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The Phygital Learning Journey: A Service Research Perspective

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"Technology will not replace great teachers, but technology in the hands of great teachers can be transformational." - George Couros

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Introduction

In the contemporary landscape of higher education, the convergence of physical and digital learning environments is reshaping pedagogical models and institutional strategies. This hybridization process (Riva & Wiederhold, 2022), transcends the mere juxtaposition of offline and online modalities, instead establishing a paradigm where learning journeys unfold seamlessly across classrooms, digital platforms, and AI-driven environments.

The COVID-19 pandemic accelerated the adoption of hybrid and blended learning (Raes et al., 2020), pushing universities to experiment with new forms of engagement and inclusivity. However, as Bond et al. (2021) argue, the rapid shift also exposed issues of inequality, accessibility, and the erosion of human-centered learning. Higher education institutions (HEI) are now challenged to design purposeful learning ecosystems that combine the efficiency of digital tools with the irreplaceable social and cognitive benefits of in-presence interaction (Redecker, 2023). The phygital approach draws inspiration from the extensive literature on the phygital customer journey (Batat, 2024; Del Vecchio et al., 2023), especially in higher education (Mele & Russo Spena, 2019; Mele, Russo Spena, Marzullo, & Di Bernardo, 2023) where the integration of multiple touchpoints into a coherent, experiential continuum is emphasized.

Drawing on service research (Grönroos, 1984; Vargo & Lusch, 2008), customer journey studies (Lemon & Verhoef, 2016), and higher education scholarship (Kuh, 2003), this thesis positions phygital learning as an ecosystemic innovation that requires conceptualizations, frameworks, and governance models. Specifically, this thesis frames the student learning experience within a phygital learning journey, unfolding across Massive Open Online Courses (MOOCs), digital platforms, social media, and AI-enabled services. In particular, the emergence of generative AI (Gen-AI) (Kasneci et al., 2023; Zawacki-Richter, 2023) is radically reshaping MOOCs and digital education, offering opportunities for personalization and adaptive learning, while raising questions of academic integrity, equity, and the role of

educators (Bond et al., 2021). As Redecker (2023) suggests, HEI is now called to rethink its pedagogical models in order to integrate strategies that bridge the gap between digital efficiency and the irreplaceable value of physical presence.

Unlike traditional educational models primarily structured around in-person lectures, HEIs are progressively adopting hybrid and blended learning methodologies, aiming to achieve sustainability and create shared value for various stakeholders. In this perspective, the generation of social value is no longer viewed as an ancillary activity but rather as an essential component of the institutional mission: hybrid models are designed also to reduce the environmental impact of educational delivery (for example, by minimizing home-to-campus commuting) and to develop sustainability competencies among students (Versteijlen & Wals, 2023). For instance, a study highlighted that hybrid learning models can expand educational offerings and contribute to sustainable development goals by integrating digital resources with conventional education approaches (Martins, et al., 2025).

The rapid digital transformation of higher education has led to the emergence of the so-called “phygital learning”, a new learning paradigm that combines the physical and digital dimensions of teaching (Vate U-Lan et al., 2016). The concept of 'phygital' goes beyond the simple integration of online and offline modalities, aiming instead to design hybrid experiences that foster deeper engagement, personalization, and value co-creation between students, educators, and institutions (García-Peñalvo, 2021). The systematic integration of digital environments and online resources enhances the accessibility and inclusivity of learning pathways, effectively addressing the needs of an increasingly diverse student population (Lomellini et al., 2025). These approaches contribute to the development of sustainable curricula and the digitalization of higher education, positively impacting student performance and innovative capacity, as highlighted by studies on sustainable digital transformation in the university sector (Shenkoya & Kim, 2023).

According to Raes et al. (2020), the adoption of hybrid and blended learning approaches accelerated during the COVID-19 pandemic, reshaping expectations and practices in universities worldwide. The integration of advanced technologies

from the fourth industrial revolution, such as artificial intelligence and augmented reality, is transforming teaching and learning practices, aligning with the principles of Education 4.0. These technologies facilitate the creation of smart campuses and support the development of living labs that bridge skills gaps and enhance students' learning experiences.

As proposed by Davidson (2023), abductive thinking within Education 4.0 implies the integration of systems and design thinking into transdisciplinary studies to address contemporary problems (Davidson et al., 2023). In this sense the student/user learning journey in HEI can now be described as a phygital learning journey, a continuous process that develops across classrooms, learning platforms, MOOCs, social media, and AI-driven environments (Giovannella & Roccasalva, 2024). At the same time, MOOCs have become a cornerstone of digital education in HEIs, offering scalability, flexibility, and access to diverse audiences (Zawacki-Richter, 2023). The recent breakthrough of Gen-A such as large language models, is now reshaping MOOCs and other digital learning formats (Kasneci et al., 2023).

The primary objective of this research is to construct and validate a novel conceptual framework for phygital learning, grounded in a synthesis of service-dominant logic (Vargo & Lusch, 2008), value co-creation (Prahalad & Ramaswamy, 2004), and established pedagogical theories of situated and experiential learning (Lave & Wenger, 1991; Kolb, 2014) though a systematic literature review. This framework reframes the educational experience away from a simple delivery model and towards a dynamic service ecosystem. In this ecosystem, educational value is not passively received by learners but is continuously co-created through the interactions between institutions, instructors, learners, and an integrated architecture of technologies. The model posits that the effective orchestration of systems of insights (AI-driven learning analytics, biometric sensors) and systems of engagement (AR/VR, IoT-enabled spaces) is the core mechanism that enables the design of personalized, adaptive, and authentic learning journeys that seamlessly bridge formal and informal contexts (Mele & Russo Spena, 2022).

Following the impetus of COVID-19, another acceleration in the adoption of phygital learning models is driven by Generative AI (Kasneci et al., 2023; Zawacki-

Richter, 2023) which offers additional opportunities for personalization and adaptive learning. However, it also raises significant questions regarding academic integrity, equity, and the evolving role of educators. A systematic understanding of these dynamics is essential for maximizing the benefits of phygital learning while mitigating potential risks.

Accordingly, this thesis is guided by three main research questions:

RQ1: How can we define the phygital learning journey in higher education institutions?

RQ2: What are the essential elements for designing a phygital learning journey within universities?

RQ3: How can higher education institutions integrate the phygital learning journey into the university ecosystem, making it a best practice with valuable outcomes?

This introduction sets the stage for the organization of the thesis into five chapters. Chapter 1 delineates the research problem, objectives, and literature gap. In this chapter, the research aims to highlight a gap in the existing literature that has motivated to explore a well-known concept, the "phygital journey," within a novel context outside its traditional domain. This exploration leads me to propose that if such a transfer is feasible, it may even pave the way for the development of a new concept: "phygital learning."

Chapter 2 answers the first research questions, through a bibliometric analysis, that will be conducted to systematically explore the existing body of literature on the topic. The approach is chosen because it allows for the identification of key authors, trends, and conceptual frameworks relevant to the definition of "phygital learning." The bibliometric method provides both quantitative and qualitative insights, facilitating a comprehensive understanding of the current research landscape. The analysis will be structured according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) model, which ensures transparency, rigor, and reproducibility in the review process (Moher, Liberati, Tetzlaff, Altman, & PRISMA Group, 2009). This systematic approach will support the development of a well-founded conceptualization grounded in the existing academic evidence. By analyzing the existing publications through a systematic literature review, it is possible to identify a set of recurring characteristics, concepts, and definitions that

contribute to understanding and formalizing a complex or still-evolving phenomenon. The process enables the development of a shared description, the identification of key criteria, and the reduction of ambiguities, thereby contributing to a more precise and commonly accepted definition of the phenomenon itself.

Chapter 3 presents a detailed analysis of the methodology adopted for the study, with particular attention to the rationale of the qualitative research design and the data collection methods employed. This chapter describes the research environment through an in-depth examination of two case studies: SHARE Africa and EURIDICE, both of which serve as phygital contexts for the analyses conducted. To facilitate qualitative analysis, a questionnaire was developed to collect information through interviews with various stakeholders involved in the projects, including students, instructional designers, faculty members, and staff from innovative learning centers. This approach aims to gather a variety of perspectives and insights related to the roles of the participating actors within a phygital learning process. The questionnaires provided quantitative support, contributing to the validation of interpretations and enabling the collection of data from a broader sample, thereby enhancing the overall robustness of the findings. The combination of qualitative and quantitative techniques within the case studies offers a well-balanced and integrated framework for exploring the role and characteristics of phygital ecosystems in the context of higher education. Following this analytical phase, it became possible to develop a conceptual model that could serve as a foundation for a series of guidelines aimed at the creation and design of phygital learning models.

Chapter 4 analyzes the responses to questionnaires and interviews concerning the various actors involved in a Phygital Learner Journey. This strategy broadens the empirical foundation and strengthens the validity of the findings (Creswell & Plano Clark, 2018). The combination of interviews, questionnaires, and log data provides an additional criterion for validating interpretations. Considering this triangulation of qualitative, quantitative, and digital trace data, the chapter presents the results, highlighting the sequence of phases that comprise a Phygital Learning Journey and specifying the objectives, touchpoints, and expected outcomes for each phase.

From a theoretical perspective, this approach allows for the interpretation of user behaviors within phygital learning ecosystems, conceiving them as part of smart learning ecosystems where the physical and digital dimensions intertwine continuously (Giovannella & Roccasalva, 2023). In line with recent research on Hybrid Learning Spaces and Phygital Learning, these environments are described as contexts in which design integrates spaces, technologies, and teaching practices to promote inclusion, motivation, and the development of transversal skills (Filippone & De Carlo, 2025; Chaturvedi et al., 2021). The analysis of responses from questionnaires and interviews supports the development of a conceptual model of the Phygital Learner Journey, designed as a reference framework for defining operational guidelines. This model aims to provide phygital ecosystem designers with a useful framework for understanding the roles and characteristics of these environments in higher education contexts, guiding them towards more informed, inclusive, and evidence-based teaching practices.

