Article

Digital Transformation of Education: The Phenomenon, Causes and Mitigation Strategies of the Digital Divide among University Teachers

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Abstract: In the context of the in-depth implementation of the national strategies of "Digital China" and "Education Digitalization", the digital transformation of higher education has become an inevitable and long-term trend. University teachers, as the core agents of this transformation, are increasingly confronted with an internal digital divide that has evolved from a simple disparity in hardware access to a multidimensional gap in sensitivity, application, and innovation capabilities. This internal divide has emerged as a key bottleneck restricting the depth, equity, and quality of digital reform in universities. Focusing on university teachers as a specific professional group, this paper systematically examines the manifestations of the digital divide across multiple dimensions, including digital awareness, mastery of digital tools, integration of technology into teaching practice, innovative pedagogical applications, and adherence to digital ethics. It further explores the complex and interrelated causes of these disparities from individual, organizational, institutional, and broader environmental perspectives. Drawing on national strategic requirements and the regional development context of the Hainan Free Trade Port, the study proposes a systematic mitigation framework encompassing top-level design, precise and differentiated support mechanisms, the cultivation of a supportive digital culture and ecology, and cross-level collaborative innovation. The aim is to provide robust theoretical references and operable practical pathways for effectively empowering university teachers and promoting connotative, equitable, and high-quality development of higher education through sustained digital transformation.

Keywords: digital transformation of education; university teachers; digital divide; digital literacy; teacher professional development; higher education policy

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1. Introduction

Digital technologies, including artificial intelligence, big data, and cloud computing, are profoundly reshaping the global higher education ecosystem. These advancements are driving changes with unprecedented depth and breadth. In this context, China has strategically prioritized the digitalization of education as a key initiative to forge new developmental pathways and establish competitive advantages. The digital transformation of higher education has emerged as a central force in achieving educational modernization and fostering the development of a robust educational system. This transformation transcends the mere integration of technology into education; it represents a comprehensive and systemic shift that encompasses educational philosophies, teaching methodologies, governance frameworks, and campus cultures. Within this transformative process, the role of university teachers has evolved significantly [1, 2]. They are no longer confined to being mere transmitters of knowledge but have assumed multifaceted roles as designers, facilitators, and collaborators in the learning process [2, 3]. The digital literacy and innovative capabilities of these educators

are pivotal in determining the success or failure of this transformation, as they directly influence the effectiveness of digital integration in higher education [4].

The teaching community, however, is far from uniform in its ability to adapt to digital transformation. Significant disparities exist among educators in their acquisition, adoption, application, and innovation capabilities concerning digital technologies, leading to the emergence of a "digital divide" within this group. Earlier discussions on the digital divide primarily addressed the "first gap," which pertains to disparities in access to hardware and network infrastructure. Contemporary research, however, has shifted its focus to the "second gap," which involves differences in digital skills, knowledge, and practical application, as well as the "third gap," which relates to the creative production of digital resources, critical thinking, and active engagement. For university educators, this divide is not limited to individual skill levels but also has far-reaching implications for the equity of teaching quality, the potential for academic innovation, and the overall effectiveness of digital transformation initiatives [5]. In the specific context of the development of the Hainan Free Trade Port, higher education institutions have been tasked with aligning with international standards and contributing to regional high-quality development. This mission underscores the urgent need for a highly skilled teaching workforce capable of leveraging digital technologies to enhance international education, drive scientific research innovation, and deliver impactful social services [6, 7]. Consequently, it is imperative to accurately identify the manifestations of the digital divide among university educators, delve into its root causes, and develop a comprehensive system of strategies to mitigate its effects [8]. Such efforts hold significant theoretical and practical value in advancing the digital transformation of higher education.

2. Multi-Dimensional Manifestations of the Digital Divide among University Teachers

The digital divide among university teachers has transformed into a sophisticated and intricate phenomenon, encompassing multiple dimensions that reflect disparities in access, usage, and integration of digital technologies. These disparities are not limited to physical access to devices or internet connectivity but extend to variations in digital literacy, pedagogical adaptation, and the ability to leverage technology for academic and professional growth. Such complexities highlight the need for a comprehensive understanding of the underlying factors contributing to these gaps, as well as the development of targeted strategies to address them effectively within the educational ecosystem [1, 9].

