



# Effect of Teaching Strategies based on STEM Approach on reative Thinking and Academic Achievement of Upper primary stage Students

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## INTRODUCTION

Since the past, education has been used as a process of development. It is a continuous process. The life of any person can be improved through education. A new society can be created through education. Education is always important for the future. The purpose of education is to make the child a skilled citizen so that the child can bring change in the society by becoming a skilled citizen. The life of any person can be improved through education. All round development of a person's personality is done and by increasing the knowledge and skills of the person, poverty and unemployment of the country can also be removed through education. by becoming a skilled citizen. It is said that through education, all-round development of a person's personality is achieved and by increasing the knowledge and skills of the person. A person's knowledge, skills and abilities are developed through education. Schools, teachers, teaching methods, courses etc. play an important role in influencing the academic performance of students. Nowadays, a lot of emphasis is being placed on science and technology in schools. With the use of science and technology, the process of education and learning of students becomes very easy. With its help, it has become very easy to understand any subject. With the use of science and technology, the teaching of teachers and learning of students is continuously improving and their opportunities for progress are increasing.

## Stem (Science, Technology, Engineering and Mathematics) Education

STEM is an acronym for science, technology, engineering, and mathematics. It may be defined as the integration of science, technology, engineering, and mathematics into a new cross-disciplinary subject in schools. The study of STEM offers students a chance to make sense of the integrated world we live in rather than learning fragmented bits and pieces of knowledge and practices about it. (Duggar, 2010). STEM is an abbreviation of the initials of the words Science, Technology, Engineering and Mathematics. All the disciplines that make up the STEM play an important role in the development of twenty-first century skills such as adaptability, communication, social skills, problem solving, creativity, self-control and scientific thinking (NRC 2012). STEM Education Science Technology Engineering Mathematics is the collection of all the four subjects in which we study all the subjects together which helps the students to develop their essential skills and competencies for the future.

“S” for science is very concerned with what is the natural world and preparing students to think and act like real scientists, ask questions, hypothesize, and conduct investigations using standard science practices (Burghardt & Hacker, 2004; Kelley & Knowles, 2016). These courses deal with physics, biology, chemistry, astronomy, etc. Meanwhile, “T” technology is the modification of the natural world to meet human wants and needs. It is very concerned with what can and should be (designed, made, and developed) from natural world materials and substances to satisfy human needs and wants. Besides, “E” engineering stands as a profession in which knowledge of the mathematical and natural world with judgment to improve ways to utilize the materials and forces of nature economically for the benefit of humankind. Meanwhile, “M” mathematics is defined as the science of patterns and relationship that provides the exact language for technology, science, and engineering (Dugger, 2010).

## NEED AND SIGNIFICANCE OF THE PROBLEM

India is one of those countries where a large number of youths prefer to make a career in the field of science and engineering. In such a situation, instead of studying four different subjects, the youth are exposed to the continuous changes through STEM education. STEM education can facilitate individual employment, economic development and international competitiveness. Government of India has taken a lot of steps to promote STEM education-

STEM education should be highly promoted in helping the students to make career for their future life for which Government of India has taken very important steps.

### 1- The Atal Tinkering Labs (ATL)

This program was started by the government in 2016. The main objective of this program is that students learn innovation skills from their own minds and its main function is to promote creative thinking and educational achievement among the youth.

### 2- Rastriya Avishkar Abhiyan (RAA)

This program was started by the government in 2015. The campaign was started by the Ministry of Human Resource Development (MHRD). The main objective of this program is to increase the love for mathematics, science, use of technology and enhance creativity in children age group of 6-18 years thereby making education enjoyable, interesting and meaningful.

**National Education Policy-2020 and STEM EDUCATION:** A seminar was organized about STEM education in which it was told that through education, along with nation building, national security is also done. Nowadays, the influence of science and technology is visible in all the countries. In India too, we are seeing its impact in the areas whether it is healthy, social or economic. We need to understand what efforts we are making in education to promote STEM education. Students have to learn by doing themselves. Driving course comes from practical arts only.

## STATEMENT OF THE PROBLEM

The present study will be conducted under the title:

**“Effect of Teaching Strategies based on STEM Education on Creative Thinking and Academic Achievement of Upper primary stage Students”.**

## REVIEWS OF RELATED LITERATURE

1- Wang, LH., Chen, B., Hwang, GJ. (2022), conducted a meta-analysis aimed at examining the impact of digital games based on STEM education on the learning achievement of K-12 or higher education students, analysing published studies from 2010 to 2020 that examined. It was found that digital games in STEM education are a promising teaching method that effectively improves learning gains.