Chapter 5 aims to address the third research question. By highlighting the impact of various design choices on achieving a delicate balance between physical, digital, and AI-driven practices, while fostering both value co-creation and academic integrity. In the last chapter of the thesis, I drafted practical guidelines for designing phygital experiences in the field of education, through a sample framework of the elements and phases necessary to create the phygital learning journey.

Finally, the conclusions consider the implications of these findings for researchers and professors, university leaders, instructional designers, and technology innovators, while acknowledging the inherent limitations of the studies undertaken.

Table 1: Overview of Thesis chapters

	Phygital Customer Journey in Education: **How can we define the phygital learning journey in higher education institutions?** (RQ1)	Phygital Learning and process: **What are the essential elements for designing a phygital learning journey within universities?** (RQ2)	Phygital Learning in HEI Context: **How can HEIs integrate the phygital learning journey into the university ecosystem, making it a best practice with valuable outcomes?** (RQ3)
Research design	Review	Review	Qualitative
Main theoretical lenses	Phygital Customer Journey	Service Innovation	Empirical research
Methodology	Bibliometric analysis (performance analysis and science mapping techniques) and content analysis of clusters	Bibliometric analysis (performance analysis and science mapping techniques) and content analysis of clusters	Action Research
Data	Documents from Web of Science database	Documents from Web of Science database	Participant observation Semi-structured interviews
Focus	A multidimensional framework for educational service design.	The impact of the phygital learning journey on the higher education system and its stakeholders	A reference framework for recognizing and designing phygital learning pathways within higher education institutions.

Source: authors elaboration

The overall contribution of this thesis is threefold.

First, the work aims to formalize phygital learning as an independent and recognizable area of research, positioning it at the intersection of studies on mixed physical-digital environments and smart learning ecosystems. Building on early

contributions that define phygital learning as a 'smart' ecosystem capable of balancing digital content and in-person experiences (Vate-U-Lan, Masouras, & Quigley, 2016), as well as the research line that interprets learning ecosystems as interconnected networks of physical and virtual spaces focused on the quality of the educational experience (Giovannella, 2014), this thesis proposes an operational definition of phygital learning, a reference taxonomy, and a systematic review of the state of the art.

Second, the thesis develops a theoretical model that interprets phygital environments as service innovation ecosystems, integrating contributions that describe phygital learning ecosystems and people-centered smart learning ecosystems as contexts designed to support well-being, agency, and processes of 'learning by being' beyond 2030 (Giovannella & Roccasalva, 2023; Giovannella & Roccasalva, 2024). The model elucidates actors, resources, processes, and value creation mechanisms, translating into a set of design principles and guidelines for the design, implementation, and evaluation of phygital ecosystems in higher education contexts, in line with the perspective that sees smart learning ecosystems as engines of green and digital transition (Giovannella, 2024).

Third, by addressing systemic challenges such as data governance, artificial intelligence ethics, and faculty professional development, the thesis proposes a strategic framework aimed at the educational sector, designed to align investments and institutional practices with both the European vision for the Digital Decade—which sets specific targets for digital skills, infrastructures, and the digitalization of public services by 2030 (European Commission, 2021; European Parliament & Council of the European Union, 2022)—and with Sustainable Development Goal 4 (SDG 4) of the 2030 Agenda, dedicated to ensuring quality, inclusive, and equitable education and lifelong learning opportunities for all (United Nations General Assembly, 2015; UNESCO, 2019).

In this regard, the thesis not only seeks to fill a gap in the literature on phygital learning and smart learning ecosystems but also aims to provide educators, instructional designers, and policymakers with theoretical and operational tools to transform phygital learning into a powerful, equitable, and sustainable driver of

educational innovation in the 21st century, in line with the most recent evidence on the 'phygital' future of higher education (Batista-Toledo & Gavilan, 2025).

CHAPTER I:

THEORETICAL FOUNDATIONS AND PHYGITAL LEARNER JOURNEY

SUMMARY**:** 1.1 Higher education as a service ecosystem – 1.2 Service-Dominant Logic and value co-creation in learning services – 1.3 Phygital learning as service innovation – 1.4 The Phygital Learner Journey: touchpoints, interactions, value outcomes – 1.5 Challenges, ethics, and governance in phygital ecosystems – 1.6 Conceptual model and propositions

1.1 Higher education as a service ecosystem

In recent years, the conceptualization of higher education has transitioned from traditional, institution-centered models to a more dynamic systemic view, often described as a "service ecosystem" (Vargo & Lusch, 2016). This perspective emphasizes the interconnectedness and co-creation of value among multiple stakeholders, including students, faculty, administrative staff, industry partners, and technological providers. Viewing universities as service ecosystems recognizes the complex, networked nature of contemporary higher education environments, where diverse resources, practices, and interactions converge to facilitate learning and innovation, as service systems that interact through mutual service exchange relationships, improving the adaptability and survivability of all service systems engaged in exchange, by allowing integration of resources that are mutually beneficial (Grönroos, 2017).

Such a model aligns with the increasing integration of digital technologies and experiential learning, fostering a context where physical and digital components coexist and interact seamlessly—a foundational aspect of phygital learning (Peters et al., 2017). Moreover, the ecosystem approach underscores the importance of adaptability and responsiveness to stakeholder needs, facilitating personalized, flexible learning experiences that are essential in today's rapidly evolving educational landscape (Adner, 2017).

This paradigm shift has been supported by empirical research demonstrating that HEI functioning as service ecosystems are better equipped to innovate, enhance stakeholder engagement, and improve overall educational quality (Chandler, 2025). Recognizing higher education as a service ecosystem thus provides a useful theoretical foundation for designing, implementing, and managing complex, integrated learning pathways such as those found in phygital contexts.

Universities are at a pivotal crossroads, facing both opportunities and challenges as the traditional models of higher education are increasingly questioned in terms of their educational and societal value, as well as their authority and relevance in a rapidly changing world (Altbach, 2015; Marginson, 2016; Sauder & Espeland,

2009). The advent of educational technology (EdTech) has been characterized as a disruptive innovation within this domain (Christensen, Horn, & Johnson, 2011). This disruption has brought profound implications for the entire ecosystem, impacting not only students and learners but also faculty, administrative staff, and the broader academic community responsible for educational organization and delivery (Selwyn, 2016; Brown, Dehoney, & Millichap, 2015).

Integration of digital tools and platforms into universities is transforming traditional pedagogical methods, administrative processes, and stakeholder interactions. This shift fosters new forms of engagement, personalization, and flexibility but also raises questions regarding the effectiveness and sustainability of these new models (Alenzi et al., 2023). Despite the increasing adoption of innovative practices, a significant gap persists in the research literature concerning the characteristics, effectiveness, and design principles of these emerging hybrid or blended learning experiences—particularly those based on the seamless integration of physical and digital elements, i.e., phygital learning.

HEI are organizations fundamentally engaged in tertiary education, encompassing teaching, research, and community service activities (OECD, 2018). They traditionally offer undergraduate, postgraduate, and doctoral programs, contributing to knowledge production, societal development, and economic growth. As complex organizations operating within broader socio-economic and technological contexts, HEIs are increasingly being understood as adaptive, innovation-driven ecosystems capable of co-evolving with their environment (Vargo & Lusch, 2016). Understanding universities as service ecosystems highlights their dynamic nature, where multiple stakeholders with diverse needs and resources interact to generate value creation through a stakeholder synergy (Tantalo, & Priem, 2014).

This perspective emphasizes the importance of contextual adaptability and stakeholder responsiveness, which are crucial for designing effective, inclusive, and sustainable learning experiences—especially as the sector navigates the digital transformation and redefines its role in society. Consequently, the exploration of how HEI can leverage their ecosystem characteristics to develop and implement

innovative, integrated phygital learning pathways is both timely and essential for advancing higher education research and practice.

Integration of digital and physical dimension is very evident above all in the educational context and in this ecosystem it's emergent, through the acquisition of new professional roles, functions, and competences, the realization of a phygital learning experience (Williamson & Piattoeva, 2020). In fact, uncertainty arising from the absence of clearly defined core elements and reference roles undermines both the shared adoption of a model and the evaluation of its effectiveness (Selwyn, 2016; Williamson & Piattoeva, 2020). Institutions have recognized this urgency: at EU level, the Recovery and Resilience Facility (Commission Notice Guidance on Recovery and Resilience Plans, 2023) and national implementation plans such as Italy's Piano Nazionale di Ripresa e Resilienza (Italian Presidency of the Council of Ministers, 2023) dedicate measures to the digital transformation and improvement of higher education, mobilizing funds and specific actions to modernize university infrastructures, digital teaching, research capacity, and staff training (European Commission, 2025). The imperative for Italy and the broader European Union to prioritize the digitalization of higher education is driven by the need to address evolving workforce demands, enhance educational access, and promote economic competitiveness.