2.1. Digital Awareness and Acceptance Gap

Some educators demonstrate a deep understanding of the critical importance and pressing need for digital transformation, actively engaging with new technologies and exploring innovative teaching methodologies [8, 10]. These individuals recognize the potential of digital tools to enhance educational outcomes and streamline processes [9, 11]. Conversely, other educators face significant challenges, including technical apprehension, resistance to change, or a reliance on established practices, often perceiving traditional methods as more dependable [12]. This reliance can stem from a belief that digital technologies are unnecessary or overly complex, leading to the perception that they are an additional burden rather than a beneficial resource. Consequently, this divergence in attitudes has resulted in a clear distinction between those who enthusiastically adopt digital innovations and those who remain hesitant or resistant, creating a notable gap in digital awareness and acceptance within the educational community.

2.2. Gap in the mastery and proficiency of digital tools

Basic operational skills encompass varying levels of proficiency in utilizing general office software, conducting online information searches, and processing multimedia materials. While some individuals demonstrate a foundational ability to perform these

tasks, others exhibit advanced capabilities that enable them to optimize workflows and enhance productivity. The disparity in skill levels highlights the need for targeted training programs to bridge these gaps and ensure a more uniform standard of digital competence across different user groups. By fostering a deeper understanding of these tools, individuals can better adapt to the evolving demands of digital environments and contribute more effectively to their respective fields [7, 13].

Professional teaching tools present a wide spectrum of mastery levels, ranging from basic functionalities to advanced applications. For instance, some educators are limited to fundamental tasks such as uploading files and conducting live video sessions, which primarily serve as technological substitutions for traditional methods. In contrast, more proficient users leverage these tools to create interactive learning experiences and analyze data to refine teaching strategies, embodying technological enhancement. This disparity underscores the importance of comprehensive training initiatives aimed at equipping educators with the skills needed to fully utilize learning management systems, online teaching platforms, smart classroom technologies, and virtual simulation software. Such efforts can significantly elevate the quality of education delivery and foster a more engaging and data-driven learning environment [14].

High-level digital literacy encompasses critical evaluation of information, creation of digital content, data-driven thinking, and adherence to digital security and ethical standards. However, there exists a notable divide in these competencies, with the majority of educators remaining at the stage of digital consumption, primarily utilizing existing resources without contributing to their development. The proportion of individuals who can be classified as digital designers or creators remains comparatively low, indicating a need for focused efforts to cultivate advanced skills in these areas [2, 4]. By promoting higher levels of digital literacy, educators can transition from passive users to active contributors, thereby enhancing their ability to innovate and address complex challenges within digital ecosystems.

2.3. Gap in the ability to integrate technology and teaching

This represents a critical dimension of the challenges faced in modern education. Many educators continue to utilize technology in ways that merely replicate traditional classroom settings or facilitate basic interactions, without achieving a profound integration of technological tools with pedagogical strategies and subject-specific content frameworks [10, 11]. The gap is evident in several aspects: the ability to design personalized, inquiry-driven, and collaborative learning experiences leveraging digital tools; the effective use of learning analytics to enable process-oriented evaluations and targeted interventions; and the capacity to sustain student engagement and foster a sense of community in blended or fully online learning environments. While some educators have successfully pioneered innovative teaching approaches, such as flipped classrooms and online collaborative projects, the majority remain at an introductory stage where technology serves primarily as a supplementary aid rather than a transformative force in education [2, 7]. Addressing these challenges requires a systematic effort to enhance educators' competencies in integrating technology with pedagogy and content, ensuring meaningful and impactful learning experiences for students.

2.4. Gap in digital resource allocation and innovative application

The acquisition and utilization of resources reveal significant disparities in access to high-quality digital course materials, academic databases, and research computing tools. In regions such as Hainan, the ability to access advanced international digital educational resources, specialized software, and databases tailored to tropical disciplines may emerge as critical areas of inequality. These disparities could hinder the development of academic programs and research initiatives, particularly in fields requiring specialized digital tools [11]. Addressing these gaps is essential to ensure equitable access to resources that

support academic growth and innovation across diverse geographical and disciplinary contexts.

The integration of digital technology into teaching and research highlights substantial differences in the capacity for interdisciplinary innovation. This includes the development of virtual teaching environments, the advancement of digital scholarship in teaching and learning, and the application of big data and artificial intelligence tools to enhance research methodologies. These disparities contribute to the emergence of distinct groups, such as those leading innovation and those adopting technology at a more basic level. Bridging this divide requires targeted strategies to promote widespread adoption of advanced digital tools and foster a culture of innovation that supports both educators and researchers in achieving their academic objectives [12].

