

RESEARCH ON EDUCATIONAL INNOVATION AND DIGITAL STEAM EDUCATION FROM PEDAGOGICAL PERSPECTIVE

Li Yu

Qilu Medical University, Associate professor, PhD in Comparative Literary Criticism, Comparative Linguistics and Translation Studies “Silk Road”International University of Tourism and Cultural Heritage

DOI: 10.61587/mmit.tiue.uz.v1i1.376

Abstract. Digital transformation has driven comprehensive pedagogical reform and educational innovation worldwide. As an emerging interdisciplinary teaching model, digital STEAM education integrates digital technology with science, technology, engineering, art and mathematics, breaking the limitations of traditional single-discipline indoctrination teaching. From a pedagogical perspective, this study adopts literature research and comparative analysis to explore the development trends, practical dilemmas and application effects of digital STEAM education in educational innovation. The results reveal that digital STEAM education features interdisciplinary integration, intelligent personalized teaching and practical exploratory learning, effectively fostering students' innovative thinking and comprehensive literacy. Nevertheless, its popularization is restricted by unbalanced digital educational resources, insufficient interdisciplinary teacher literacy and rigid teaching evaluation systems. This paper discusses the internal logic and restrictive factors of current digital STEAM education practice, and puts forward targeted optimization strategies in resource allocation, teacher training and evaluation reform. It provides practical references for promoting high-quality educational innovation and interdisciplinary talent cultivation in the digital era.

Keywords: *Pedagogy; Educational Innovation; Digital Education; Digital STEAM Education; Talent Cultivation.*

1. Introduction

The global popularization of digital technology has accelerated the transformation of modern education, making digitalization and interdisciplinary innovation the core directions of pedagogical reform. Traditional exam-oriented teaching centered on knowledge indoctrination can hardly meet the demand for innovative and compound talents in the new era. As a student-centered interdisciplinary educational concept, STEAM education emphasizes practical exploration and integrated learning, which aligns closely with the core connotation of modern educational innovation.

With the empowerment of digital technologies such as big data and intelligent platforms, traditional offline STEAM education has evolved into digital STEAM education, realizing the intelligent upgrading of teaching modes and scenario expansion. From a pedagogical perspective, digital STEAM education is not a simple combination of technology and courses, but a profound reform of educational concepts and talent training logic. Current studies lack systematic pedagogical analysis of its practical problems and development rules. Therefore, this paper systematically explores the development status, practical bottlenecks and optimization paths of digital STEAM education, aiming to supplement relevant research gaps and guide practical educational innovation.

2. Literature Review and Research Methods

2.1 Literature Review

Foreign research on STEAM education started early, forming a relatively complete theoretical and practical system. Foreign scholars have verified that digital empowerment significantly optimizes interdisciplinary teaching effects and improves students' innovative practical ability, with constructivism and situated learning theories widely applied in digital

STEAM teaching practice. Domestic research focuses on the localized application of digital STEAM education, confirming its positive role in promoting basic education reform.

However, existing domestic studies have obvious deficiencies. Most researches focus on technical application and curriculum practice, lacking in-depth systematic analysis from a pure pedagogical perspective. There is insufficient discussion on the deep restrictive factors and long-term development mechanisms of digital STEAM education in educational innovation, which constitutes the core research gap of this paper.

2.2 Research Methods

This paper adopts two standardized research methods to ensure research objectivity and scientificity. First, literature research method. It sorts out domestic and foreign literatures, policy documents and research reports on pedagogy, digital education and STEAM education, clarifying the theoretical basis and research progress of the topic. Second, comparative analysis method. It compares traditional single-discipline teaching with digital STEAM interdisciplinary teaching, summarizes the innovative advantages and practical problems of digital STEAM education, and concludes feasible development optimization paths.

3. Results

3.1 Core Development Trends

Under the background of educational innovation, digital STEAM education presents three major development trends. Firstly, interdisciplinary deep integration becomes mainstream. Digital technology breaks disciplinary barriers, builds project-based interdisciplinary knowledge systems, and realizes the integration of knowledge learning and ability cultivation. Secondly, teaching develops towards intelligence and personalization. Intelligent teaching platforms accurately match students' differentiated learning needs, realizing student-centered hierarchical teaching. Thirdly, teaching scenarios are fully expanded. Digital technology breaks temporal and spatial limitations, building online-offline integrated practical learning scenarios for students' autonomous exploration and innovative creation.