2- Fatih Ozkan & Todd Kettler (2022) observed that, the main objective of this research was to provide a general framework of the impact of STEM education on the academic success of gifted students and their social emotional development by using the meta synthesis method. This research aimed to include the thematic meta synthesis for the years from 2010 to 2020. The descriptive distribution of the 28 studies that met the criteria is given according to the data source of the publications. This research concluded that STEM education has positive effects on the academic success of gifted students and their social-emotional development. STEM education works to fulfil educational, social, emotional, needs of the gifted students.

3- Hardinata, A., Djulia., Bukhari., & Siregar, A. (2021) states that, this research was a qualitative descriptive study to develop lesson plans and teaching materials based on STEM and science literacy in English for science curriculum. This research was based on interviews with teachers and students on knowledge of STEM and science

literacy. The results were described in which the samples were selected through random sampling technique. In this, 41 students were selected. In this research, students' interest and knowledge towards science was continuously studied with the help of lesson plans based on STEM and science literacy.

4- De Meester, J., De Cock, M., Langie, G. and Dehaene, W. (2021) states that this study models the process of designing learning materials for integrated STEM (iSTEM) in secondary education, as gone through by four multidisciplinary teams of STEM teachers in Flanders (Belgium). The research revealed that a STEM education-based model can promote teachers training programs and pre- and in-service teachers can be empowered through highly integrated STEM education.

5-N Sirajudin, J Suratno and Pamuti (2020) defines that, this study aimed to describe the effectiveness of the STEM learning model in improving the creative thinking skills of students. It was quasi-experimental research with Post-Test-Only Design with Non- equivalent Groups. Based on data analysis, there was an effect of STEM education on students' creative thinking skills. Based on the research results obtained from students' creativity varies between low and moderate and the answers to the creativity tests given show lower results than expected. STEM can be recommended as an alternative and approach in learning biology, especially in improving students' creative thinking abilities. Creative thinking is important to everyone, because to proof of the truth of the formulation of an assessment can be encouraged by way of thinking.

6- Siregar, N. C., Rosli, R., Maat, S. M., & Capraro, M. M. (2020) define that, this was a meta-analysis study that looked at the impact of STEM programs on students' mathematics achievement by employing experimental research designs published between 1998 and 2017, and a report was prepared after which it was seen in the report that, STEM education has a positive impact on the mathematics achievement of the students.

7- Nurramadhani, A., Lathifah, S.S., & Permana, I. (2020) reported that this research was conducted on students from 26 universities who took courses in Science, Environment, Technology and Social Curriculum. In this research, it was reported that electronic module, along with STEM teaching, improved the students' question asking skills and their problem-solving skills. The better way to conduct this research was to develop a STEM based model to investigate the development of students' question asking skills. In this research, research methodology design ADDIE (Analyse, Design, Develop, Implementation, and Evaluation) was used. Finally, it was found that question asking skills and quality of questions have improved among the students.

8- Toma, R. B., & Greca, I. M. (2018) define that, in this research, STEM education approach was applied to two fourth grade Elementary Education classes in Spain. It looked at the impact of a STEM-based curriculum on primary education students' science-related and attitude scale achievement. The findings found that fourth grade children who participated in an integrated STEM project demonstrated significantly more favourable attitudes toward science than children who did not participate in the STEM project.

## OBJECTIVES OF THE STUDY

The Objectives of the present study are as follows:

1. To develop the STEM Education based lesson plans as Teaching Strategies for Upper Primary Stage Students.
2. To study the effect of STEM Education based Teaching Strategies on Creative Thinking of Upper Primary Stage Students.
3. To study the effect of STEM Education based Teaching Strategies on Academic Achievement of Upper Primary Stage Students.

## HYPOTHESES OF THE STUDY

In order to test the objectives of the study the following null hypotheses have been formulated:

**H01:** There will be no significant effect of STEM Education based Teaching Strategies on Creative Thinking of Upper

Primary Stage Students.

**H02:** There will be no significant effect of STEM Education based Teaching Strategies on Academic Achievement of Upper Primary Stage Students.

**H03:** There will be no significant difference in mean Pre-test scores of the Experimental group and Control group in the variables, namely Creative Thinking, Academic Achievement.

**H04:** There will be no significant difference in mean Post-test scores of the Experimental group and Control group in the variables, namely Creative Thinking, Academic Achievement.

**H05:** There will be no significant difference in mean Pre-test scores of the boys of Experimental group and Control group in the variables, namely Creative Thinking, Academic Achievement.

**H06:** There will be no significant difference in mean Pre-test scores of the girls of Experimental group and Control group in the variables, namely Creative Thinking, Academic Achievement.