3. Analysis of the causes of the digital divide among university teachers

The emergence of the digital divide among university teachers stems from the interplay of various complex factors. To fully understand this phenomenon, it is essential to examine it through a multi-dimensional framework that encompasses individual, organizational, institutional, and environmental perspectives [7]. At the individual level, disparities in digital literacy, access to training, and personal motivation play a significant role. Organizational factors, such as resource allocation, administrative support, and workplace culture, further influence the extent of digital adoption. Institutional policies, including funding priorities and curriculum design, also contribute to the divide. Finally, broader environmental elements, such as technological infrastructure and socio-economic conditions, shape the overall landscape, necessitating a comprehensive and integrative approach to address these challenges effectively.

3.1. Individual level

Age and generational factors: While different generations of teachers experience distinct technological growth environments and exhibit varying levels of learning agility, these differences are not the ultimate determinants of their ability to adapt [2, 11]. Instead, the pivotal factors lie in individual attitudes and the willingness to engage in continuous learning. Teachers who actively embrace lifelong learning and maintain a positive outlook toward technological advancements are more likely to overcome generational disparities. This underscores the importance of fostering a mindset that values adaptability and personal growth, as these traits enable individuals to navigate the evolving educational landscape effectively [2].

Cognitive load and time conflict: Teachers often face significant challenges in balancing their professional responsibilities, which include teaching, conducting research, and participating in social service activities. These competing demands leave limited time for engaging with and mastering complex digital technologies. For younger educators, in particular, the pressure to excel in multiple areas can create a sense of being overwhelmed [8]. The cognitive demands associated with learning new technologies further amplify this burden, potentially leading to heightened levels of anxiety. Addressing these challenges requires institutional support, such as providing structured training programs and reducing non-essential workloads, to create an environment where educators can explore technological tools without undue stress [13].

Intrinsic motivation and beliefs: Teachers' intrinsic motivations, including their belief in the educational value of technology, self-efficacy, and willingness to innovate, serve as critical drivers for bridging the technological divide [6, 7]. These psychological factors empower educators to embrace change and integrate new tools into their teaching practices. However, resistance can arise from risk aversion and apprehension about altering established teaching habits. Such concerns may stem from uncertainties about the effectiveness of new methods or fear of failure. To mitigate these barriers, it is essential to cultivate a supportive environment that emphasizes the benefits of innovation and

provides opportunities for experimentation, thereby reinforcing confidence and reducing resistance to change.

3.2. Organizational and institution level

The support service system within institutions often operates in a fragmented manner, with departments such as teacher development centers, network information centers, and academic affairs offices functioning independently without sufficient coordination. Training programs predominantly emphasize technical tool operation, overlooking the integration of pedagogical strategies and innovative design thinking. This approach results in monotonous content that lacks continuity and fails to provide personalized support tailored to individual needs [4]. Furthermore, the evaluation and incentive mechanisms for educators remain misaligned with the demands of modern teaching practices. Current systems prioritize research outputs, such as academic papers and projects, while undervaluing the substantial efforts invested in teaching innovation, particularly in digital education. This imbalance diminishes motivation for educators to engage deeply in innovative teaching practices, as their contributions are rarely recognized or rewarded in ways that support career progression.

Disparities in digital infrastructure and cultural development significantly impact the teaching experience within institutions. The construction and maintenance of campus networks, smart teaching environments, and digital resource platforms play a crucial role in shaping educators' ability to deliver effective instruction. However, the absence of a robust culture that fosters innovation, encourages experimentation, and tolerates failure creates barriers to progress. Additionally, the lack of a cohesive digital teaching community hinders collaboration and the sharing of best practices among educators [5]. These challenges underscore the need for a more inclusive and supportive environment that promotes the integration of technology and collaborative efforts in teaching methodologies.

3.3. Macro-level systems and environmental aspects

A lack of sufficient policy coordination and resource investment remains a significant challenge [5]. While overarching frameworks and strategies exist at the national level, discrepancies emerge in the implementation of specific policies and the allocation of dedicated funding across different regions and institutions. These inconsistencies hinder the establishment of a unified and effective approach [5]. Furthermore, the development of a standardized framework and certification system for assessing and enhancing teachers' digital literacy remains in its infancy, leaving a gap in ensuring consistent professional development and competency across the educational sector [11].

