Chapter 12
Artificial Intelligence and the Development of Creative Skills in STEM Education

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ABSTRACT

This chapter examines the role of artificial intelligence in promoting educational creativity in STEM and shows how AI tools can transform the learning process from a traditional one to a dynamic, problem-based, and personalized experience. By analyzing various dimensions such as fostering divergent and convergent thinking, designing creative scenarios, and ethical and technical challenges, the present study provides a comprehensive picture of the opportunities and limitations of this transformation. Finally, the need for purposeful design, teacher preparation, and an interdisciplinary approach to effectively utilize AI in education is emphasized.

1. INTRODUCTION

In recent decades, the role of creative skills in science, technology, engineering, and mathematics (STEM) education has been recognized as one of the main axes of the transformation of educational systems. While traditional educational systems have often focused on the transfer of knowledge and strengthening analytical and logical capabilities, global developments in the fields of industry, technology, and the humanities have made the cultivation of creativity, innovative thinking, and the ability

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to solve complex problems independently a fundamental necessity in educating the next generation (Giang et al., 2024). With the entry of artificial intelligence into the field of education, new perspectives have emerged in the field of creating creative, interactive, and personalized learning experiences; perspectives that can significantly reduce the limitations of traditional STEM education structures (Alangari, 2022).

Unlike creativity in the arts, creativity in STEM often manifests itself in the form of generating new solutions, designing innovative concepts, or discovering complex patterns in scientific data. In this context, AI can not only provide new tools for data analysis and process simulation, but also provide opportunities to foster individual and group creativity by creating interactive learning environments (Nozari, Abdi, & Szmelter-Jarosz, 2025). In particular, advanced language models, machine learning algorithms, and machine vision systems have enabled students to go beyond conventional numerical analysis formats and, instead of repeating formulas, build and test new ideas in virtual environments (Sirajudin & Suratno, 2021).

On the other hand, the emergence of automated design tools, generative modeling, and AI-powered computing platforms have expanded teaching methods in which students can develop their own experimental prototypes, engineering designs, and scientific predictions with high accuracy without deep programming or computing knowledge (Kalogeras, Mejri, & Efthimiou, 2022). This development has, on the one hand, increased the level of access to scientific innovation for students at younger ages, and on the other hand, has narrowed the boundary between the role of knowledge receiver and knowledge producer (Pramesti, Probosari, & Indriyanti, 2022). In other words, in environments equipped with artificial intelligence, the learner can simultaneously act as a learner and a designer of creative ideas.

An important point to note in this regard is the change in the nature of the role of the teacher and the learning environment. In the traditional educational environment, the teacher was generally considered the main source of knowledge and learners were placed in a hierarchical structure. However, in the AI-driven environment, the teacher's role has evolved into a guide, facilitator, and designer of the learning experience. In such an environment, the learner will be able to discover personalized paths to develop their creative skills through interaction with intelligent systems (Nozari, Abdi, & Jahangard, 2025). This structural transformation is important because STEM education requires not only strengthening basic knowledge, but also developing "innovative design capacities" on a global scale.

However, the use of AI in creative STEM education also comes with challenges. One of the main concerns is the reduction of independent thinking in students due to excessive dependence on suggestive and generative systems. In addition, assessing the originality of ideas generated by students using AI tools has become a methodological and pedagogical issue in itself (García Aranda et al., 2020). Despite these challenges, research evidence shows that if learning environments are prop-