesis (H0 2) is not rejected at .05 level of significance. It means there is no significant relationship between scientific creativity and achievement in science among English medium secondary class students of Sagar city.

Since there is low positive correlation between scientific creativity and achievement in science among English medium secondary class students of Sagar city, this means if the degree of scientific creativity increases then achievement in science among English medium secondary class students of Sagar city will also increase accordingly. Similarly, on decreasing the degree of scientific creativity the achievement in science will also decrease among English medium secondary class students of Sagar city.

H03 – There is no significant relationship between mathematical creativity and achievement in science among English medium secondary class students of Sagar city.

Table – 4. Showing the coefficient of correlation between mathematical creativity and achievement in science among English medium secondary class students of Sagar city

Variables	N	Mean	SD	R
Mathematical Creativity	94	33.67	12.107	0.435*
Achievement in Science	94	23.05	7.959	

*Significant at .01 level

The table – 4 shows that the means for mathematical creativity and achievement in science among English medium secondary class students of Sagar city are 33.67 and 23.05 respectively and their respective standard deviations are 12.107 and 7.959. The value of product moment coefficient of correlation between mathematical creativity and achievement in science is .435 which is positive, moderate and significant at .01 level. Therefore, null hypothesis (H0 3) is rejected at .01 level of significance. It means there is significant relationship between mathematical creativity and achievement in science among English medium secondary class students of Sagar city.

Since there is moderate positive correlation between mathematical creativity and achievement in science among English medium secondary class students of Sagar city, this means if the degree of mathematical creativity increases then achievement in science will also increase accordingly. Similarly, on decreasing the degree of mathematical creativity there will be decrease in the achievement in science among English medium secondary class students of Sagar city.

H0 4–There is no significant contribution of scientific creativity and mathematical creativity in prediction of achievement in science among English medium secondary class students of Sagar city.

To test the hypothesis H04 prediction of achievement in science on the basis of scientific creativity and mathematical creativity among English medium secondary class students of Sagar city, multiple regression analysis was used by developing regression equation. The regression equation had been developed by the following procedures-

For the present study, the criterion variable to be predicted is X1(Achievement in Science) and predictor variables will be X2(Scientific Creativity) and X3(Mathematical Creativity).

Table -5. Showing means and standard deviations of achievement in science, scientific creativity and mathematical creativity among English medium secondary class students of Sagar city

S.N.	Variables	Mean	SD
1.	Achievement in Science	$M_1=23.05$	$\sigma_1=7.959$
2.	Scientific Creativity	$M_2=84.43$	$\sigma_2=42.804$
3.	Mathematical Creativity	$M_3=33.67$	$\sigma_3=12.107$

The table - 5 shows that values of mean and standard deviation for criterion variable to be predicted i.e. achievement in science are 23.05 and 7.959 respectively. Similarly, the mean and standard deviation for first predictor variable i.e. scientific creativity are 84.43 and 42.804 respectively and mean and standard deviation for second predictor variable i.e. mathematical creativity are 33.67 and 12.107 respectively.

Table -6. Showing coefficients of correlations, partial coefficients of correlations, partial standard deviations and partial regression coefficients of achievement in science, scientific creativity and mathematical creativity among English medium secondary class students of Sagar city

S.N.	Coefficient of Correlations	Partial Coefficient of Correlations	Partial Standard Deviations	Partial Regression Coefficients
1.	$r_{12}=0.154$	$r_{12.3}=0.01986$	$\sigma_{1.23}=7.16511$	$b_{12.3}=0.00350$
2.	$r_{13}=0.435$	$r_{13.2}=0.41214$	$\sigma_{2.13}=40.61690$	$b_{13.2}=0.28206$
3.	$r_{23}=0.315$	$r_{23.1}=0.88969$	$\sigma_{1.23}=10.46938$	

The regression equations -

$$x_1 = b_{12.3}x_2 + b_{13.2}x_3 \quad (\text{Deviation form})$$

$$(X_1 - M_1) = b_{12.3}(X_2 - M_2) + b_{13.2}(X_3 - M_3) \quad (\text{Score form})$$

Or

$$X_1 = b_{12.3}X_2 + b_{13.2}X_3 + k \quad (\text{where } k \text{ is a constant})$$

Substituting the values in the above equation, the regression equation is

$$X_1 = 0.00350X_2 + 0.28206X_3 + 13.257$$

This equation helps us to predict achievement in science from known values of X_2 (scientific creativity) and X_3 (mathematical creativity).