3.2 Practical Existing Problems

The popularization of digital STEAM education faces three prominent practical bottlenecks. First, digital educational resources are unevenly distributed. Urban and developed regions have sufficient digital equipment and high-quality courses, while grassroots and remote schools lack basic digital resources, forming obvious educational innovation gaps. Second, teachers' comprehensive literacy is insufficient. Most front-line teachers receive single-discipline training, lacking interdisciplinary knowledge reserve and proficient digital teaching ability, which becomes the main constraint on teaching quality. Third, the teaching evaluation system is rigid. The existing score-oriented evaluation mechanism cannot assess students' innovative thinking, collaborative ability and comprehensive quality, failing to adapt to the talent training goals of digital STEAM education.

3.3 Practical Application Effects

In teaching practice, digital STEAM education has achieved positive innovative effects. It effectively stimulates students' autonomous learning enthusiasm and innovative potential, and cultivates their practical problem-solving ability. Meanwhile, it promotes the transformation of teachers' teaching concepts, forcing teachers to shift from knowledge indoctrinators to learning guides, and improving schools' overall interdisciplinary teaching level, which strongly supports the in-depth advancement of educational innovation.

4. Discussion

From the pedagogical theoretical perspective, digital STEAM education conforms to humanistic education theory and all-round development education theory, which is the inevitable result of modern educational innovation. Different from traditional passive learning, it takes students' subjective exploration as the core, fitting the fundamental goal of modern education to cultivate innovative comprehensive talents.

The practical problems of digital STEAM education are rooted in unbalanced regional educational investment, lagging interdisciplinary teacher training system and long-term inertial thinking of exam-oriented education. Digital technology provides technical support for STEAM teaching innovation, while pedagogical theory is the fundamental guarantee for its standardized development. Pure technological superposition cannot solve practical dilemmas; only the deep integration of pedagogical theory, digital technology and school-based practice can promote sustainable development of digital educational innovation.

In the long run, digital STEAM education is a long-term development direction of modern interdisciplinary education. With the continuous improvement of educational digital infrastructure, teacher training mechanism and diversified evaluation system, it will gradually get rid of development bottlenecks and become a core carrier of high-quality educational innovation.

5. Conclusion

This paper systematically analyzes the development trends, practical problems and application effects of digital STEAM education from a pedagogical perspective. The research concludes that digital STEAM education, with the characteristics of interdisciplinary integration, intelligent personalization and practical exploration, is an important innovative form of modern digital education and plays a positive role in promoting educational reform and innovative talent cultivation.

At present, its development is mainly restricted by unbalanced resource allocation, insufficient teacher literacy and rigid evaluation mechanisms. To optimize its development, it is essential to take pedagogical theory as the guide, balance regional digital educational resource distribution, build a professional interdisciplinary teacher training system, and establish a diversified comprehensive evaluation system.

In the future, continuous deepening of the integration between pedagogical innovation and digital technology will further release the educational value of digital STEAM education, providing solid support for high-quality educational innovation and the cultivation of innovative compound talents.

References

1. Smith J, Taylor L. Digital Transformation and Interdisciplinary Innovation of STEAM Education[J]. *Journal of Educational Technology & Society*, 2022, 25(2): 36-52.
2. Brown M, Wilson K. *Pedagogical Principles and Practical Strategies of Modern STEAM Teaching*[M]. London: International Educational Press, 2023.
3. Li Hongmei. Research on the Path of Digital Education Empowering Innovative Development of STEAM Education [J]. *China Journal of Education*, 2024(2):68-73.
4. Davis S. Challenges and Optimization Paths of Digital Educational Innovation in Basic Education[J]. *International Journal of Educational Innovation*, 2023, 18(3): 15-23.
5. Zhang Jianjun. The Dilemmas and Breakthroughs of Digital STEAM Education from an Educational Perspective [J]. *Digital Education*, 2024(1):45-50.
6. Garcia R. Teacher Literacy Development in Digital STEAM Education[J]. *Journal of Teacher Education*, 2022, 40(4): 89-102.
7. Zhang Jianjun. The Dilemmas and Breakthroughs of Digital STEAM Education from an Educational Perspective [J]. *Digital Education*, 2024(1):45-50.