These digitalization efforts, facilitated by resources from the Piano Nazionale di Ripresa e Resilienza (PNRR) and aligned EU programs, aim to equip students with the digital skills essential for success in an increasingly technology-driven world. In Italy, the PNRR allocates significant funds to the "Education and Research" mission, with a notable portion dedicated to projects like Digital Education Hubs (DEHs) (Italian Ministry of University and Research, MUR, 2024). These DEHs, envisioned as both physical and virtual spaces, are designed to foster digital skills and innovative teaching methods, offering resources, training, and support for students, teachers, and the broader community. While specific budget allocations vary across projects, digital education initiatives represent a substantial percentage of the total PNRR funding for education, reflecting the strategic importance of digital transformation. Furthermore, many universities are strengthening their Teaching and Learning Centers (TLCs) to support faculty in integrating technology

and innovative pedagogies into their teaching practices. At the EU level, initiatives such as the Digital Europe Program and Erasmus+ provide additional funding for digital skills development and transnational cooperation (European Commission, 2024). Together, these initiatives, with their combined financial commitment, underscore a strategic effort to modernize higher education systems, improve student outcomes, and ensure that graduates are well-prepared to meet the challenges and opportunities of a rapidly changing digital landscape. Beyond initiatives aimed at digitalization, most research projects funded by the PNRR foresee the integration of a physical classroom component with a digital one, considering the latter essential to ensure the continuation of the project in terms of long-term sustainability. The full integration between in-person classrooms and online courses is entrusted not only with the success of learning pathways for Philosophiae Doctor (PHD) students and researchers but also with the very continuation of these initiatives: the phygital learning projects aim to promote and integrate HEI without boundaries (SHARE PNRR Document of Project, 2023; EURIDICE Document of Project, 2024). Beyond initiatives aimed at digitalization, most research projects funded by the PNRR foresee the integration of a physical classroom component with a digital one, considering the latter essential to ensure the continuation of the project in terms of long-term sustainability.

These initiatives have a single goal: to build the foundation for an ecosystem of universities that transcends national borders and aligns with common objectives, set not only in European plans (European Commission, 2019) but also in the 2030 Agenda (United Nations, 2015).

Digital technologies serve as a critical instrument for supporting the expansion and sustainability of these learning ecosystems, which by their very nature are transnational, interconnected, and global. Through the dissemination of digital platforms, online collaboration tools, e-learning environments, and global networks, it becomes possible to overcome geographical and temporal barriers, thereby creating more flexible and inclusive learning spaces (Kirkwood & Price, 2014). Digital technologies enable the integration of resources and expertise from various parts of the world, facilitating the development of international and multidisciplinary learning communities that share common objectives and engage

in real-time exchange (Selwyn, 2016). These tools promote the personalization of educational experiences, adapting to the diverse needs of students and other stakeholders involved in these ecosystems, and enhance the capacity to monitor and evaluate the effectiveness of pedagogical practices in a more precise and continuous manner (Hattie & Timperley, 2007).

When combined with initiatives promoting interoperability and standardization, digital approaches can ensure that resources and expertise are accessible and usable worldwide, thereby fostering the creation of a genuinely transnational and open educational ecosystem (Perisic et al., 2023). Consequently, digital technologies constitute a key element in advancing and consolidating higher education systems that are more open, collaborative, and capable of effectively addressing the challenges posed by globalization and the ongoing digital revolution.

The theoretical-operational framework necessitates a transdisciplinary approach. Isolated perspectives—such as pedagogy that overlooks service design and user experience, marketing that understands the customer journey but lacks pedagogical depth, or computer science that provides tools without an integrated human-centered framework—are inherently inadequate for fully comprehending the phenomenon's multifaceted nature (Tab. 2).

Table 2:Summary table of involved disciplines

Discipline	**Main focus**	**Technologies used**	**Application examples**
Education and Pedagogy	Hybrid and personalized learning	AR, VR, AI e-learning	AI for science lessons, VR for history
Engineering and Technology	Development of enabling technologies	AR, VR, IoT, HMI	Engineering simulations in VR
Medicine and Health Science	Medical training and clinical practice	AR VR simulators	VR surgical simulators, AR for anatomy
Art, Design and Architecture	Creation and visualization of works/projects	AR, VR, 3D modeling	Virtual museums, architectural projects with AR

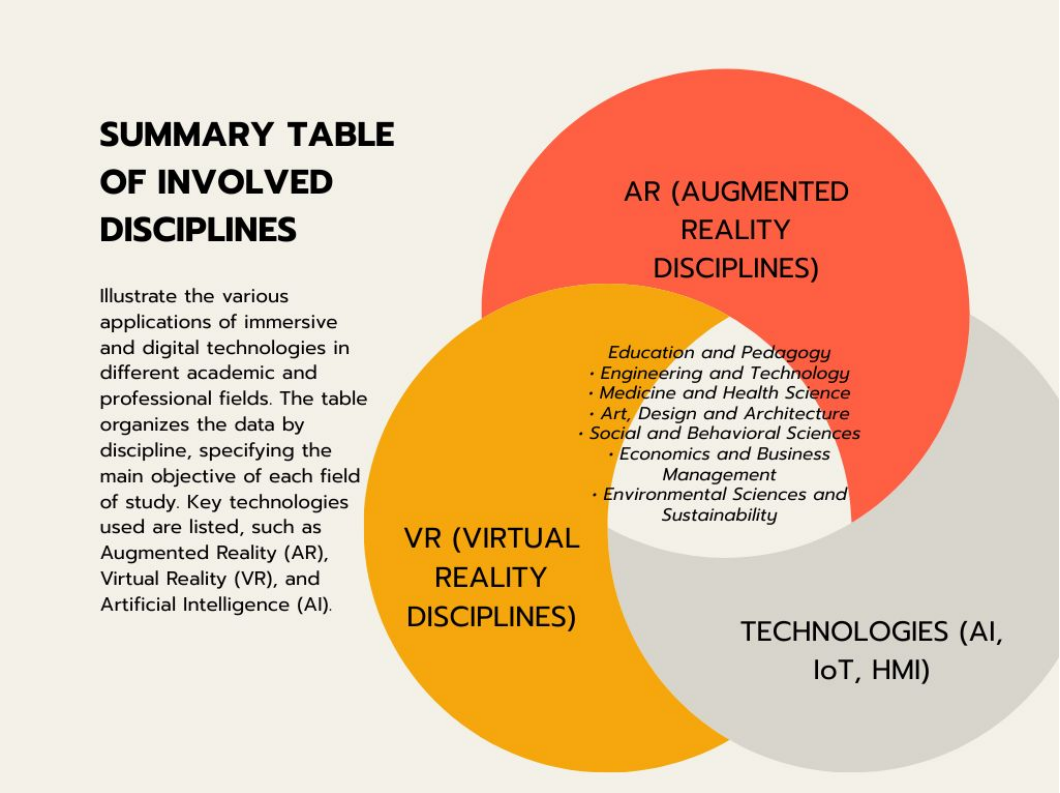
Social and Behavioral Sciences	Social and behavioral impact	digital platforms, AR, VR	Study of student engagement
Economics and Business Management	Corporate training and skill development	AR, VR, simulations	VR for negotiations, AR for resource management
Environmental Sciences and Sustainability	Environmental awareness and education	AR VR	AR apps for ecosystems, VR for climate change

Source: own production

The impact of the phygital model is causing a fundamental disruption across various disciplines that study human interactions and social dynamics.

In service design, a significant evolution is evident toward a more integrated approach that combines physical and digital elements to enhance user engagement, as highlighted by Stickdorn et al. (2018). Similarly, the field of user experience (UX) is adapting to this new reality, requiring designs that ensure a seamless and fluid experience between online and offline environments, as emphasized by Garrett (2019). In computer science, there is a notable renewal, with emerging technologies enabling increasingly sophisticated solutions that integrate physical and digital worlds, fostering intelligent and adaptive systems, as described by Russell and Norvig (2020). The marketing discipline is also undergoing a transformation, adopting strategies that leverage data and innovative technologies to create highly personalized and engaging experiences, a trend highlighted by Lemon and Verhoef (2016). Lastly, sociology is examining how these changes are reshaping social dynamics and interaction patterns within an increasingly interconnected society (Castells, 2020). The cross-disciplinary analysis has been deliberately conducted to illustrate how these fields are experiencing paradigm shifts, with education being addressed last because it is the domain where the focus will be further developed. It is within education that a paradigmatic change in the conception of learning is occurring, requiring a redefinition of methodologies and experiences in response to the challenges of a society that is increasingly hyperconnected and rapidly evolving (Selwyn, 2019; Stickdorn et al., 2018; Garrett, 2019; Russell & Norvig, 2020; Lemon & Verhoef, 2016; Castells, 2020).

Figure 1:Summary table of involved disciplines – diagram



Source: Own production - image generated by AI

The image (Fig. 1) features a Venn diagram illustrating how various disciplines are interconnected through emerging immersive and digital technologies. It highlights three primary domains: AR (Augmented Reality) and related disciplines, VR (Virtual Reality) and associated fields related to virtual environments, and technologies such as AI, IoT, and HMI. In this way, it emphasizes how the disciplines situated at the intersections of these domains are both diverse and interdependent, underscoring a multidisciplinary approach that integrates knowledge from education, pedagogy, engineering, medicine, design, social sciences, economics, management, and environmental sciences.

This diagram provides a clearer understanding of the research perspective: instead of analyzing each discipline in isolation, it may be more advantageous to adopt a transdisciplinary approach (Nicolescu, 2018). Rather than starting from traditional fields, one can examine technological innovations — such as AR, VR, and AI —

and then identify the disciplines they intersect with, thereby creating new areas of investigation and practice. This approach resonates with the viewpoints of various scholars who stress that the integration of technology-focused disciplines is crucial for developing comprehensive solutions that go beyond traditional limits (Isabirye & Moloi, 2025). It underscores the necessity of recognizing the convergence among areas influenced by technological advancement. The importance of a transdisciplinary approach (Verma & Verma, 2024) in tackling modern complexities — promoting a true synthesis of theory and practice — is particularly relevant when establishing a new framework. Therefore, it is essential to align the theoretical perspective with the inherent characteristics of the technology to uncover emerging interdisciplinary spaces and enhance the overall understanding of how digital and immersive technologies are transforming new academic and professional fields.