Table -7. Showing the regression coefficients and P value between scientific creativity and mathematical creativity among English medium secondary class students of Sagar city

Model	Unstandardized coefficients		Standardized coefficients	P value	95% confidence interval for B	
	B	SE	Beta		Lower bound	Upper bound
SC	0.004	0.018	0.019	0.846	-0.033	0.040
MC	0.282	0.065	0.429	0.000	0.152	0.412

i. Unstandardized coefficients -

The table - 7 shows that if scientific creativity (SC) index increases by one unit then the index of achievement in science (AS) also increases by 0.004 and the total variation in achievement in science index is -0.033 to 0.040. There is no significant contribution of scientific creativity and mathematical creativity in prediction of achievement in science among English medium secondary class students of Sagar city. Since the P value (=0.846) is greater than 0.05, therefore the result is not significant at 0.05 level of significance. This shows that scientific creativity and mathematical creativity do not significantly contribute in prediction of achievement in science among English medium secondary class students of Sagar city.

The table - 7 also revealed that if mathematical creativity (MC) index increases by one unit then the index of achievement in science (AS) also increases by 0.282 and the total variation in achievement in science index is 0.152 to 0.412. Since the P value (=0.000) is less than 0.05, therefore the result is significant at 0.05 level of significance. This shows that mathematical creativity contributes significantly in prediction of achievement of science among English medium secondary class students of Sagar city.

ii. Standardized coefficients -

The table - 7 also shows that if mathematical creativity increases by 1 standard deviation from its mean then the index of achievement in science also increases by 0.429 standard deviation from its mean. Similarly, if mathematical creativity decreases by 1 standard deviation from its mean then the index of achievement in science also decreases by 0.429 standard deviation from its mean respectively. It means if mathematical creativity has 1 s variation from its mean then achievement in science also has variation of 0.429 s from its mean.

Table -8. Showing the model summary of contribution of scientific creativity and mathematical creativity among English medium secondary class students of Sagar city

Model	R	R ²	Adjusted R ²	Standard Error of estimation
1	0.436	0.190	0.172	7.242

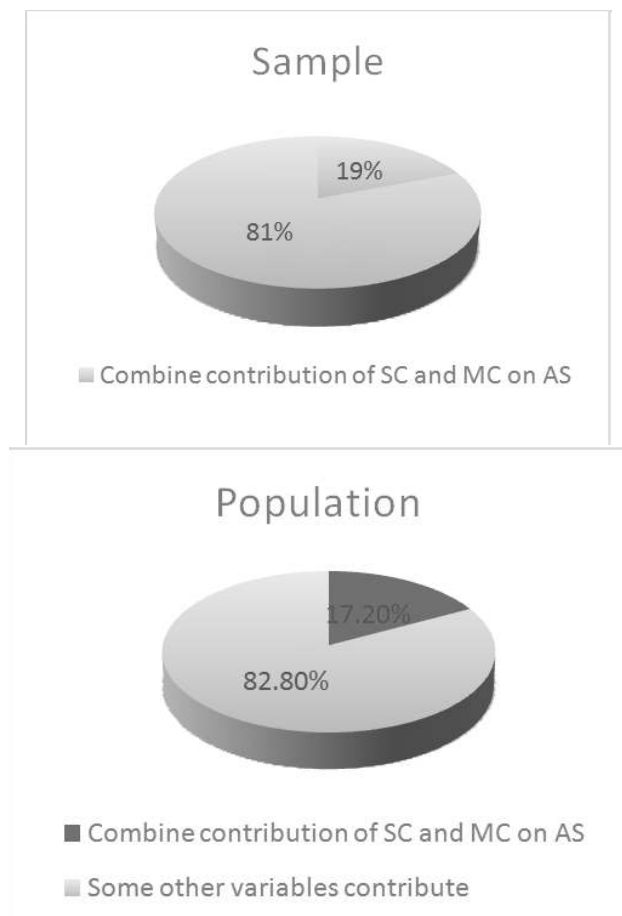
In the present study, the predictor variables are scientific creativity and mathematical creativity whereas the dependent variable is achievement in science among English medium secondary class students of Sagar city.

