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STEAM: Importance of Arts Integration in STEM

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Abstract

India has a long tradition of holistic and multidisciplinary learning, from universities such as Takshashila and Nalanda, to the extensive literature of India combining subjects across fields. NEP-2020 recommends that all branches of creative human endeavor, including mathematics, science, vocational subjects, professional subjects, and soft skills which undoubtedly have Indian origins, must be considered as 'arts', so this notion of a 'knowledge of many arts' or often called as the 'liberal arts' must be included again to Indian education, as it is the kind of education that is prerequisite for the 21st century. Recently, a multidisciplinary approach to education in the form of STEAM (Science, Technology, Engineering, Arts, and Mathematics) has aroused global interest. STEAM education is viewed as an advanced learning procedure that will reshape the Indian education system. This research is being conducted to find the effect of STEAM Learning Approach on the Creative Thinking Skills of learners at the Elementary Level. Quasi-Experimental Design has been used on two intact sections of 40 learners of class VII. Mean, Standard Deviation, and Critical ratio (t) were calculated. It can be concluded that STEAM Learning Approach does enhance the Creative Thinking Skills of learners.

Keywords: STEM, STEAM, Integration of Arts, Creative Thinking Skills

Introduction

I. Introduction

STEAM is the abbreviation for coordinating Science, Technology Engineering, Art, and Mathematics disciplines. STEAM can be clarified as "the inclusion of Arts and Humanities in STEM education" (Spector, 2015, p.5). STEAM education can be considered a mode of tackling issues while drawing on imaginative and cooperative abilities to build interest and commitment in these fields. STEAM education has been proposed to advance useful commitment among the students in issues and issues related to science, arithmetic, and related curricular regions (Stroud

and Baines, 2019). STEM students when learning through art-making, experience enhancement of creativity, broadened perspectives, and discover their unknown strengths. Schools are finding it challenging to keep up with the expectations of learners and have already begun bowing to their need for revelation based, adaptable, multidisciplinary, experiential learning through STEAM. According to Maltas, (2015) this methodology of learning assists with thriving the fundamental abilities like innovativeness, collaboration, correspondence, soundness, adaptability and independence, and so forth in students to set them up for worldwide rivalry. One of the primary objectives of STEAM is to get ready understudies to take care of true issues "through innovation, creativity, critical thinking, effective communication, collaboration, and ultimately new knowledge" (Quigley and Herro, 2016, p. 410). This multidisciplinary and comprehensive learning is an imaginative medium through which students can learn sciences, innovations, arithmetic with aesthetic sciences, humanities, dialects, sociologies, proficient abilities, professional abilities, morals, profound quality, human qualities, and so on at the same time period forth simultaneously. Thus, this approach to learning is supposed to bring the paradigm shift from traditional rote educational philosophy which primarily focuses on test scores to a philosophy that values the learning process as much as the results. This approach to learning is a pioneer, but a collaboration of Arts with Science and other subjects is not a new idea.

Historical Background:

The United States of America started focusing on how to improve their performance in PISA tests. In this aspect, they first try to improve their Science and Maths, and further integrated Engineering and Technology. Thus, the STEM approach to learning emerges. STEM refers to groups from four disciplines that are working together in order to solve complex, real-world problems (Vilorio, 2014, p. 3). In the present scenario, the number of students pursuing STEM is decreasing (Liao, 2016, p. 44) with an additional problem that the STEM curriculum excludes the arts and therefore is lacking in teaching creative and innovative thinking (Liao, 2016, p. 45). Vilorio (2014) states that “Critical and creative thinking help STEM workers in problem-solving…” because it helps them to formulate innovative solutions or creatively approach problems (p. 9).

This lack leads art educators to be concerned about the integrity of the art and its place in education in STEM (Liao, 2016, p. 45). This is how the STEAM (STEM + Arts) movement has come to accomplishment. The National Art Education Association (NAEA), United States defines STEAM as, “the infusion of art and design principles, concepts, and techniques into STEM instruction and learning” (Liao, 2016, p. 45). At present, there is little understanding of STEAM teaching as few research works are done on STEAM teaching practices and thus the use of STEAM is growing nationally and internationally.