1.2 Service-Dominant Logic and value co-creation in learning services

The paradigm of Service Dominant Logic (SDL), as developed by Vargo and Lusch (2004, 2016), fundamentally redefines how we understand value creation in various service contexts, including education. Unlike traditional transactional models that focus on the transfer of static goods or knowledge from providers to consumers, SDL emphasizes that value is co-created through dynamic, reciprocal interactions among multiple actors within a service ecosystem. While the S-D logic was originally developed and presented in a marketing context (Vargo & Lusch, 2004), it was not intended to be restricted to the marketing area.

Rather, Vargo and Lusch (2008, p. 3) contend that "*S-D Logic is a generalizable mindset*" and it can be applied in many different contexts, including education (Baron & Harris, 2006; Chalcraft & Lynch, 2011). Value is understood not as something embedded solely in products or services but as a co-constructed result of active interactions between organizations and consumers — interactions that are mediated and enhanced through multisensory, multisystem engagement channels (Prahalad & Ramaswamy, 2004).

A key aspect of Service-Dominant (S-D) Logic is the concept of value co-creation, which is central to its framework. Among five core axioms, three explicitly emphasize the importance of co-creating value, highlighting its primary role in this paradigm. Since value is always co-created by multiple actors—such as students, professors, and other stakeholders—there are implications for what universities and educators do. Specifically, Axiom 2 states that "*value is co-created by multiple actors, always including the beneficiary*" (Vargo & Lusch, 2017, p. 47), emphasizing that the active engagement of the student, as the beneficiary, is essential. Etgar (2008) introduces the idea of co-production, which is closely related to co-creation but places a particular focus on consumer decision-making. The author argues that co-production results from consumers' choices reflecting their preferences, meaning students decide whether and how to participate in the co-creation of value. This suggests that if educators and institutions create conducive opportunities, students are more likely to actively engage, contributing to the development of knowledge or other forms of value. Conversely, if a student opts

out of engagement, it is a personal decision, though the quality and presentation of opportunities offered by the university also play a significant role. Educational processes are not merely about delivering predetermined content but involve active participation and collaboration among learners, educators, institutions, technological tools, and broader societal influences. This relational process of co-creation underscores the importance of dialogue, personalization, and contextual understanding, positioning learners as active agents who shape their educational experiences rather than passive recipients.

For effective learning to occur, students must choose to participate in co-creation processes, which must be designed to be appealing and accessible. To facilitate this, Etgar (2008) proposed a five-stage process for co-creation:

(1) establishing the initial conditions,

(2) motivating students to engage,

(3) weighing the costs and benefits of co-creation,

(4) engaging actively in co-productive activities,

(5) assessing and evaluating the outcomes of the process.

Applying this framework to learning programs can create an environment conducive to meaningful co-creation of value, ultimately benefiting the students. Given the reliance of online learning environments on student participation, engagement and willingness to learn are critical; without them, virtual classrooms risk failing to deliver quality education (Beckman & Khare, 2018).

These services now include traditional classroom instruction, online courses, webinars, peer learning communities, mentorship programs, and informal opportunities such as social media engagement and experiential activities. All these elements contribute to an ongoing, participative process of knowledge development, skill acquisition, and personal growth. The intangible, participatory, and dynamic nature of learning services aligns closely with the core principles of SDL, which emphasize that value emerges from meaningful interactions rather than isolated exchanges.

A conceptual systematic review (Omland et al., 2025) reinforces the align between Service-Dominant Logic and co-creation in higher education: dialogue, positioning, voice, and agency as core, interconnected concepts characterizing co-creational

interactions. These elements are not only outcomes of co-creation but also vital prerequisites for productive engagement, highlighting the relational and participatory nature of learning services. The study's analytical framework underscores the importance of fostering inclusive interactions where students' agency and voice are valued, reflecting the S-D Logic emphasis on value co-creation among all stakeholders within a service ecosystem. It concludes that educational experiences should be designed to be participant-centered and adaptable, enabling continuous, collaborative contributions towards knowledge development and shared value creation in learning services (Omland et al, 2025).

In the context of Lifelong Learning (LLL), these learning services have become even more critical, as the rapid advancement of technology, globalization, and societal change demand continuous upskilling and reskilling across different phases of life (Fischer, 2020). LLL transcends the traditional boundaries of formal education, encompassing a broad spectrum of learning experiences that are personalized, flexible, and accessible through digital platforms. Digital ecosystems facilitate persistent and scalable engagement, enabling individuals to participate in learning activities suited to their unique needs, preferences, and life circumstances. This perspective highlights that the co-creation of value in learning services is inherently relational and contextual—dependent on the interactions among learners, trainers, educational institutions, industry partners, and technological infrastructures. Such ecosystems foster a participatory environment where feedback, social support, and shared practices continuously shape and refine the learning experience. The approach aligns with the principles of SDL by emphasizing that the educational journey is a collaborative process, where all stakeholders contribute to and benefit from shared knowledge and competencies.

Accreditation agencies have raised the demands on HEIs to provide quality education and to recognize the complexity of management through their rigorous professional accreditation process (Payne, Storbacka, & Frow, 2008). Understanding learning as a service grounded in SDL provides a robust theoretical foundation for innovative educational design, emphasizing stakeholder engagement, personalization, and adaptability. It encourages the development of learner-centered approaches that leverage digital technologies to create inclusive,

dynamic, and meaningful learning experiences across the lifespan (Beard in Beckman & Khare, 2017).

1.3 Phygital learning as service innovation

According to the principles by Vargo and Lusch (2016), services are at the core of value creation within decentralized and interactive systems, where the active participation of all involved actors is fundamental. Phygital learning as a service innovation constitutes an emergent paradigm that transcends conventional modes of educational delivery, positioning itself as a complex system of advanced services designed to enable value co-creation among institutions, learners, and a broad spectrum of stakeholders. This approach relies on the synergistic integration of physical and digital components, forming an advanced learning ecosystem characterized by shared governance and iterative co-design processes (Weller, 2021).

Extended Reality Technology (ERT) emphasizes that immersive and transformative technologies — such as augmented reality, virtual reality, and mixed reality — are central to designing engaging service experiences within phygital environments. These technologies innovate interaction and co-creation methodologies, fostering more personalized, immersive, and resilient learning settings. By facilitating interaction between physical and digital elements, extended reality enhances not only the experiential quality of learning but also the capacity for flexible delivery and inclusion, thus contributing to the renewal of educational infrastructures through immersive and simulation-based environments (Batat et al., 2022).

This paradigm shift resonates with the broader processes of digital transformation and service innovation, enabling a redefinition of engagement and delivery modalities that actively involve users in co-creative and experiential learning processes. The integration of theoretical frameworks with frontier technologies thus positions phygital learning as a quintessential example of service innovation—equipped to address the challenges of an ever-evolving social and technological landscape (Batat et al., 2022).

As highlighted by Mele and Russo Spena (2022), the *phygital experience* is best understood as a practice-based approach that emphasizes the orchestration of system architectures capable of leveraging both insights and engagement. These

architectures involve a dynamic interplay between systems of insights—data-driven mechanisms that analyze behaviors, preferences, and emotional responses—and systems of engagement, which facilitate personalized, multisensory interactions across multiple channels. The integrated architecture enables organizations to create continuous, coherent experiences that transcend isolated touchpoints, characterized instead by fluid, multisensory, and multisystem interactions. This is a characteristic not only for customer but for users and in particular for learners, as a specific kind of customer in the educational organizations.

The phygital experience is possible for a user involved in an organization not as commercial enterprises but also to institutional entities such as universities, research centers, and public agencies. The integration of insights and engagement systems facilitates a shift from traditional value delivery models towards one of value co-creation—a process where value is actively shaped through ongoing interactions, mutual contributions, and shared experiences between the organization and its stakeholders (Vargo & Lusch, 2008; Prahalad & Ramaswamy, 2004). If the customer journey underscores the importance of emotional, behavioral, and social dimensions within the *phygital* context in particular for the millennials (Mele and Russo Spena, 2021) this could be true also in phygital learning journey. Millennials navigate journey through a web of interconnected emotional responses, behaviors, and social influences, often moving fluidly between physical and digital environments based on contextual cues. It highlights that the *phygital* experience must evoke emotional engagement, facilitate social sharing, and adapt dynamically to individual needs, reinforcing the importance of an architecture that captures and leverages these fluctuating factors. In corporate settings, co-creation involves customers, employees, and partners working collaboratively to develop and refine products, services, or experiences, leveraging the full potential of multisystem architectures for mutual benefit. Thus, the concept of *value co-creation* underscores the importance of designing interconnected, system-oriented ecosystems that facilitate active stakeholder involvement in generating shared value, whether in commercial or institutional contexts.

Early applications of the *phygital customer journey* focused on retail and tangible goods, accumulating evidence underscores its critical relevance within service

sectors such as Education and Training. In this sector, the *value co-creation* paradigm assumes even greater importance, as learners and educators jointly develop personalized, meaningful learning experiences that foster engagement, persistence, and deep comprehension (Ballina, Valdés, & Del Valle, 2019). Similarly, in educational institutions it means fostering ongoing dialogue and collaboration between students, teachers, and technological platforms, transforming the learning process into a co-creative endeavor that enhances engagement, personalization, and meaningful participation.

Building on the broader discussion of the phygital journey, its application in the Education sector reveals significant transformative potential. It's possible a shift from the concept of "*customer*" to that of "*user*," identifying within the education cycle a specific type of "*user*" that encompasses a heterogeneity of students, ranging from those traditionally enrolled in educational systems to those engaged in upskilling and reskilling programs (Calise, Delgado Kloos et al, 2019).

