Emergent: Journal of Educational Discoveries and Lifelong Learning (EJEDL) Vol: 3, No 4, 2024, Page: 1-6

Developing Students' Spatial Imagination In Steam Education

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DOI: https://doi.org/10.47134/emergent.v3i4.49
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Received: 20-10-2024
Accepted: 21-11-2024
Published: 21-12-2024

Abstract: This article discusses STEAM educational technologies and their use, the significance of using STEAM educational technologies in developing spatial imagination of primary school students as well as defines several definitions of the concept of imagination, and methods for developing students' spatial imagination.

Keywords: Imagination, STEAM Educational Technology, Spatial Imagination, Technology, Spatial Thinking, Creative Task

Introduction

Developing spatial imagination in primary school students is a pedagogical problem that demands care and attention in the educational process, and it is still important in terms of enhancing education quality and efficiency. Furthermore, Decree No. 5712 of the President of the Republic of Uzbekistan calls for the gradual establishment of "Presidential Schools" specialising in STEAM (science, technology, engineering, arts, and mathematics) in each region of the Republic from 2019 to 2021and the provision of the most modern, high-quality education there (Upadhyay, 2021).

The acronym STEAM includes science, technology, engineering, art, and mathematics, and these disciplines enable students to study and experiment with concepts while connecting them to real-world situations (Faulconer, 2020).

The term STEM was coined in 1990 by bacteriologist R. Colwell in the United States (Woodford, 2022). D. Ramali, an American scientist, began regularly using it in 2001. STEM education was later recognised as an A-(art) subject, and the use of this educational

technology was reflected in the areas within each discipline as well as their areas of activity (Hau, 2020).

According to Sangirova (2022), the psychological and hygienic requirements for the implementation of STEM education and the pedagogical conditions for the development of scientific literacy and practical competencies in young students (Ortiz-Revilla, 2021).

Tashibekova (2022) justified the methodological system of using STEAM educational technology in teaching natural sciences in primary grades and forming a scientific worldview in students. Based on STEAM educational technology, a project of STEAM practical exercises was developed to form the skills of creative activity in natural sciences. Developing students' spatial imagination requires the implementation of various methods. Many studies have been conducted on the basis of STEM technology and its pedagogical and psychological characteristics (Shen, 2021).

Caiwei Zhuning (2023) in her research paper "Fostering spatial ability development in and for authentic STEM learning" showed methods for developing spatial imagination of K-12 students through integrated STEM practices in formal or informal educational contexts. Creative and critical thinking, imagination, perception are the main processes in working with STEAM educational technology. Therefore, at this stage of the work, it is necessary and important for us to dwell separately on the concept of imagination. In order to clarify one of the main concepts of our dissertation research - the formation of spatial imagination, the aim was to analyze scientific works on physiology, pedagogy and psychology, as well as to determine its place in educational activities and the direct learning process. Attention was paid to how STEAM education can be used and further developed to develop students' spatial imagination (Malele, 2020).

Methodology

To develop students' spatial imagination in STEAM education provides students with the opportunity to think creatively, expand their imagination and develop design skills. STEM education is consistent with real life realities and oriented towards students' professions, and includes tasks of varying difficulty levels that are consistent with pedagogical approaches (observation, conversation, questioning, use of literature and other sources, ability to imagine project work in advance, data collection and analysis), but that can delight each student and make them enjoy their work performed independently (Choi, 2021).

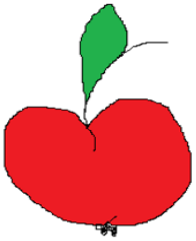
Spatial imagination plays a fundamental role in understanding and applying concepts in STEAM disciplines. It is essential for interpreting scientific diagrams, visualizing engineering designs, and creating artistic representations. However, traditional education methods often neglect the explicit development of this skill. STEAM education, with its emphasis on integration and real-world application, provides an ideal framework for enhancing spatial imagination (Lindberg, 2020).

