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DIGITAL COMPETENCY AND PEDAGOGICAL INNOVATION: INSIGHTS FROM A SYSTEMATIC REVIEW

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Keywords	***Abstract***
Digital Competency, Higher Education, Pedagogical Innovation, Technology Integration.	Higher education institutions now demand digital competence from students as it affects their educational methods and student involvement. The research analyses the base features of digital competency while examining teacher difficulties when adding digital resources to educational environments as well as the advantages digital literacy brings to educational advancement. The study demonstrates through literature review that digital integration requires essential knowledge of technology and teaching combined with ethical practices along with cyber security understanding. The research indicates that digital competency supports interactive training and student-oriented education yet insufficient infrastructure combined with institutional shortcomings and restricted staff development barriers its universal acceptance. The research demands standardized assessment frameworks for digital competency and urges researchers to investigate the prolonged effects digital competency has on teaching effectiveness. Better digital transformation outcomes for higher education will result when structured policies complement investments in digital infrastructure and

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	training faculty members with new skills.

1. INTRODUCTION

Higher education is no different: it has been transformed by the rapid digitalization of society into such a degree where a digital competency needs to be integrated into every teaching and learning process. Today in the 21st century digital competency (ability to use digital technologies effectively and critically with a purpose of performing communication, problem solving and innovation) has become a necessary skill both for educators and students (Zakharevych & Hryhorenko, 2024). With the increasing reliance on Information and Communication Technologies (ICT) in education, it is natural for digital proficiency to be regarded as a crucial enabler of learning environments that enable effective learning and to achieve better results. The need to make students digital literate, think critically, and be able to negotiate a changing digital labour market (Lucas et al, 2022) is driving this transformation.

Online and hybrid learning models prove to be the strength and weakness of digital pedagogy during the COVID 19 pandemic. They show that although educators have strong content knowledge, technological proficiency and integration of digital tools in their online instruction have gaps, which affect the effectiveness (Nupen & Jagernath, 2024). Technology integration is guided by such digital frameworks as TPACK model and SAMR framework to prompt educators towards meaningful technology integration, to develop analytical thinking, active learning and assessment strategies (Pham et al., 2024). Nevertheless, the key challenges are the lack of digital infrastructure, a shortage of professional development opportunities, as well as the lack of change to pedagogy.

In the face of the Fourth and Fifth Industrial Revolution, higher education is coming into alignment with the demands of the world of education, therefore necessitating the building of digital competency in educators who maintain a sustainable innovation in education. This will fill in the gaps, if not closed, offered by the status; helping digital transformation translate into good pedagogy and better learning outcomes. This review investigates how digital competency influences pedagogical innovation, focusing on higher education settings. The study seeks to address the following research questions:

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1. *What are the key components of digital competency in higher education?*
2. *What are the challenges educators face in integrating digital tools into teaching practices in higher education?*
3. *How does digital competency facilitate pedagogical innovation in higher education?*
4. *What are the gaps in the current literature on digital competency and teaching pedagogy in higher education?*

2. METHODOLOGY:

Search Strategy:

The Systematic Search was conducted across the Multiple Databases such as ProQuest, J-Gate, Elsevier Mendeley and Google Scholar Search Engine. The search term Included "Digital competency in higher education", "Pedagogical innovation and technology in higher education", "Digital skills and teaching effectiveness in higher education", "Higher education and digital tools"

***Inclusion & Exclusion Criteria*:**

To ensure relevance and quality, inclusion and exclusion criteria were established. The inclusion criteria required that studies be published between 2020 and 2025, be peer-reviewed, focus on higher education settings such as engineering, nursing, and business management, and examine the relationship between digital competency and teaching pedagogy. Studies focusing solely on K-12 education, non-English articles, and conference proceedings without full texts were excluded. The selection process involved an initial title and abstract screening, followed by a full-text review. Data extraction focused on study objectives, methodology, key findings, and implications for teaching and learning. The findings were synthesized to provide insights into current trends, gaps, and future research directions in digital competency within higher education.