1.4 The Phygital Learner Journey: touchpoints, interactions, value outcomes

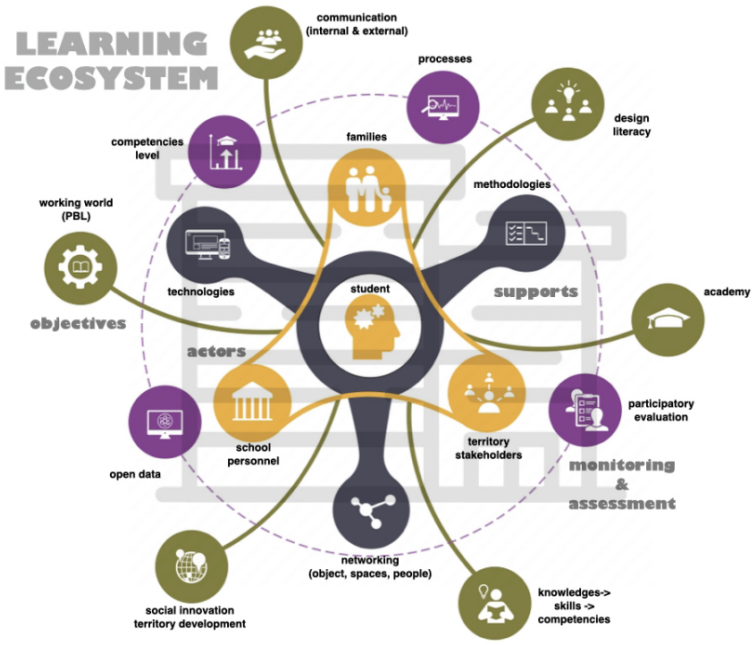
The integration of physical and digital environments does not merely enhance engagement but fundamentally redefines the learning experience, creating more immersive, personalized, and accessible Educational pathways (Yeganeh, Fenty, Chen, Simpson & Hatami, 2025). Grounded in systematic research (Calise & Musella, 2019; Mele & Russo Spena, 2022), the *phygital* approach recognizes that learners today benefit from multisensory spaces where tangible interaction and virtual engagement complement each other.

Technologies such as augmented reality (AR), virtual reality (VR), and mixed reality (MR) serve as key enablers within these ecosystems, offering experiential learning opportunities that replicate real-world contexts and promote active involvement (Bacca et al., 2014). These immersive tools foster deeper engagement, enhance comprehension, and support the development of critical thinking and problem-solving skills through realistic, context-rich scenarios. Furthermore, the deployment of advanced learning analytics in *phygital* environments allows educators to gather real-time insights into students' emotional states, engagement levels, and social interactions (Papamitsiou & Economides, 2014). These insights enhance personalized instructional strategies, allowing for adaptive content delivery that is customized to meet individual needs effectively. Supporting this notion, reports from the European Commission (2020) emphasize that *phygital* solutions enable lifelong learning by enabling seamless transition between formal and informal Educational settings, breaking down barriers of time and geography. They also encourage social learning, peer collaboration, and co-creation of knowledge, which are associated with heightened motivation, persistence, and retention. The approach not only fosters the development of transversal skills — such as digital literacy, adaptability, and intercultural competence — but also supports inclusivity by expanding access to quality Educational resources regardless of socio-economic or geographical limitations (Maunsell, 2023). A kind of Learning Ecosystem is "*people in place centered design*" and has the objective to guarantee learner well-being (Giovannella, Roccasalva, Di Torino, 2024).

By enabling multisensory and flexible engagement, the *phygital experience* doesn't mean only the combine of digital platforms and physical learning practices but signifies a move towards learner-centered and participatory models that are more aligned with the demands of contemporary society and the global knowledge economy. This transformational approach is further magnified within the framework of learning for traditional students but also for lifelong learning—a global paradigm at the core of contemporary educational policies and practices. Digital technologies such as online platforms, remote learning environments, and international academic exchanges underpin this evolution, enabling cross-border mobility and the widespread dissemination of knowledge (Gibbs, 2018). Digital platforms thus streamline activities of exchange, be they of economic or of other (e.g., social; communicative) nature. Moreover, from their position 'in between' other parties, platforms set up specific rules and codes of conduct that make such exchange possible: they haven't a neutral role. Platforms not only make specific forms of activity possible through the architecture of the platform interfaces; as intermediaries they equally regulate such activity (Decuypere, Grimaldi & Landri, 2021).

Digital Innovations support the transition from traditional, localized Educational models to more interactive, collaborative, and learner-centered environments, where engagement and co-creation are foundational. Education must adapt to the complexities of digital ecosystems by fostering active participation, learner autonomy, and transversal skills (Gibbs, 2018; Calise and Reda, 2021) emphasize — such as critical thinking and digital literacy — that are crucial for thriving in a highly interconnected, rapidly evolving global society. The trajectory recasts Education as a continuous, integrated process—crucial for developing resilience, promoting social inclusion, and enabling learners to contribute meaningfully at both local and global levels.

Figure 2:Learning Ecosystem



Source: Del Vecchio, P., Secundo, G., & Garzoni, A. (2023). Phygital technologies and environments for breakthrough innovation in customers' and citizens' journey. A critical literature review and future agenda. Technological Forecast

The adoption of a phygital approach in Education is not limited to adding technology to a classroom but involves a fundamental redesign of the learning process to make it more interactive, personalized, and engaging, in line with the principles of modern experience design (Pine & Gilmore, 1999; Verhoef et al., 2015; Lave & Wenger, 1991; Kolb, 1984; Siemens & Long, 2011; Selwyn, 2016). Specifically, it investigates how phygital learning redefines traditional learning models, identifies strategies for enhancing pedagogical effectiveness, and examines its potential to drive service innovation in Education. By leveraging emerging technologies such as AI, IoT, and AR/VR, phygital learning can transform Educational service delivery, making it more inclusive, accessible, and engaging. This question translates the findings from the previous analyses into concrete contributions for theory, practice, and service innovation.

In a phygital learning system, touchpoints represent the various points of interaction between users—such as students, instructors, and other stakeholders—and the different components of the educational ecosystem, seamlessly integrating physical

and digital elements. Touchpoints include digital platforms where students access content, participate in interactive lessons, and engage in discussion forums. Digital platforms have revolutionized the landscape of higher education by providing accessible, scalable, and flexible environments for learning. These platforms facilitate the delivery of a wide range of educational resources and experiences, breaking down traditional barriers related to geography, time, and cost. Among the most significant innovations within this domain are Massive Open Online Courses (MOOCs), which have emerged as a disruptive innovation in the education sector (Pappano, 2012). MOOCs offer free or low-cost courses from prestigious universities and institutions to a global audience, enabling millions of learners worldwide to access high-quality education without the need for physical presence. A minimum definition of MOOC is given by the Oxford Dictionary: "*a course of study that is made available over the internet and that can be followed by a large number of people"* (Calise, 2018). The innovative opportunity of MOOCs isn't limited to learning processes in the web (Sancassani et al., 2021) but invests the entire path of teaching, creating blended educational products, integrated with traditional teaching, transforming learning into a "phygital learning concept" that can be described as an integration between different ecosystems (Vate U-Lan et al., 2016) and creating also in Education a phygital environment as integrating digital technologies including physical elements and social presence (Mele, 2021).

The advent of MOOCs has dramatically expanded access to higher education, democratizing learning and fostering lifelong learning opportunities (Downes, 2015). The COVID-19 pandemic further accelerated this growth, as widespread lockdowns and social distancing measures forced educational institutions and learners to shift rapidly toward online environments. During this period, the usage of platforms hosting MOOCs surged dramatically. According to the Class Central report, the total number of MOOC users worldwide has increased significantly, reaching over 220 million registered learners as of 2021 (Class Central Report, 2021). The rapid growth highlights the essential role that digital platforms now play in supplementing traditional education and addressing the demands for more flexible, accessible learning solutions.

The pandemic period served as a catalyst, pushing institutions and learners to prioritize online and asynchronous learning modalities, which accelerated the adoption and acceptance of MOOCs and other digital platforms. The proliferation of these instruments, supported by advancements in digital technology, data analytics, and personalized learning algorithms, has established a new norm in education—one that is increasingly inclusive and adaptable to individual needs. As the landscape continues to evolve, digital platforms will likely remain central in shaping the future of lifelong and blended learning models, fostering an ecosystem where education is more connected, open, and accessible than ever before.

Other touchpoints include onsite classes, which also encompass in-person sessions such as laboratories, workshops, and face-to-face lessons that facilitate direct interaction and hands-on experiences. Devices like tablets, laptops, and smartphones serve as essential tools that enable learners to connect with educational resources anytime and anywhere, supporting the mobility and flexibility characteristic of phygital environments (Kirkwood & Price, 2014).

