

ORIGINAL ARTICLE

Identifying the Challenges of the Fourth Industrial Revolution in University Education

Samin Sepehrian ¹, Mitra Ezati ², Fatemeh Nasrollahi-Nia³

1. Ph.D. Student in Educational Management, University of Tehran, Tehran, Iran.
2. Associate Professor, Department of Educational Management and Planning, University of Tehran, Tehran, Iran.
3. Assistant Professor, Department of Educational Management and Planning, University of Tehran, Tehran, Iran.

Correspondence:

Mitra Ezati

Email: ezati.m@ut.ac.ir

Receive Date: 12/Oct/2025

Revise Date: 09/Nov/2025

Accept Date: 17/Dec/2025

Publish Date: 21/Mar/2026

How to cite:

Sepehrian, S. Ezati, M. Nasrollahi-Nia. (2026). Identifying the Challenges of the Fourth Industrial Revolution in University Education, *Technology and Scholarship in Education*, 6 (1), 20, 1-4. <https://doi.org/10.30473/t-edu.2025.76112.1350>

ABSTRACT

The Fourth Industrial Revolution refers to a period of technological transformations characterized by the emergence and integration of advanced technologies such as artificial intelligence, the Internet of Things, virtual and augmented reality, big data, and robotics. This revolution, by influencing the boundaries between the real and virtual worlds, has brought about fundamental changes in industries, the economy, society, and particularly in educational systems. The rapid pace of these technological developments has created numerous challenges for educational systems -especially higher education- and has made it necessary to reconsider and quickly adapt educational systems to new technologies. This study was conducted with the aim of identifying the challenges of the Fourth Industrial Revolution in higher education. To achieve this aim, a qualitative approach and the systematic design of grounded theory at the conceptual ordering level were employed. Data were collected through semi-structured interviews, which continued using a purposive sampling strategy until theoretical saturation was reached (22 interviews). Data analysis was performed using ATLAS.ti9 software and the first stage of Strauss and Corbin's coding procedure. In the challenges section, 117 initial concepts were identified, which after comparison and integration, resulted in 19 subcategories. These subcategories were classified and presented in the form of five main categories: "managerial and infrastructural challenges," "individual challenges," "educational challenges," "research challenges," and "social and cultural challenges". The findings indicate that, to effectively deal with these challenges, universities must adopt a comprehensive approach in which the development of technological infrastructure, empowerment of professors and students in digital skills and critical thinking, revision of curricula and assessment methods, and formulation of clear supportive and ethical policies are prioritized. Implementing such strategies can provide the basis for the effective use of new technologies and for improving the quality of higher education in the era of the Fourth Industrial Revolution.

KEY WORDS

Fourth Industrial Revolution, University Education, Challenges, Higher Education.



Introduction

The Fourth Industrial Revolution (4IR), with its unprecedented speed and scale, is fundamentally altering industries, economies, and societies (George, 2024). Higher education institutions, as primary centers for knowledge production and specialized human capital development, are at the forefront of these changes (Penprase, 2018). However, the rapid pace of technological advancement presents significant challenges that necessitate a critical re-evaluation of existing educational structures and methods (Al-Ghnmimi et al., 2022). While previous studies have explored the impacts of 4IR on higher education, much of the existing research, both internationally and domestically, has either been theoretical, focused on single aspects like artificial intelligence, or has not provided a comprehensive, empirically grounded analysis of the multi-dimensional challenges universities face (Smith, 2023; Lubinga et al., 2023; Tarine & Mehralizadeh, 2023). This study addresses this gap by aiming to identify and analyze the diverse challenges posed by 4IR to university education.

Method

This study employed a qualitative approach using the systematic design of grounded theory, specifically at the level of conceptual ordering (Strauss & Corbin, 2014). The study population consisted of faculty members from public universities in Tehran with relevant expertise. A purposive sampling strategy was used, and data were collected through 22 semi-structured, in-depth interviews, continuing until theoretical saturation was reached. The average interview duration was 43 minutes. The interviews were audio-recorded, transcribed verbatim, and analyzed using ATLAS.ti9 software. Data analysis followed the open coding procedure of Strauss and Corbin (2014). To ensure rigor, several strategies were employed: member checking, peer review of the interview protocol by two experts, and parallel coding, which resulted in an inter-coder agreement of 87%.