The table - 8 shows the value of R square (R^2) is 0.190, F is 10.65 and P value is 0.000. This means the common contribution of independent variables called scientific creativity and mathematical creativity to predict the achievement in science is only 19.0% among the total number of students of English medium secondary class of Sagar city.

which were chosen as sample. It also means that the 81% contribution in achievement in science is unpredictable in this study and it may be due to contribution of some other variables have to predict.

If we generalize the result over all the population of English medium secondary class students of Sagar city then we can show the value adjusted R square from the table – 8 which is equal to 0.173. This means the contribution of independent variables namely scientific creativity and mathematical creativity to predict achievement in science is only 17.3% among the total number of students of English medium secondary class of Sagar city which were belonging in the total population of the study. The P value is 0.000 which is less than 0.05 and 0.01. This means the common contribution of mathematical creativity and scientific creativity to predict achievement in science among English medium secondary class students of Sagar city is significant at 0.01 level of significance. Thus, we can say that the common contribution of independent variables called scientific creativity and mathematical creativity to predict achievement in science among English medium secondary class students of Sagar city is significant and genuine and it is not due to by chance. Thus, the hypothesis H04 is rejected at 0.01 level. It means the contribution of scientific creativity and mathematical creativity to predict achievement in science is significant among English medium secondary class students of Sagar city.

Figure – 1. Combine contribution of scientific creativity and mathematical creativity in prediction of achievement in science for the selected sample and the population



The above figure – 1 of pie diagram (of sample) shows the area wise prediction of combine contribution of scientific creativity and mathematical creativity in prediction of achievement in science for the sample of English medium secondary class students of Sagar city which is 19.0% of the total area and a shade of sky-blue colour in the figure. The pie diagram (of population) shows the area wise prediction of combine contribution of scientific creativity and mathematical creativity in prediction of achievement in science for the population of English medium secondary class students of Sagar city which is 17.3% of the total area and a shade of green colour in the figure. If we compare both the pie diagrams represented for sample and population of English medium secondary class students of Sagar city, we can see there is not a major difference on the area of prediction. Thus, if we generalize the result to the whole population then there is only 1.7% variation in prediction of achievement in science between both the sample and population by contribution of scientific creativity and mathematical creativity.

VII. FINDINGS

- The study found that there is low positive correlation ($r = 0.315$) between scientific creativity and mathematical creativity among English medium secondary class students of Sagar city.
- The study found that there is negligible positive correlation ($r = 0.154$) between scientific creativity and achievement in science among English medium secondary class students of Sagar city.
- The study found that there is moderate positive correlation ($r = 0.435$) between mathematical creativity and achievement in science among English medium secondary class students of Sagar city.
- The study found for unstandardized coefficients that if scientific creativity index increases by one unit, then the index of achievement in science also increases by 0.004 accordingly and the total variation in achievement in science index is -0.033 to 0.040 among English medium secondary class students of Sagar city. This shows that the result was unreliable and invalid.
- Total variation in achievement in science index was 0.152 to 0.412. Therefore, we can say that mathematical creativity had significant contribution in prediction of achievement in science among English medium secondary class students of Sagar city.
- The common contribution of independent variables called scientific creativity and mathematical creativity in prediction of achievement in science among English medium secondary class students of Sagar city is only 19.0% among the total number of students which were chosen as sample. It also means that the 81% contribution in prediction of achievement in science is not due to variables of scientific creativity and mathematical creativity but some other variables have contribution in the prediction of achievement in science among English medium secondary class students of Sagar city.