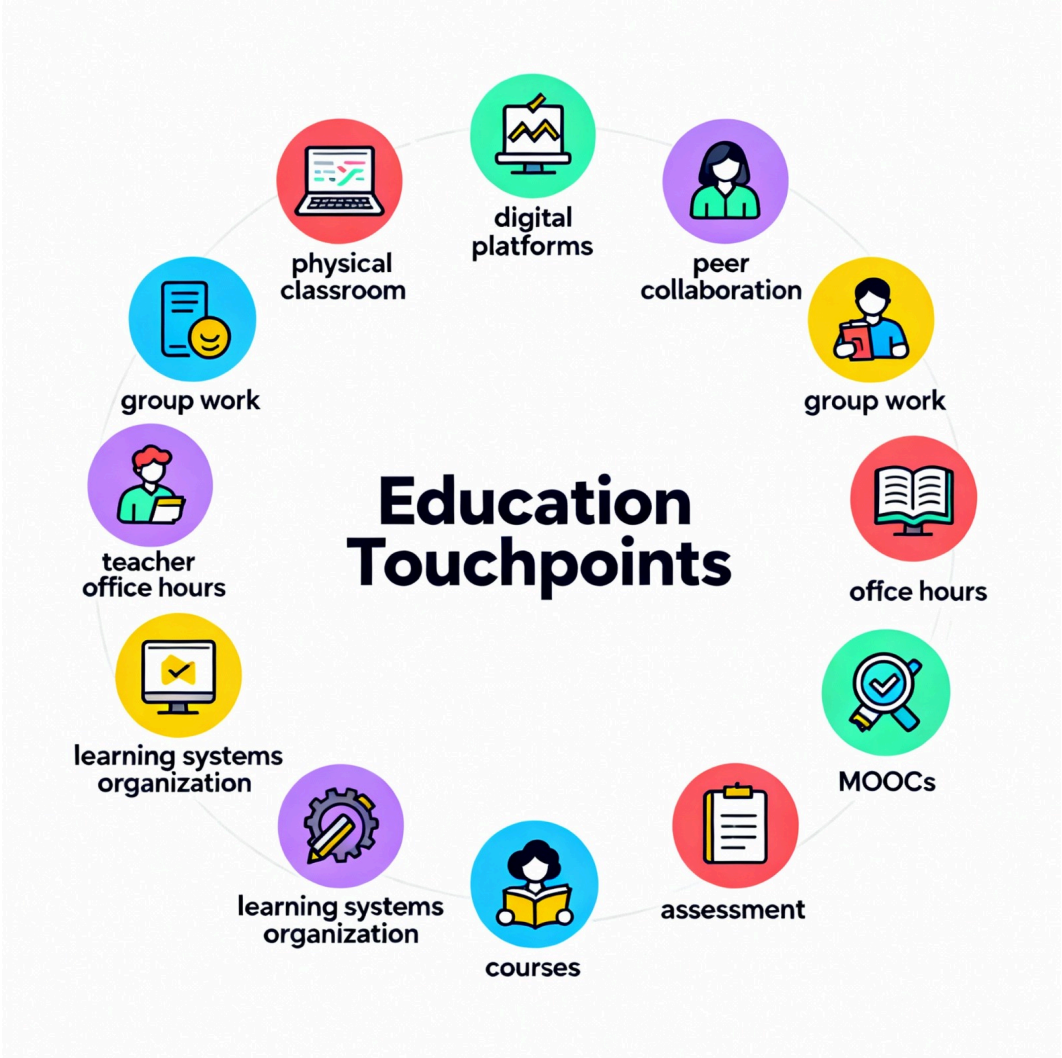
Communication tools—such as chat applications, video conferencing, and collaborative platforms—further enhance interaction by bridging physical gaps and creating continuous channels for dialogue and teamwork. Hybrid labs and co-working spaces exemplify physical environments that are digitally enhanced, allowing access both physically and virtually to foster innovation and collaborative learning (Perisic et al., 2023). Events like webinars, seminars, and workshops blend in-person participation with online attendance, broadening the reach of educational activities. Feedback and assessment systems, often digital, collect insights from learners and facilitators, enabling ongoing evaluation of pedagogical effectiveness (Hattie & Timperley, 2007).

Within the physical campus, services such as libraries, reception areas, and study zones increasingly incorporate digital interfaces—like self-check-in systems and online booking platforms—that improve efficiency and user experience. Support services, including digital tutoring, mentoring, and help desks, are vital touchpoints that operate both virtually and in person, ensuring continuous guidance for learners. Lastly, shared resources such as digital repositories, virtual libraries, and online

content portals create centralized access points for educational materials that complement physical learning experiences.

Multiple touchpoints are essential for designing a fluid, integrated learning journey that capitalizes on the strengths of both physical and digital worlds. Such a comprehensive approach not only enhances personalization and engagement but also fosters a learning environment adaptable to diverse needs and contexts (Ghezzi et al., 2020). By thoughtfully combining these touchpoints, educational institutions can create more inclusive, engaging, and effective learning experiences—aligned with the evolving demands of digital transformation (Kirkwood & Price, 2014).

Figure 3: Education Touchpoints



Source: Own production- image generated by AI

1.5 Challenges, ethics, and governance in phygital ecosystems

Phygital ecosystems, characterized by the seamless integration of digital and physical elements, pose also a variety of complex challenges that merit careful ethical and governance considerations.

Technology is not neutral: it embodies specific values and interests, and it can have political implications (Winner, 1986). The choice of the digital technologies to facilitate the process is an ethical question, linked to learning analytics management. The first challenge and most pressing issues concerns data privacy and security, as these systems rely heavily on the collection, processing, and analysis of vast amounts of personal data generated through user interactions with both digital platforms and physical environments. According to Verhoef et al. (2021), effective data governance is crucial to protect individual privacy while enabling organizations to leverage data for personalized and adaptive learning experiences. However, the risk of data breaches, misuse, or insufficient transparency in data handling can undermine user trust and compromise ethical standards. Learning Analytics represent a category of tools and methods used to collect, analyze, and interpret data generated by students' learning processes, with the aim of optimizing pedagogical practices and fostering personalized educational experiences (Grimaldi, 2020; Amaturo & Aragona, 2019). Their implementation raises significant ethical concerns, as the storage and use of such data involve issues related to privacy, security, and students' autonomy. As highlighted by multiple studies, including those by Williamson et al. (2020), managing Learning Analytics requires careful consideration of risks such as surveillance and the potential misuse of data, which can undermine fundamental principles of privacy protection and individual rights. Therefore, although the potential benefits of these tools are noteworthy, their application must be accompanied by rigorous ethical frameworks and data management policies that ensure transparency and accountability.

Furthermore, the integration of digital platforms in the traditional system could generate the paradox of “platformization of education” (Nieborg & Poell, 2018; Perrotta, 2020; Van Dijck et al., 2018). It is increasingly manifest that this

platformization constitutes a very distinct process that is altering the meaning, possibilities and potential functions of education (Perrotta, 2020; Van Dijck et al., 2018). The growing proliferation of digital platforms in the educational sector has led to the emergence of the phenomenon known as "platformization" of education. This process involves technology assuming a dominant and often monopolistic role, transforming educational spaces into privatized and commercialized environments (Selwyn, 2016). Additionally, numerous scholars, emphasize how platformization can profoundly alter pedagogical relationships, even in face-to-face interactions, making authentic dialogue and personalized care more difficult—principles fundamental to humanistic pedagogy (Biesta, 2009). Consequently, the transformation raises significant ethical and pedagogical concerns, such as the loss of autonomy among educational actors, the risk of data monopolization, and the diminishment of core values like participation, freedom, and responsibility within the educational process.

Another significant challenge lies in ensuring equitable access to phygital ecosystems. Infrastructural and technical barriers —unequal access to reliable connectivity, devices, and interoperable platforms —risk exacerbating the digital divide and undermining equity goals (European Commission, 2020). Data governance and privacy concerns emerge as Customer Relationship Management (CRM), Learning Management System (LMS), sensor data, and learning analytics converge; institutions must adopt robust consent, anonymization, storage, and ethical-use policies to preserve trust (Siemens & Long, 2011; Selwyn, 2016). As these environments depend on advanced technological infrastructure — such as high-speed internet, devices, and smart environments — there is the danger of exacerbating existing inequalities, leaving disadvantaged populations behind and creating a digital divide (Robaeyst, Baccarne, & Schuurman, 2022). Ethical considerations extend further into issues of user autonomy and informed consent; individuals must be fully aware of how their data and interactions are being used and retain control over their digital footprints. This highlights the importance of implementing transparent policies aligned with principles of responsible data stewardship and user empowerment (Floridi & Taddeo, 2016).

From a governance perspective, managing these multilayered ecosystems requires adaptable and multi-stakeholder frameworks: the need for dynamic governance models can respond to technological advancements while safeguarding human rights and societal values. In the case studies examined below, it will be evident how the bureaucratic rules belonging to individual governments pose a challenge for phygital learning environments.

As these ecosystems are inherently decentralized, involving universities, technology providers, policymakers, and users, establishing clear regulations and accountability mechanisms becomes particularly challenging but essential. Ensuring compliance with legal standards such as the General Data Protection Regulation (GDPR) is necessary, yet not sufficient; ongoing oversight, ethical audits, and stakeholder dialogue are crucial to prevent misuse and address ethical dilemmas proactively.

The rapid evolution of smart technologies and their deployment in phygital environments require continuous ethical reflection and policy adjustment. The responsible governance of these ecosystems must balance innovation and agility with principles of fairness, inclusion, and sustainability. Building trust and social acceptance depends on transparency, accountability, and the ability to adapt governance models as new challenges emerge. Addressing these governance and ethical challenges is not solely a technical task but a moral imperative to ensure that phygital ecosystems serve society equitably, respect individual rights, and promote sustainable development.

Phygital designs can enable richer personalization at scale through adaptive learning pathways, competency-based progression, and micro-credentialing tied to authentic, practice-based assessments. Integrated analytics can surface early-warning signals for at-risk learners and inform formative feedback cycles, improving retention and learning gains (Siemens & Long, 2011). Phygital spaces—flexible classrooms, makerspaces, AR/VR labs—scaffold situated, experiential learning that bridges theory and practice and enhances transferability of skills to real-world contexts (Kolb, 1984; Lave & Wenger, 1991).

1.6 Conceptual model and propositions

The preceding analysis shows that phygital learning, though rapidly emerging in practice, suffers from a significant theoretical deficit and currently exists more as a collection of fragmented applications and practitioner-led "buzzwords" than as a coherent field of academic inquiry.