**H07:** There will be no significant difference in mean Post-test scores of the boys of Experimental group and Control group in the variables, namely Creative Thinking, Academic Achievement.

**H08:** There will be no significant difference in mean Post-test scores of the girls of Experimental group and Control group in the variables, namely Creative Thinking, Academic Achievement.

## OPERATIONAL DEFINITIONS OF THE TERMS TO BE USED IN THE STUDY

**STEM Education-** “STEM is an acronym for science, technology, engineering, and mathematics. It may be defined as the integration of science, technology, engineering, and mathematics into a new cross-disciplinary subject in schools.” (Dugger, 2010).

### Operational Definition-

STEM Education is a mixed approach of Science, Technology, Engineering, Mathematics in which science aspect, technical aspect, engineering aspect and mathematics aspect are included on the basis of prior knowledge. STEM Education is an integrated mixture of four subjects. It is not an academic theory; it incorporates real world’s applications and teaching methods to prepare students for a better life.

**Teaching Strategies-** Teaching strategies are specific actions and plans used by teachers on the basis, teacher achieves his educational goals. For this he uses brainstorming, role playing, case studies, problem solving activities, use of multimedia, hands on activities, group discussion, problem solving tasks etc. This is a flexible process.

**Operational Definition-** In the present study, Teaching Strategies will be taken as the process of systematic methods of teaching used in lessons to achieve learning objectives. Teaching Strategy is the strategy, used by teachers to achieve their teaching and learning goals. For this, many teaching and learning activities are done by teachers. Teacher Strategies are also known as the Instructional Strategies, learning strategies.

**Creative Thinking-** Creative thinking is a development of ideas, objects that are new novel, interesting, effective, and have a certain aesthetic sensibility as a system (Mishra, Henriksen, & the Deep-Play Research Group, 2013).

**Operational Definition-** Creative thinking is the way of thinking in which, a person comes up with some new ideas, suggestions about the solution of the problem. It is the ability to think outside the box.

### Academic Achievement-

Academic Achievement is the academic performance of the student, on the basis of which we conclude to what extent the student has developed her strengths and abilities during the teaching-learning process.

**Operational Definition-** In the present study, academic achievement will be measured by total marks scored by the students of 6<sup>th</sup> class in exams, by the permission of school authority.

### **Upper Primary Stage Students**

The Upper Primary Stage comprises of classes 6<sup>th</sup> to 8<sup>th</sup> (age group- 11 to 14years) according to NEP (2020).

### **Operational Definition-**

In the present study, Upper Primary Stage students will be in class 6<sup>th</sup> who will be between 11 to 14 years of age.

## **METHODOLOGY OF THE STUDY**

### **Variables of the Study**

The variables related to the present study have been classified as:

1. **Independent variable:** STEM Education based Teaching Strategies
2. **Dependent variables:** Creative Thinking and Academic Achievement
3. **Extraneous variables:** age, anxiety, class room climate, noise, light, test time etc.

### **Method of the Study**

For the present study Quasi Experimental Research design will be used to test the effect of STEM Education based Teaching Strategies on Creative Thinking and Academic Achievement of Upper Primary Stage Students.



**RESEARCH DESIGN**

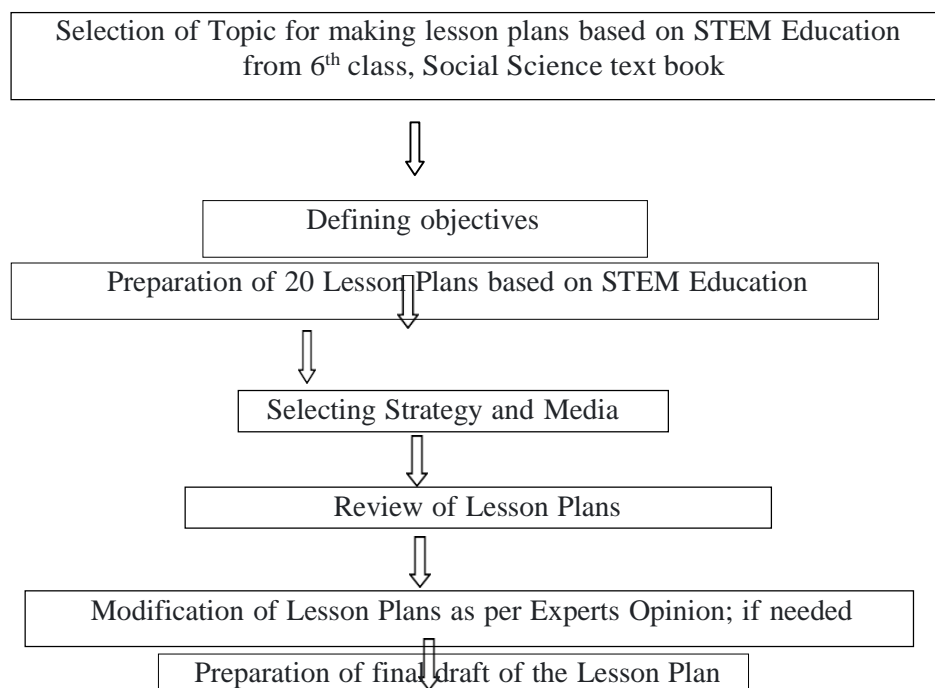
The research design will be Two Group Pre-Test Post-test. It is given in table-1