Since practical work is the leading activity in STEAM lessons, each small experiment, project work helps students develop creative skills, develop spatial imagination, and ensure the effectiveness of the lesson. The following methods and educational technologies can be used to help develop students' spatial imagination.

The method **"Listen - imagine – describe"** requires each participant to fill in the table below (See table 1). The teacher provides information to students about a certain subject. For example, it can be (fruits, vegetables, transport).

Stage 1. Students must write the name of the first fruit or vegetable that comes to their mind and draw its image.

Table 1. Method "Listen - imagine – describe"

Listen	Imagine	Describe
This fruit is…	The first fruit that comes to mind is an apple.	

Stage 2. The teacher reads a story or fairy tale. Students listen to the story, imagine, depict what they imagine in the image, and express the story they heard in their speech through the images they draw. This method greatly helps students not only to listen, but also to imagine, draw what they imagine, and develop their speech (Chung, 2022).

Action in imagination is another task that requires students to do creative task. Students should describe the action in their imagination. This creative task can be complicated in groups of classes. Draw an arbitrary broken line on a plane. Imagine that people are moving along the lines you drew, describe the action in your imagination (see Figure 1).

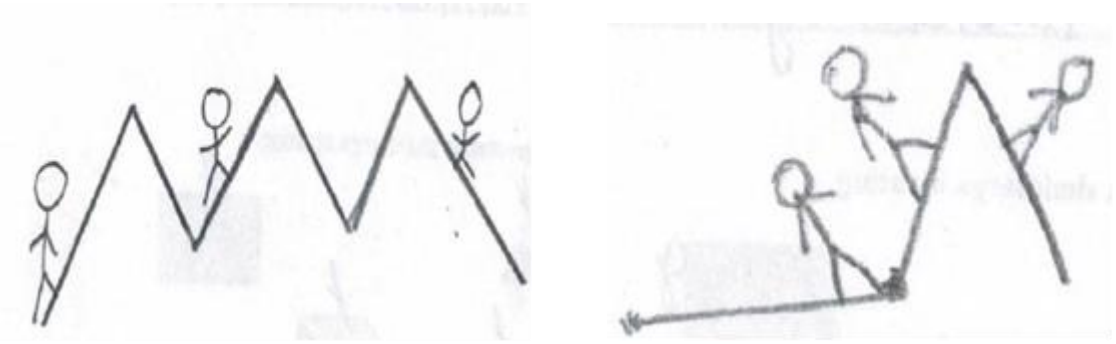


Figure 1. Action in imagination task completed by 4th grade students

Assigning interesting tasks increase students' interest in science, the student is happy and enjoys the drawing he draws, his self-confidence increases, and most importantly, their spatial imagination skills will be developed by imagining the location of trees and houses on the mountain or moving on the mountain (Wilson, 2021).

Result and Discussion

Effective educational activities involve students in solving their own problems independently, creating free and independent communication, expressing their imagination, and making appropriate use of all the opportunities provided (Khamhaengpol, 2021).

Focussing only on the content of knowledge in education results in low educational efficacy. Only a pupil with developed thinking abilities will have a good grasp on knowledge. Therefore, it is vitally crucial to educate pupils how to think. The assignments in textbooks are extremely important in increasing students' thinking skills and developing their imagination (Salas-Pilco, 2022).

In order to develop students' spatial imagination and logical thinking skills, we have developed a special system of creative and logical tasks for primary school students to study science materials and complete creative tasks on them, to thoroughly master the subject through completing tasks, and to apply the knowledge they have learned in life. This system of tasks creates a great opportunity for students to increase their interest in science, develop independent work skills, and apply them in life (Ozkan, 2021).

Conclusion

Spatial imagination is a critical competency in STEAM education, underpinning success in fields that require creativity, problem-solving, and technical expertise. By integrating hands-on activities, digital tools, project-based learning, and arts, educators can cultivate this skill effectively. Preparing students with strong spatial reasoning abilities ensures they are equipped to meet the demands of a rapidly evolving, technology-driven world (Bertrand, 2020).

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