A first attempt to conceptualize and clarify the concept was outlined in a 2016 publication: "*Phygital learning was designed to improve quality and effectiveness of education particularly within the psychomotor domain which requires extensive practice to establish a tangible and developed skill*" (Vate-U-Lan, Quigley & Masouras, 2016, p.32). The conceptual model is closely related to the profound transformations of the entire education system.

In an "*onlife*" environment educational processes must be reinvented when information is ubiquitously available (Floridi, 2015), and learning has become a constant feature of actual hyperconnected lives, with learning is an essential practice in a social context called “learning society” (Florida, 2002). In this era of unprecedented technological disruption, universities are one of the institutions facing complex transformations that alter their roles and social impact. Within the field of education, not only are the spaces and modalities of learning undergoing progressive redefinition within scholarly debate, but the growing demand for educational technologies is also giving rise to a market of considerable scale: the EdTech sector has expanded from a few tens of billions of dollars (or less, depending on the definitions adopted) to over $240–300 billion in 2024 (OECD, 2024). The relationship between innovations enabled by new technologies and their effective adoption by users, together with the emergence of learning journey that transcend traditional age and social boundaries—broadening the student population beyond the millennial generation to include workers and professionals—necessitates a comprehensive redefinition of educational contexts and processes.

The enforced digitalization of learning due to COVID-19 acted as a tsunami for existing Educational models; the subsequent return to traditional school life consequently required the integration of digital tools that had often been overlooked

by the Education system in the past. The consequential of social distancing has led to some major policy changes in the functioning of higher education guided towards “online pivot” (George, 2020). For over a decade, scholars have been discussing about innovative pedagogical approaches tailored to the longstanding "brick and mortar" universities as they transitioned to online instruction (Anglin, 2012) and the topic has been more relevant after COVID when two different dimensions - digital and physical- linked each other. For instance, the combination of physical classrooms and digital tools enables a more adaptive and flexible learning environment (Calise and Reda, 2021), where data-driven insights can be used to tailor educational content and interactions to individual learner needs. So, differently for other kinds of journeys, as the customer one, in Education was learning journey, initially traditional in presence, then purely digital, and finally, since 2020, it has begun to incorporate both dimensions, thus becoming phygital.

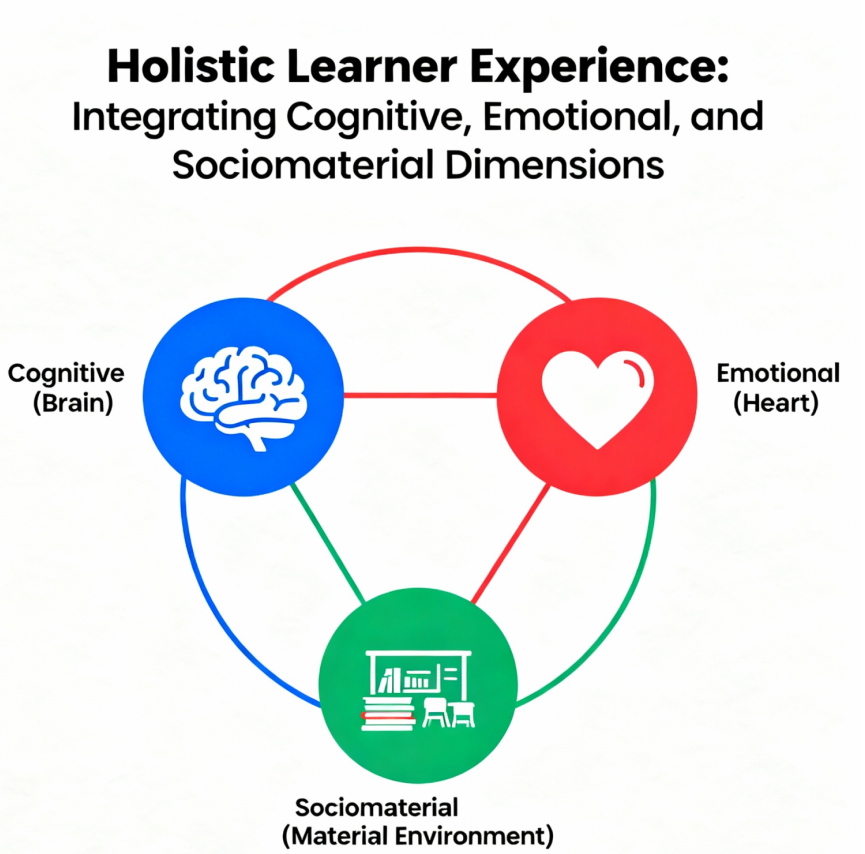
The conceptual model of phygital learning cannot overlook the presence of various technologies, ranging from augmented and immersive realities to digital and AI technologies, but, more importantly, it requires the integration of multiple dimensions and methodologies. This integration aims to make the learning experience more fluid and extensive, involving multiple actors in an expansive process that can no longer be confined to the sole relationship between teacher and student. As digital and physical learning environments become increasingly interconnected, the *phygital journey* could offer a deeper, more meaningful learning experiences suited to the demands of knowledge society and for creating a transnational academic ecosystem, as in the case studies analyzed.

The architecture of the *phygital journey* in education involves sophisticated systems of insights — such as learning analytics— and systems of engagement, including virtual and augmented reality applications, which combine to produce multisensory, engaging, and contextually responsive learning experiences (Mele and Russo Spena, 2022). Students engaging in *phygital learning* environments report higher motivation and satisfaction, attributing this to more dynamic, interactive, and socially connected experiences that transcend traditional classroom boundaries (Chaturvedi, 2021). Moreover, research from the European Commission’s report on digital Education (European Commission, 2020) emphasizes that the phygital

model supports lifelong learning by enabling learners to seamlessly shift between online and offline modes, fostering continuous engagement and co-creation of knowledge. This approach aligns with broader pedagogical shifts towards learner-centered, participatory Education, which recognizes that the active involvement of students in their learning process—augmented by integrated physical and digital touchpoints—can significantly enhance the development of transversal skills such as digital literacy, collaboration, and critical thinking (Calise & Musella, 2019).

So, a proposition for a phygital learning journey pertains to decentralized and distributed learning processes: while anchored in a typical top-down system of academic learning, these experiences encompass multiple contexts, both geographic and disciplinary and could become an holistic experience with integrations of more dimensions.

Figure 4: Holistic Learner Experience



Source: Own production- image generated by AI

The incorporation of artificial intelligence into blended and *phygital learning* amplifies both opportunities and governance requirements: AI-powered adaptive systems continuously monitor learners' behaviors, skills, and difficulties to customize content sequencing and pacing, ensuring learners receive appropriately leveled support and remain motivated — an especially valuable feature in heterogeneous higher-education cohorts (Calise & Reda, 2021).

By combining phygital design with AI-enabled personalization, assessment automation, and immersive AR/VR experiences, educational institutions can create adaptive, embodied, and participatory learning ecosystems. Realizing this vision requires concurrent investment in infrastructure, ethical governance, faculty capacity, and rigorous evidence generation to ensure that phygital integration enhances both effectiveness and equity in Higher Education (European Commission, 2020; Long & Siemens, 2011).

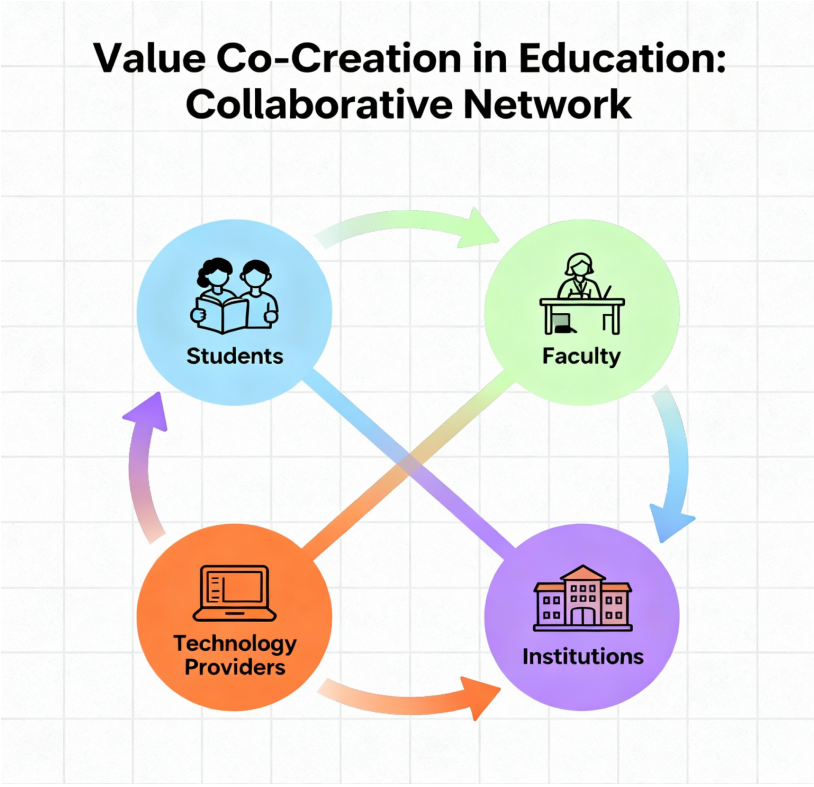
Despite the growing practical interest and solid theoretical potential, the field of *phygital learning* is characterized by a significant gap in the academic literature. Several systematic reviews conducted in related fields, such as marketing and management, highlight a critical asymmetry: while the term "phygital" is widely used and implemented by professionals, research on its theoretical development and empirical validation is still lacking (Mele, Russo Spena, Marzullo & Di Bernardo, 2023).