Imbalances in regional and institutional development present notable barriers to equitable access to digital resources [10]. For instance, disparities exist among various types of higher education institutions, including central-affiliated universities, provincial key universities, local applied universities, and vocational colleges. These differences significantly influence the availability of digital educational resources and opportunities for collaboration with industries and enterprises [6]. Such disparities limit teachers' exposure to practical applications of advanced technologies, thereby restricting their ability to integrate these innovations effectively into their teaching practices.

The rapid pace of technological advancements creates a stark contrast with the slower progression of institutional training programs. Digital technologies continue to evolve at an unprecedented rate, introducing new tools and methodologies that could transform education [2]. However, the training programs designed to equip teachers with the necessary skills to utilize these technologies often lag behind. This gap is particularly evident in areas such as the educational applications of emerging technologies, including generative artificial intelligence. As a result, teachers face challenges in acquiring the knowledge and skills required to stay current with these advancements, which limits their

ability to fully leverage the potential of such innovations in their professional environments.

4. Systemic Strategies to Bridge the Digital Divide for University Teachers

Bridging the digital divide requires a comprehensive and structured approach that goes beyond isolated technical training sessions [14]. It necessitates the establishment of a robust and interconnected support framework that integrates multiple dimensions. This framework should include the cultivation of conceptual leadership to guide strategic thinking and innovation, the implementation of systematic institutional support to ensure resource availability and accessibility, the promotion of cultural immersion to foster adaptability and inclusivity in digital practices, and the adoption of evaluation-driven mechanisms to continuously assess and refine the effectiveness of these strategies. Such a holistic approach ensures sustainable progress in addressing the digital divide among university educators [4].

4.1. Strengthen top-level design and improve institutional guarantees

Universities should prioritize the integration of digital education strategies into their overarching development plans. This involves explicitly embedding the enhancement of teachers' digital competencies as a core objective [4]. Institutions must formulate detailed strategies that outline specific goals, actionable pathways, and clearly defined responsibilities for relevant stakeholders. By doing so, universities can ensure a systematic approach to fostering digital proficiency among educators, aligning institutional growth with the evolving demands of modern education [12].

To drive progress in teaching innovation, universities should reform their teacher evaluation and incentive systems. This entails introducing precise metrics and weighted indicators for assessing achievements in areas such as digital resource development, application, and pedagogical innovation [6]. These criteria should be integrated into processes like professional title evaluations, job appointments, performance reviews, and promotion decisions. Additionally, institutions should establish dedicated funds and reward mechanisms to support digital teaching advancements, thereby recognizing and valuing the intellectual contributions of educators in this domain. Such measures will encourage sustained engagement and creativity in digital education practices.

Developing a robust framework for teachers' digital literacy is essential for aligning educational practices with contemporary standards. Universities should design a comprehensive framework tailored to specific subjects and levels, taking into account both international benchmarks and the unique needs of their institutions [6]. Furthermore, the introduction of flexible certification systems, such as micro-certifications and digital badges, can serve as effective tools for documenting and acknowledging educators' progress in digital skill development. These certifications provide a dynamic and scalable approach to recognizing professional growth, fostering a culture of continuous improvement in digital education capabilities [8].

4.2. Build a precise and continuous teacher development support system

To address the diverse needs of educators, a structured approach to training should be implemented, emphasizing precision and specialization [13]. This involves tailoring programs to accommodate varying levels of digital proficiency, distinct disciplinary backgrounds, and unique professional growth objectives [12]. Training content should evolve from basic technical tool usage to the integration of teaching methodologies and innovative instructional design frameworks. Practical application can be enhanced through interactive formats such as workshops, salons, teaching consultations, peer observation sessions, and online communities. These methods foster active engagement and ensure that educators can effectively translate theoretical knowledge into practice, thereby enriching their pedagogical strategies and enhancing student learning outcomes.

A comprehensive support service platform should be established to streamline access to essential resources and guidance for educators. This platform would integrate technological tools, pedagogical strategies, and resource repositories, enabling teachers to efficiently address challenges, receive technical assistance, and refine their teaching designs [5]. Additionally, it could provide centralized access to digital teaching materials and consultation services [3]. In regions such as Hainan, there is potential to develop a shared repository of digital educational resources and case studies tailored to specialized fields, including tropical agriculture, advanced marine technologies, and international commercial law. Such initiatives would not only enhance resource accessibility but also foster collaboration and innovation within the educational community [4, 13].