- The common contribution of independent variables namely scientific creativity and mathematical creativity in prediction of achievement in science of English medium secondary class students of Sagar city is only 17.3% among the total number of students representing the total population.
- The common contribution of independent variables called scientific creativity and mathematical creativity in prediction of achievement in science among English medium secondary class students of Sagar city is significant and genuine and is not due to by chance.

- The study found the following regression equation in score form-

$$X_1 = 0.00350X_2 + 0.28206X_3 + 13.257$$

This equation helps us to predict achievement in science from the known values of X2 (Scientific Creativity) and X3 (Mathematical Creativity) among English medium secondary class students of Sagar city.

- The study found that there is only 1.7% variation between both the sample and population in prediction of achievement in science by the contribution of scientific creativity and mathematical creativity among English medium secondary class students of Sagar city.

VIII. CONCLUSION

The present study has completed under certain conditions and limitations as mentioned. The resultant value of the contribution of scientific creativity and mathematical creativity in prediction of achievement in science among English medium secondary class students of Sagar city is less in the comparison of some previous studies related to similar variables and conditions in different situation and geographical areas. In present scenario the methods of teaching and learning of teachers and students in school environment are losing the ways of creative thinking; however, the participation and involving in various activities conducting by the administration of school enhancing some qualities to work with the coordination. In today's world when the achievements of science are increasing day to day, we need a proper study to travel parallel with the scientific world and some genuine ideas and originality to enhance the achievements in science. But this study represents that the distance between creativity and achievements in science increasing day to day. So, the study concludes that there is a big necessity to enhance creativity including its all dimensions and science process skill with the cognition development of students so the achievement of students in science should be included as most part of these certain factors. For this the support of teachers, parents, guardians, friend circle of a student plays very important role as these are directly influencing the student. Some others which indirectly influencing to the students are policy maker, curriculum designer and head of administration also have a vital impact in the enrichment of achievement of a student. The result of this study also showed that in the present education system of secondary schools established at Sagar city mainly focused on the cognition development of students but this result also showed that the process for this is not functioning very well and the development of cognition is also less in present situation. This study also gave a hint for

one more thing which is not directly mention in this study work that in the current education system of Sagar city there is a big necessity of interdisciplinary way of teaching for enhancing the strength of critical and divergent thinking. It is required to expanding broad ideas and generating concepts to enhance achievements in science. It is found by the study that the students of Sagar city are poor in mathematical creativity than scientific creativity so for this there should be some creative laboratory in mathematics where the students do some creative works like to formulate so many equations from a given one using different ways without changing the original value and meaning of it; as in Sagar city there is no lab for mathematical creativity. The project works of students should be based on creative thought process and should be avoid all the things which promote to the students to learn using rote methods.

IX. EDUCATIONAL IMPLICATIONS

The educational implications revealed by the study are as follows -

- This study will help us to understand the opportunities for secondary class students to express their ideas.
- 'Create' should be taken as a major objective of science teaching at secondary level of study.
- Promote divergent thinking and originality of ideas among secondary class students.
- Understanding the previous knowledge and views of the secondary class students are a pre-requisite for effective teaching in classrooms.
- This study will be helpful for teachers in understanding the role of scientific creativity and mathematical creativity on achievement in science and their importance for secondary class students.
- This study will help teachers to create an effective activity and creativity-based learning environment to develop achievement in science among secondary class students.
- This study will be helpful to aware the teachers about the tractions of scientific knowledge through appropriate curriculum and methods among secondary class students.
- This study will help school authorities and administrators to incorporate creativity-based activities in classrooms and schools along with other activities in a proper and responsible way.
- This study will be helpful for the educational policy makers, administrators and curriculum developers in planning and constructing curriculum by keeping in mind the creativity and its different dimensions and their importance for secondary class students.
- This study will be helpful policy makers and agencies to develop and organise training programmes for teachers of secondary level to train them effectively in transaction of science knowledge based on different types of transactional modes.
- This study will be helpful for the parents and guardians in understanding of different creative views and original thoughts of their children and its need and importance and children's active participation in enrichment of achievement in science.

- This study will be helpful to understand the concepts of teaching at secondary level in present scenario.

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