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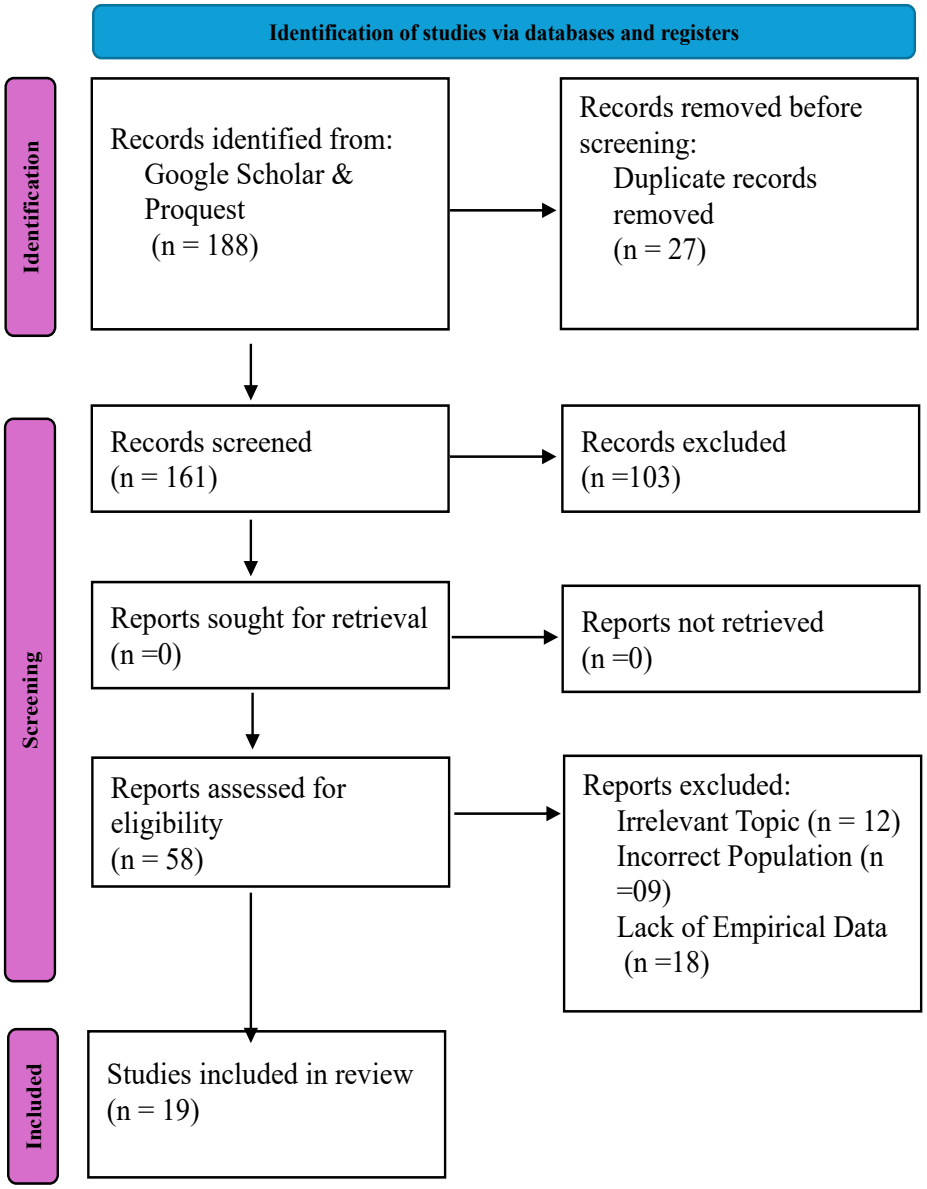

Figure 1: Prisma Flowchart

All reference articles identified for the Systematic Literature Review (SLR) exist as 100% peer-reviewed journal publications. Digital competency in higher education stands as the main focus of 80% of the selected articles that either explore assessment frameworks (Jorge-Vázquez et al., 2021) or examine pedagogical integration (Tondeur et al., 2023). Empirical research represents 70% of the total articles with both quantitative survey methods and quantitative statistical analysis and qualitative case study and conceptual modeling approaches (Iqbal et al., 2024; Sánchez-Macías et al., 2023). The

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studies encompass global perspectives to a degree of 60% although developing nations receive attention from 40% of the total publications (Vieira et al., 2023). Most studies within this literature review examine digital transition during the COVID-19 pandemic using sources published between 2020 and 2024 (Hatos et al., 2022).

3. KEY COMPONENTS OF DIGITAL COMPETENCY IN HIGHER EDUCATION

Technological and pedagogical competencies in digital competency in higher education are just one of its components. Technical proficiency according to Geovanny et al. (2023) refers to the ability of teachers/expert to use digital tools such as learning management systems, collaborative platforms and multimedia resources and other tools. Secondly, pedagogical skills refer to the skills which can be used to integrate these tools in teaching strategies and in the process enhance student engagement and learning outcomes (Jorge-Vázquez et al., 2021). Also, data privacy, digital cybersecurity awareness as well as digital citizenship are other digital ethics responsible for use of technology responsibly (Rahiman & Kodikal, 2023). The required competencies for educators whereby an Education 4.0 (Miranda et al., 2021) can be fostered in a digitally enriched learning environment.

4. CHALLENGES IN INTEGRATING DIGITAL TOOLS INTO TEACHING PRACTICES

Integrating digital tools in higher education presents the educators with many hurdles, including the absence of technical skills, unwillingness to change and lack of institutional backing. The topic of limited training opportunities on technological advancements as experienced by many educators was pointed out by Hatos et al. (2022). Finally, adapting to change is also complicated by a penchant for inertia to change from traditional 'teaching methods' (Pham et al., 2021). Furthermore, institutional constraints including inadequate allocation of funds to digital infrastructure as well as lack of access to reliable internet tend to block seamless technology integration (Rodríguez-Abitia et al. 2020). Therefore, professional development programmes and institutional policies aimed to facilitate digital competency growth (Iqbal et al., 2024) these barriers need to be addressed.