Efforts should be made to cultivate leaders in digital teaching and foster collaborative communities among educators [8]. By identifying and supporting individuals who demonstrate exceptional innovation in digital pedagogy, these pioneers can take on leadership roles to inspire and guide their peers. Establishing virtual research spaces and interdisciplinary teacher learning communities can further facilitate collaboration, enabling educators to share experiences, exchange ideas, and co-create solutions to practical teaching challenges. These initiatives encourage a culture of continuous improvement and collective problem-solving, ultimately advancing the quality of education and fostering a dynamic professional environment.

4.3. Optimize infrastructure and create an innovative cultural ecosystem

Enhancing the usability and intelligence of digital infrastructure is a critical step toward fostering a modern educational environment [12, 13]. Efforts should focus on optimizing network systems, upgrading smart classrooms, and ensuring that digital tools are stable, user-friendly, and interconnected. In the context of universities in Hainan, there is significant potential to introduce, develop, and integrate advanced teaching and research digital platforms. These platforms should align with regional industrial application scenarios and support the broader goals of constructing a smart free trade port [5]. Furthermore, fostering a cultural atmosphere that encourages exploration and tolerates failure is essential. School management should actively support teaching innovation by creating an environment where experimental practices are not only accepted but also encouraged. This can be achieved by organizing teaching innovation competitions, showcasing exemplary case studies, and implementing teaching leave programs. Such initiatives emphasize the value of teaching excellence and provide educators with the confidence and resources needed to experiment with new methodologies, ultimately driving progress in educational practices [1, 9].

Facilitating collaborative empowerment between educational institutions and external entities is vital for advancing academic and practical capabilities. Establishing partnerships with leading technology enterprises, other universities, and research institutions can provide educators with invaluable opportunities to engage with cutting-edge technologies and participate in real-world projects. Such collaborations enable teachers to gain hands-on experience, broaden their digital perspectives, and enhance their practical skills [10]. Joint training programs and cooperative initiatives can further strengthen these partnerships, ensuring that educators remain at the forefront of technological advancements. By fostering these connections, schools can bridge the gap between theoretical knowledge and practical application, ultimately enriching the educational experience for both teachers and students [7].

4.4. Stimulate internal motivation and empower teachers' autonomous development

Emphasizing the importance of value guidance and belief formation is crucial in fostering a deeper connection between educators and their professional roles [3]. Development activities should highlight the transformative potential of technology in education, focusing on its ability to enhance students' core competencies and overall growth. By aligning technological integration with the broader mission of education,

teachers can cultivate a stronger sense of purpose and innovation. This approach not only reinforces their commitment to teaching but also inspires them to explore creative methods to address diverse educational challenges.

Providing personalized development paths and resources is essential for fostering teacher autonomy and professional growth [6]. Educators should be encouraged to establish digital development goals that align with their unique interests and the specific demands of their teaching environments [8]. By granting them the freedom to select learning resources and pathways, their engagement and motivation can be significantly enhanced. Advanced technologies, such as artificial intelligence, can play a pivotal role in this process by offering tailored recommendations for learning content and development plans. This individualized approach ensures that teachers receive support that is both relevant and impactful, enabling them to continuously refine their skills and adapt to evolving educational needs [2, 11].

Strengthening data empowerment and promoting evidence-based teaching improvement are vital for enhancing educational practices [2]. Teachers should be equipped with the skills to analyze and interpret data generated during the teaching process, enabling them to uncover meaningful insights about their instructional methods [2, 13]. By understanding the implications of this data, educators can engage in reflective practices and make informed adjustments to optimize their teaching strategies. This evidence-driven approach not only fosters professional growth but also provides immediate and tangible feedback on the effectiveness of technology integration [5]. Such positive reinforcement encourages teachers to embrace innovative tools and methodologies, ultimately contributing to a more dynamic and effective educational environment.