Findings

The data analysis led to the extraction of 117 initial concepts, which were consolidated into 19 subcategories and subsequently into 5 main categories of challenges. The main categories are:

- **Managerial and Infrastructural Challenges:** Includes limited access to advanced equipment, insufficient internet speed and bandwidth, lack of financial resources and long-term support, and the crisis of adaptation to rapid technological change.
- **Individual Challenges:** Encompasses excessive profit-oriented views towards education, inefficient executive functions (e.g., reduced deep thinking and creativity), a tendency towards ease leading to the decline of independent thinking, and psychological harms such as stress and addiction to technology.
- **Educational Challenges:** Involves low quality and diversity of educational resources, inconsistency of traditional teaching methods with modern approaches, limitations of online education (e.g., low interaction), ineffectiveness of current curricula and goals, weakness in skill development and empowerment, and inadequate assessment methods.
- **Research Challenges:** Includes ambiguity in the validation and accuracy of AI-generated responses, leading to fake citations and unreliable data, as well as superficiality in research, where quantity is prioritized over quality.
- **Social and Cultural Challenges:** Encompasses cultural incongruence and reduced human interaction, inequality in access to technology (digital divide), and legal and ethical threats concerning intellectual property, privacy, and academic dishonesty.

Discussion and Conclusion

The Fourth Industrial Revolution has fundamentally transformed higher education, introducing multifaceted challenges. This study identified these challenges across five core categories: managerial-infrastructure, individual, educational, research, and socio-cultural. The findings reveal that infrastructure and managerial shortcomings form the central barrier, as deficiencies in technology, funding, and institutional adaptability severely impede effective responses to change—a finding consistent with prior research (Ivanashko et al., 2024; Singaram et al., 2023). Furthermore, uncontrolled reliance on smart technologies fosters cognitive superficiality and diminishes intrinsic motivation (Masoudi, 2023), while simultaneously creating legal and ethical ambiguities in research practices (Rasul et al., 2023). Socially, the digital divide and reduced human interaction threaten educational equity (Moyo, 2022). To address these challenges, a comprehensive strategy is essential. Universities must prioritize developing technological infrastructure, enhancing digital and critical thinking skills among faculty and students, and revising curricula and assessment methods. Additionally, establishing transparent validation standards for AI-driven research, ensuring equitable access to technology, and formulating clear legal-ethical frameworks for content ownership and privacy are imperative. Implementing these integrated strategies will enable higher education to effectively adapt to the 4IR era.

Conflict of Interest

according to the authors , the present article does not have any conflict of interest .this article has not been published in any publication , either internal or external.

Acknowledgments

The authors acknowledge and express their sincere gratitude to all faculty members, friends, and professors who contributed to and assisted in the writing of this article.

References

- Al-Ghnmimi, S., Al-Maskari, A., & Al-Riyami, T. (2022). A Framework to Measure Higher Education Institutions' Readiness for the Fourth Industrial.
- George, A. S. (2024). The fourth industrial revolution: a primer on industry 4.0 and its transformative impact. *Partners Universal Innovative Research Publication*, 2(1), 16-40.
- Ivanashko, O., Kozak, A., Knysh, T., & Honchar, K. (2024). The Role of Artificial Intelligence in Shaping the Future of Education: Opportunities and Challenges. *Futurity Education*, 4(1), 126-146.
- Lubinga, S. N., Maramura, T. C., & Masiya, T. (2023). Adoption of Fourth Industrial Revolution: challenges in South African higher education institutions.
- Masoudi, O. A. (2023). *The application of artificial intelligence in the future of higher education. Futures Studies, Higher Education and Sustainable Development*, 2(2), 382–396 [in Persian]
- Moyo, Z. (2022). The fourth industrial revolution: a literature study of challenges associated with access to education in rural schools in Zimbabwe. *Journal of Educational and Social Research*, 12(3), 125.
- Penprase, B. E. (2018). The fourth industrial revolution and higher education. *Higher education in the era of the fourth industrial revolution*, 10(1), 978-981.
- Rasul, T., Nair, S., Kalendra, D., Robin, M., de Oliveira Santini, F., Ladeira, W. J., ... & Heathcote, L. (2023). The role of ChatGPT in higher education: Benefits, challenges, and future research directions. *Journal of Applied Learning and Teaching*, 6(1), 41-56.
- Singaram, S., Mayer, C. H., & Oosthuizen, R. M. (2023). Leading higher education into the fourth industrial revolution: an empirical investigation. *Frontiers in psychology*, 14, 1242835.

- Smith, L. (2023). Implications of the Fourth Industrial Revolution on Higher Education. In *The 10th Focus Conference (TFC 2023)*, 354-366.
- Strauss, A., & Corbin, J. (2014). *Basics of qualitative research: Grounded theory procedures and techniques* (B. Mohammadi, Trans.). Tehran: Institute for Humanities and Cultural Studies. (Original work published 1990).
- Tarine, H., & Mehralizadeh, Y. (2023). *Higher education transformations and the Fourth Industrial Revolution. Academic Management*, 5(2), 122–153 [in Persian]