**Table 1: Research Design of the Study**

Groups	Pre-test	Treatment	No. of Lessons	Post-test
Control Group (N=40Approx.)	Pre-test of Upper Primary Stage Student's Creative Thinking and Academic Achievement	Teaching of Science lessons using Traditional Method (3 months Approximately)	20 Lessons (Duration of each lesson 45 min Approx.)	Post-test of Upper Primary Stage Student's Creative Thinking and Academic Achievement
Experimental Group (N=40Approx.)	Pre-test of Upper Primary Stage Student's Creative Thinking and Academic Achievement	Teaching of Science lessons using STEM education (3 months Approximately)	20 Lessons (Duration of each lesson 45 min Approx.)	Post-test of Upper Primary Stage Student's Creative Thinking and Academic Achievement

**STEPS FOR DEVELOPING STEM EDUCATION BASED LESSON PLANS**

The lesson plans based on STEM education will be developed by the researcher in following steps:





### SAMPLE OF LESSON PLAN

In the present study, the researcher will follow the procedure to develop the lesson plans based on STEM Education; given in table

An example of lesson plan for the STEM activity to achieve learning outcomes.

**Table: Sample Lesson Plan for 6<sup>th</sup> Class Students of Social Science**

<b>Title of the lesson: Our Solar System</b>		
<p><b>Objectives:</b> 1. To enable the students to understand about our Solar System, planets, moon, star etc.</p> <p style="text-align: center;">2.To let them know how our solar system works.</p> <p><b>Teaching Learning Material Required:</b> Related video, globe, model of solar system, different colours balls, glue, card board sheet etc.</p>		
PHASE	TEACHING LEARNING ACTIVITY	NOTES
Preparation	1.Students will watch a video presented by the teacher related to our solar system	<b>S(Science):</b> observe earth, stars, planets etc.  <b>T(Technology):</b> learn to use how make model of solar system with the help of
Presentation	1.Teacher will explain about our solar system, planets, moon, stars etc.  2. Students will conduct a demonstration with the help of teacher.	colourful, different shaped balls etc.  <b>E(Engineering):</b> create a model of solar system.  <b>M(Mathematics):</b> create mind map to
Practice	1.Students will create a Mind map about solar system.  2.Students will make a model of solar system with the help of teacher.	know the differences of mass, size distance of planets etc.

### SAMPLE SELECTION

For the present study, the target population will be Upper Primary Stage Students (UP Board) of Lucknow. Class 6<sup>th</sup> students will be selected as a sample and number of sample units will be 80 approximately. One Experimental group and one Control group; 40 approx. in each group. Purposive Sampling will be used for selection of board and school. Intact Sampling will be assigned for selection of section of science as control and experimental (intact group).

### TOOLS OF THE STUDY

In the present study, Pre-test and Post-test will be constructed for testing/ evaluating the achievement of science subject which will be taught using STEM education. Tools will be used are as follows:

**Creative Thinking:** Verbal test of Creative Thinking constructed by Torrance (TTCT-Verbal)

**Academic achievement:** Academic achievement was measured by total marks scored by the students of 6<sup>th</sup> Std in exams, by the permission of school authority.

## STATISTICAL TECHNIQUES

**Descriptive Statistics:** Mean, Standard deviation will be used to know the nature of data.

**Inferential Statistics:** Analysis of Co-Variance (ANCOVA) will be used for comparison between control and experimental group differences by controlling covariate effect.

**Graphical Representation** will be used for presenting data and results in visual form.

## DELIMITATIONS OF THE STUDY

The study will be limited to the following points:

- The study will be delimited to Upper Primary School of Lucknow city (Uttar Pradesh) only.
- The study will be delimited to UP Board only.
- The study will be conducted on class 6<sup>th</sup> students.
- The study will be delimited to science subject only.

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