5. Conclusion

The essence of educational digital transformation lies in empowering individuals to adapt and thrive in a rapidly evolving technological landscape. Addressing the digital gap among university educators is pivotal to the success of this transformation. This study highlights that the digital divide extends across multiple dimensions, including awareness, digital literacy, integration depth, and innovative application. The root causes of these disparities stem from the intricate interplay of personal, organizational, and systemic factors. Consequently, fragmented or isolated interventions are insufficient; a comprehensive and systematic approach is required. Universities must adopt a strategic, long-term vision, treating the enhancement of educators' digital competencies as a foundational priority. By fostering institutional innovation, universities can inspire intrinsic motivation among educators. Additionally, the establishment of robust support systems can empower educators to integrate digital tools effectively into their teaching practices. Cultivating an innovative cultural ecosystem further supports their professional growth, transforming challenges posed by the digital divide into opportunities for advancement. For regions at the forefront of reform and development, higher education institutions have a unique responsibility to lead this transformation. They must not only address internal disparities but also focus on nurturing educators with global perspectives, advanced digital teaching skills, and cross-cultural competencies. Such efforts will ensure a well-prepared workforce capable of contributing to regional and global educational advancements. By prioritizing these objectives, higher education can serve as a catalyst for broader societal progress, offering innovative solutions and insights that extend beyond local contexts to influence global educational practices. This comprehensive approach underscores the transformative potential of digitalization in higher education, paving the way for a more inclusive and interconnected academic future.

References

1. J. Sjöberg and P. Lilja, "University teachers' ambivalence about the digital transformation of higher education," *International Journal of Learning, Teaching and Educational Research*, vol. 18, no. 13, pp. 133-149, 2019.

2. A. Alhubaishy and A. Aljuhani, "The challenges of instructors' and students' attitudes in digital transformation: A case study of Saudi Universities," *Education and Information Technologies*, vol. 26, no. 4, pp. 4647-4662, 2021.
3. E. Mondragon-Estrada, I. Kirschning, J. A. Nolazco-Flores, and C. Camacho-Zuñiga, "Fostering digital transformation in education: technology enhanced learning from professors' experiences in emergency remote teaching," in *Frontiers in Education*, vol. 8, p. 1250461, Aug. 2023.
4. O. V. Yureva, L. A. Burganova, O. Y. Kukushkina, G. P. Myagkov, and D. V. Syradoev, "Digital transformation and its risks in higher education: Students' and teachers' attitude," *Universal Journal of Educational Research*, vol. 8, no. 11B, pp. 5965-5971, 2020.
5. F. J. García-Peñalvo, "Avoiding the dark side of digital transformation in teaching. An institutional reference framework for eLearning in higher education," *Sustainability*, vol. 13, no. 4, p. 2023, 2021.
6. A. Balyer and Ö. Öz, "Academicians' Views on Digital Transformation in Education," *International Online Journal of Education and Teaching*, vol. 5, no. 4, pp. 809-830, 2018.
7. M. Akour and M. Alenezi, "Higher education future in the era of digital transformation," *Education Sciences*, vol. 12, no. 11, p. 784, 2022.
8. D. M. Voronin, V. G. Saienko, and H. V. Tolchieva, "Digital transformation of pedagogical education at the university," in *International Scientific Conference "Digitalization of Education: History, Trends and Prospects" (DETP 2020)*, pp. 757-763, May 2020.
9. M. Bond, V. I. Marín, C. Dolch, S. Bedenlier, and O. Zawacki-Richter, "Digital transformation in German higher education: student and teacher perceptions and usage of digital media," *International Journal of Educational Technology in Higher Education*, vol. 15, no. 1, p. 48, 2018.
10. V. N. Kormakova, A. G. Klepikova, M. A. Lapina, and J. Rugelj, "ICT competence of a teacher in the context of digital transformation of education," in *CEUR Workshop Proceedings*, vol. 2914, pp. 138-150, Aug. 2021.
11. L. Aleksieva, "Preparing pre-service teachers for the digital transformation of education: Exploring university teacher educators' views and practical strategies," *Education Sciences*, vol. 15, no. 4, p. 404, 2025.
12. J. M. Tsarapkina, A. V. Anisimova, B. D. Gadzhimetova, A. M. Kireycheva, and A. G. Mironov, "The impact of digital education transformation on technical college teachers," in *Journal of Physics: Conference Series*, vol. 2001, no. 1, p. 012030, Aug. 2021.
13. J. Paños-Castro, O. Korres, I. Iriondo, and J. Petchamé, "Digital transformation and teaching innovation in higher education: A case study," *Education Sciences*, vol. 14, no. 8, p. 820, 2024.
14. M. Romero, T. Romeu, M. Guitert, and P. Baztán, "Digital transformation in higher education: the UOC case," in *ICERI2021 Proceedings*, pp. 6695-6703, 2021.