Integration of Arts:

Rabalais, (2014) also argues that Arts is the missing part that connects innovation and creativity to scientific understanding. When the learners are taught a single concept, they connect the concept with their life experiences. When there are more such concepts and teaching ways, there will be a greater chance of retention and recall. Incorporating Arts into other learning methods empowers learners to view a concept through various focal points, as well as utilize these experiences in solving various problems and leading the life smoothly. In the view of Riley (2013) integration of Arts engages learners to explore any content through multiple content areas simultaneously and comprehend it through Arts. We should empower the young people of tomorrow to search out different answers to complex issues, and the expansion of human expressions inside the STEM fields can battle this issue. The divergent Art classroom issues never have one response. The art classroom gave the opportunity to learners to develop their own learning through dynamic interaction. Creative liberty powers learners to explain their own understanding of the material in a unit through the investigation of conceivable outcomes. Coordinated workmanship schooling prompts can work as vehicles of comprehension, or a union of center substance information. Thus learners explore the scientific method using five components of Arts (music, drama, visual arts, dance, and literature) frequently the visual arts (Edwards, 2010; Riley, 2013). Edward further explains that visual arts activities include drawing, painting, and printing (two-dimensional visual works) and the creation of models, sculptures, etc (three-dimensional). Learners ought not to be surveyed on how well they can recall the Phenomenon by name yet rather on the inward activities, properties, or how they connect with the person. Art class incorporates performance, simulations, and intelligence through projects to be completed by learners in collaboration performing different roles that are related to the real world. Instructors can cultivate performing various tasks through the joining of music and narratives connecting with the substance during studio time, or by platform obligation and giving different tasks to support using time effectively. Expressions incorporated learning units can fill in as a vehicle for understanding the substance of the STEM fields as well as education overall. In the event that instructors across disciplines collaborate to focus on arts-integrated project-based learning, the young people of tomorrow will be proficient. The STEAM project-based learning leads to the development of different skills in learners like problem-solving, collaboration, and creative and critical skills (Messie, 2015). The main aim of education is to enable learners to use thinking skills like creative and critical thinking, problem-solving, collaboration, communication, and scientific and technological abilities as these skills are very much required for lifelong education and sustainability.

Objective and Hypothesis:

Research on the STEAM approach to learning is still being explored at international levels but these areas need to be explored in the Indian educational system also. Therefore, the research

question which needs to be answered is- Does the STEAM Learning Approach influence the Creative Thinking Skills of learners at the Elementary Level? So, the objective of this research is- To study the effect of the STEAM Learning Approach on the Creative Thinking Skills of the learners at the Elementary Level. To achieve this objective research hypothesis was formulated as- There is an effect of STEAM Learning Approach on Creative Thinking Skills of the learners at the Elementary Level. As we cannot test the research hypothesis statistically, therefore the null hypothesis was formulated as There is no effect of the STEAM Learning Approach on the Creative Thinking Skills of the learners at the Elementary Level. To achieve the objective of this study an intervention program based on the STEAM Learning Approach for class VII in science was prepared.

Method of the Study:

The proposed study is Quantitative in nature. Non-Equivalent Control Group Design of Quasi-Experimental Design was utilized. Non-Equivalent Control Group Design includes one experimental and one control group. The experimental group was instructed by STEAM Learning Approach while the control group was educated by conventional strategy. For this examination, Government Middle School, Delha, Gaya, Bihar was picked advantageously. Every one of the students of class seventh with two intact sections was taken in which one section was allocated as an experimental group and the other as a control group randomly for an assortment of information. The data was gathered from the instrument 'Creative Thinking Skill Test' for Creative Thinking Skills which was self-created by the researcher. This test is based on three dimensions: fluency, flexibility, and originality. The intervention program in view of the STEAM Learning Approach was created for class VII and is essentially a STEAM-based project. Each project depends on everyday issues for which learners found the solution. Based on these solutions students made their projects, checked the workability of these projects, and at last gave their presentations.

Figure 1: Pictures of Learners with their Project

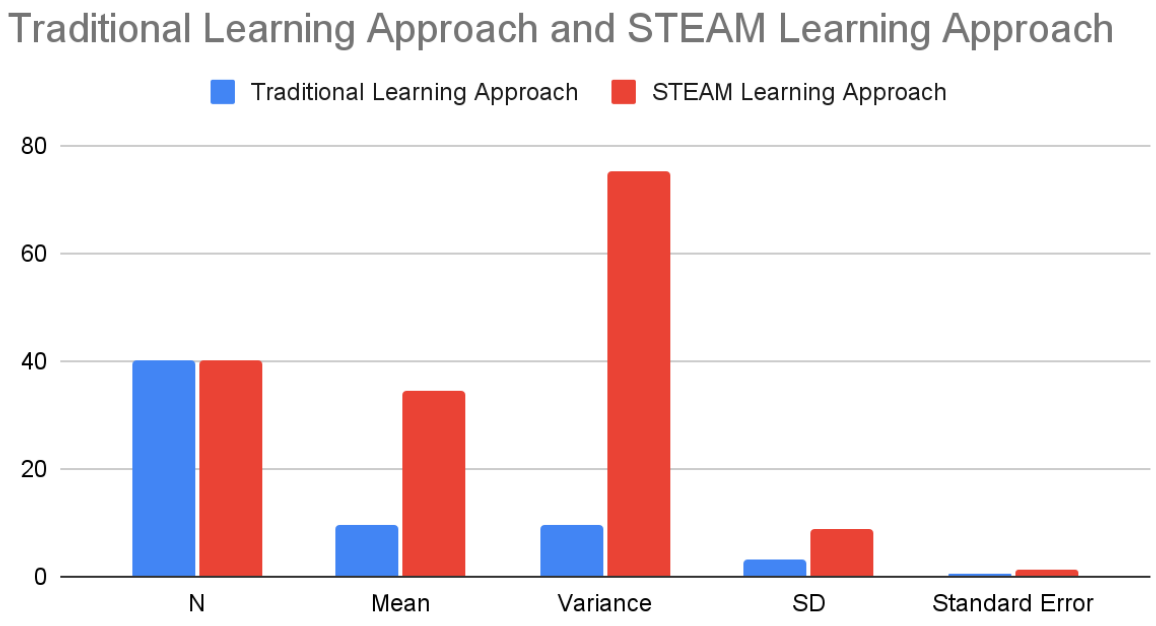
Analysis of the Data and Finding of the Study:

Three STEAM projects were assigned to the experimental group while the control group was taught through traditional methods. In the first project, students made toys with waste products to solve the financial problem caused due to Covid-19. In the second project, students made different lamps and wall decors to lighten their classrooms to solve the problem of irregularity of current. While in the third project to solve the problem of scarcity of drinking water, students made a water filter, drip irrigation model, and a soil moisture sensor for the garden and lawn to prevent water loss.

After collecting data from the sample, it was analyzed through Mean, Standard Deviation, and the Critical ratio (t). With reference to the Objective and Null Hypothesis (H0), it was found that with df= 75 the calculated value of t is 4.99 which is greater than the table value (1.99) at a 0.05 level of significance. So, the test statistic t is significant at a 0.05 level. Hence the null hypothesis is rejected and the research hypothesis is accepted. Thus, it can be concluded that there is a significant difference between the mean scores of Creative Thinking Skills of the learners learned by the traditional method and learners learned by the STEAM Learning Approach. It was found that the learners who learned by STEAM Learning Approach scored high on the Creative Thinking Skills Test. Therefore, it establishes that STEAM Learning Approach enhances the Creative Thinking Skills of learners.

t-Test		
	STEAM Learning Approach	Traditional Learning Approach
Mean	34.55	9.5
Variance	75.22820513	9.487179487
Observations	40	40
SD	8.67341946	3.080126538
Standard Error	1.37138803	0.487010767
Hypothesized Mean Difference	0	
df	48	
t Stat	17.21300054	
P(T<=t) two-tail	0	
t Critical two-tail	1.677224138	

Table I: Critical Ratio (t) Table for scoring Creative Thinking Skills



Result and Discussion:

The result shows that this STEAM project-based learning enhances the creative thinking skills of learners. The students were able to connect the science concept during the project formation and also, they can relate it to their daily life. Students were also able to get various creative ideas to solve the problem as well as suggest and make the final project.

I found different new things while making the project, so I felt that my creative ideas were developed.

(Student Reflective Journal, Student 21, December 02, 2021)

I knew new things about electric circuits and thus my creative ideas flourished.

(Student Reflective Journal, Student 10, December 02, 2021)

These answers of learners are the indicators of the ability to think fluently. Learners can generate new ideas and can see a problem from a different perspective. As a result, learners can change their way of thinking to provide different solutions to a problem when they are facing one. *During the discussion, along with answering the question, Learner No 24 also kept asking questions, thus his way of thinking was developed as he was able to create questions from different perspectives*.

(Observation of, Student 24, December 02, 2021)

Learner No 24 has good flexibility in thinking skills as this can be seen through the observation results.

Can we directly attach the LED with a cell without connecting it with a wire?

(Student Observation Sheets, Student 17, December 02, 2021)"

Thus learners have their own ideas while designing the product. Therefore, they become accustomed and continue to develop their creative thinking skills and finally connect the Science and different disciplines of STEAM with their day-to-day life.

Conclusion:

The aim of this study was to explore that STEAM project-based learning can be used in science teaching. The important dimensions of creative thinking skills have been stimulated in the study by active questioning, discussion, and self-reflection as well as examining, analyzing and interpreting. Learners implement their knowledge in solving the problem by thinking fluently and with different perspectives. The help of effective integration of instructions in the STEAM learning approach empowers learners to think creatively and innovatively. For this approach of education to be effective, it is fundamental to invest and strengthen teachers with knowledge and skills so that they shall be able to transact STEAM-based curricula. Besides, a trained teacher will only be able to take care of students learning at different levels. Further research is required to be done to examine the integration of other disciplines like Arts and Social Sciences while considering different new approaches to STEM like STEAM and STREAM.

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