5. PEDAGOGICAL INNOVATION IN HIGHER EDUCATION

Digital competency is in significantly contributing to the pedagogical innovation through providing medium for interactive, student centered learning experiences. According to Tokovska et al. (2022), digitally competent teachers can use adaptive learning technologies and virtual simulations including gamification to improve the student engagement. Personalised learning pathways developed by the use of artificial intelligence powered tools geared toward various student needs is presented by (Rahiman & Kodikal, 2023). Additionally, digital tools allow for collaborative learning that take down the lines dividing a traditional classroom forgiving a global exchange of knowledge (Pyörälä and Myyry, 2023). For that purpose, it is very critical to support digital competency development in educators in order to stimulate the instructional innovation and enhance student learning outcomes.

Robin Joseph Sera & Shobha (2026). Digital Competency and Pedagogical Innovation: Insights from a Systematic Review. International Journal of Multidisciplinary Research & Reviews, 5(7),56-64.

6. GAPS IN THE CURRENT LITERATURE ON DIGITAL COMPETENCY AND TEACHING PEDAGOGY

Despite a wealth of research on digital competency, our understanding of how they affect the teaching pedagogy are still in gaps. Sánchez-Macías et al. (2023) explain that there is no standardized framework for the assessment of educators' digital competencies in different higher education institutions. Furthermore, existing studies frequently disregard the specific difficulties confronted by lecturers in the setting of low source of revenue (Tondeur et al., 2023). Additionally, very little research has been done into long term effects of digital competency on teaching effectiveness and student success (Vieira et al., 2023). Gaps in the future research are addressed with longitudinal studies and, more importantly, research in diverse educational contexts to build comprehensive, applicable to the global digital competency models.

7. RESULTS:

Digital competency serves as a fundamental factor that improves the educational experiences of teaching and learning within higher education institutions. Digital proficiency in educators allows them to implement interactive technologies and thereby increase student engagement and knowledge retention according to Geovanny et al. (2023) and Jorge-Vázquez et al. (2021). Several barriers prevent total digital tool implementation in educational institutions including institutional limitations and untrained professionals along with resistance to digital transformation (Hatos et al., 2022; Pham et al., 2021; Rodríguez-Abitia et al., 2020). The evidence shows educators need specialized training programs and supportive administrative strategies to build their digital competence and italo-qbal et al. 2024; Sánchez-Macías et al. 2023 showed similar findings

The integration of adaptive learning technologies with gamification and virtual simulations becomes possible through digital competency which advances educational innovation as explained in the research by Tokovska et al. (2022) and Rahiman and Kodikal (2023). Artificial intelligence-based educational tools enhance student personalize learning while meeting various student educational needs (Miranda et al., 2021). Through digital tools educational institutions can achieve collaborative learning which builds an interconnected educational environment that promotes inclusion (Pyörälä & Myyry, 2023).

Minimal research on digital competency assessment standardization and its prolonged effects on teaching quality continues to exist in academic literature (Tondeur et al., 2023; Vieira et al., 2023). The Digital strategies implemented by educational institutions meet different levels of success because schools have varying access to digital infrastructure (Rodríguez-Abitia et al., 2020). The assessment standardization and worldwide application of digital competency needs longitudinal assessments and studies in different regions with the development of universal frameworks (Sánchez-Macías et al., 2023).

Robin Joseph Sera & Shobha (2026). Digital Competency and Pedagogical Innovation: Insights from a Systematic Review. International Journal of Multidisciplinary Research & Reviews, 5(7),56-64.

8. CONCLUSION:

Modern higher education depends on digital competency because this competency affects both teaching methods and student interactions while determining academic results (Miranda et al., 2021; Rahiman & Kodikal, 2023). Many educational professionals encounter three main challenges: insufficient training for digital skills and weak institutional backing as well as uneven technological resources (Hatos et al., 2022; Rodríguez-Abitia et al., 2020). Strategic policies along with training programs for faculty and technological investments should be devised to achieve smooth integration of digital tools within higher education (Iqbal et al., 2024). Further research requires longitudinal evaluation of digital competency effects on teaching quality over extended periods according to Vieira et al. (2023). Increasing research on underdeveloped regions allows the creation of universal digital competency assessment frameworks (Tondeur et al., 2023). New research about emerging technologies such as artificial intelligence and virtual reality needs to examine their influence on higher education learning environments (Tokovska et al., 2022). Through multidisciplinary collaboration between education researchers and professionals in psychology and technology experts gain deeper understanding of how digital competency supports teaching quality and student academic achievement results (Geovanny et al., 2023; Pyörälä & Myyry, 2023).

Disclosure of Generative AI Use

This manuscript was prepared with assistance from artificial intelligence tools to enhance organization, clarity, and synthesis of literature.

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CONFLICTS OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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