There is a substantial body of literature on the effectiveness of blended learning, defined as the integration of traditional face-to-face and e-learning teaching paradigms (Wong et al., 2014). It happens because the deployment of technologies in teaching and learning is not a new paradigm in higher education (Poon, 2012) and following the forced digitalization during the pandemic era, these studies have grown even further (Anthony, Kamaludin, Romli, Raffei, et al, 2022). Research in closely related fields, such as synchronous hybrid learning, is described as predominantly 'exploratory and qualitative in nature,' with an urgent need for empirical studies to evaluate its pedagogical impact (Raes, Detienne, Windey & Depaepe, 2020). The most comprehensive systematic reviews on "phygital transformation" focus almost exclusively on commercial and retail contexts, analyzing the customer journey and shopping experience, without an explicit

discussion of its application in the educational sector (Mele, Russo Spena, Marzullo, Di Bernardo, 2023). Having identified the criteria that characterize the Phygital Customer Journey — such as seamless integration, personalization, contextualization, multidimensional engagement, and the use of enabling technologies (Mele & Russo Spena, 2021) — it is possible to apply some same characteristics as a framework to define a concept model for *Phygital Learning* journey.

The theories of value co-creation (Vargo & Lusch, 2004, 2016) are highly applicable to higher education, as the learning process is fundamentally a collaborative creation of value among educators, students, and the broader community. This framework aligns with constructivist pedagogical theories, which emphasize the active role of learners in constructing knowledge through social interaction and shared experiences (e.g., Jonassen, 1999; Siemens, 2005). Phygital Learning emerges as a dynamic and collaborative process that integrates physical and digital elements to enhance educational value creation.

Figure 5: Value co-creation in Phygital Learning Journey



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Thus, a dual gap emerges: a conceptual one, linked to the weakness of theorization, and a contextual one, given the lack of systematic transposition and validation of the construct for a framework model for the educational domain.

The current state of affairs—characterized by a practice-driven phenomenon coupled with insufficient theoretical development—strongly justifies the methodological approach taken in this doctoral thesis. Firstly, a Bibliometric Analysis is essential for mapping the intellectual structure of this emerging field (Wang, Chengliang & Chen, Yu & Wang, Haoming & Jing, Yu-Hui & Zhu, Ke, 2023). A quantitative method allows for the identification of foundational authors, the most influential journals, thematic research clusters, disciplinary origins, and the evolutionary trajectories of the scientific debate, offering a big picture view of the discipline that a traditional narrative review could not provide. Bibliometric analysis is particularly suitable for tracing the development of an interdisciplinary and cross-cutting topic like phygital learning.

In an area not yet formally recognized as a distinct sub-discipline, mapping the relevant literature, identifying core concepts—drawn from marketing, computer science, and Educational sciences—and highlighting influential researchers helps to establish the first comprehensive overview of this emerging intellectual territory. The process of mapping serves to legitimize *phygital learning* as a coherent and specialized field of inquiry, transforming it from a mere "buzzword" into a structured research domain. Consequently, this thesis functions as a critical intervention aimed at bridging the gap between theory and practice, translating nascent experiments into a solid theoretical framework and providing empirical evidence to inform future developments.

The second part was instead organized using a qualitative methodology that involved the selection of two case studies, examined through participant observation, the administration of a questionnaire to various stakeholders involved in the projects, and the analysis of relational dimensions. The questionnaires were structured based on the key words from the analysis conducted and enabled a broader understanding of the phenomenon. Building upon the context outlined and the research gap identified, this doctoral thesis seeks to address the existing lacunae

in the literature by systematically mapping and synthesizing the current knowledge landscape of phygital learning. The study aims to delineate the intellectual architecture of this emerging field, solidify its conceptual foundations, and pinpoint key themes, theoretical references, and practical implications to guide future research and innovation in Educational services.

CHAPTER II

SCIENTIFIC LANDSCAPE: BIBLIOMETRIC POSITIONING OF PHYGITAL LEARNING RESEARCH

SUMMARY**:** 2.1 Rationale for bibliometric analysis in service innovation studies – 2.2 Data sources, indicators, and analytical procedures – 2.3 Results: research trends, thematic clusters, and knowledge evolution – 2.4 Integration with the Phygital Learner Journey model –2.5 Implications for theoretical positioning of the qualitative study

2.1 Rationale for bibliometric analysis in service innovation studies

This chapter aims to further the understanding of phygital experiences in learning and to delineate the concept of "phygital learning." However, to formalize a definition of the phygital user journey within the context of higher education, it is not appropriate to directly adopt the concept of "customer journey" (Lemon & Verhoef, 2016; Rawson, Duncan & Jones, 2013) as equivalent to that of "student journey" (Lee & Lee, 2018), since the latter remains too specific and primarily rooted in the marketing field (Verhoef, Kannan & Inman, 2017). To comprehensively explore the potential characteristics of this definition and the current state of scientific research in this area, an initial bibliometric analysis was conducted on the concept of "phygital."

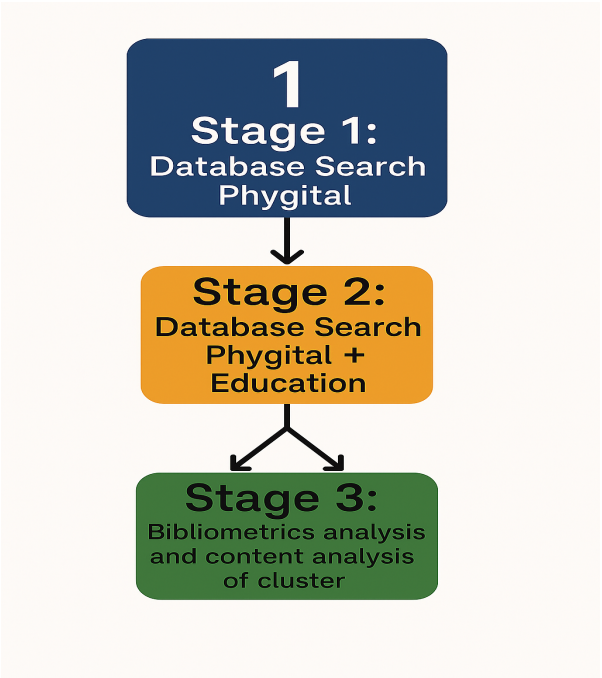
This effort aimed to identify the co-occurring disciplines and the academic fields related to it: analysis serves to uncover the main disciplines investigating this domain and offers various perspectives on the subject. Subsequently, the scope of the investigation was narrowed to the field of education, employing keywords such as "phygital" and "education," including variants like "learning," "training," "pedagogy," and "e-learning" (Anderson & Krathwohl, 2001; Biggs & Tang, 2011).

The term “phygital” refers to the deliberate integration of physical and digital elements to create seamless, context-aware experiences that amplify users’ sensory, social, and cognitive engagement. Its origins cross disciplinary boundaries: media scholars such as De Kerckhove (1995) highlight how digital technologies extend human perception and reconfigure lived space. Design scholarship and practice (Alexander et al., 2025) emphasize how phygital interventions reshape spatial practices and community dynamics. Technical contributions focus on interoperable Internet of Things (IOT) and data architectures that facilitate seamless transitions across channels. Phygital domain has found particularly fertile ground in retail, where sophisticated sentiment analysis techniques are used to create circular, customer-centric shopping experiences (Selvabaskar & Sekarini, 2025). This advanced retail development—driven by real-time insights from physical and digital touchpoints—highlights a key distinction between the phygital and more

general hybrid models. Phygital approach emphasizes not merely blended modalities but a closed-loop system in which data-driven adjustments to both physical and digital interfaces continuously refine and personalize the customer journey (Pantano & Pizzi, 2020). This dynamic process relies on real-time data analytics to adapt experiences, ensuring a seamless integration that enhances engagement and satisfaction.

Beyond disciplinary boundaries, phygital also engages with philosophical questions about the nature of environments shaped by information and computation. Luciano Floridi's philosophy of information offers a useful conceptual framework: by conceptualizing realities as informational environments, or the "infosphere," it redefines physical and digital as integrated layers where agents, artifacts, and data co-constitute contexts of action and meaning (Floridi, 2011; Floridi, 2014). From this vantage point, phygital spaces are ontologically hybrid, embodying affordances and constraints that are simultaneously material and informational. This raises normative concerns regarding designers' responsibilities, such as value-sensitive design, informational justice, privacy, and the effects of mediated environments on autonomy and flourishing.

Figure 6: Stages of research



Source: own production

2.2 Data sources, indicators, and analytical procedures

The study was conducted in two phases, each comprising a bibliometric analysis based on the Web of Science (WoS) database, widely regarded as the leading global source for published articles and citation analysis due to its rigorous inclusion criteria and high-quality indexing (Leydesdorff & Bornmann, 2016).

Web of Science represents one of the leading international academic databases, renowned for its extensive coverage of scientific journals, research articles, conference proceedings, and other peer-reviewed documents. As highlighted by Garfield (2006), its reliability and high quality establish Web of Science as a crucial resource for supporting advanced scientific research, providing access to high-impact and rigorously validated sources. The platform's ability to trace the evolution of research trends over time, identify the most influential publications, and map collaboration networks among authors and institutions grants it a strategic role in analyzing emerging topics within the scientific literature. Further insights underscore how the bibliometric tools integrated into the platform enable monitoring the development of innovative research areas, thus facilitating the discovery of new scientific frontiers (Khudhair et al., 2021). The data analysis capabilities of Web of Science make this tool particularly well-suited for researchers and scholars seeking a comprehensive understanding of the evolving dynamics and emerging trends in rapidly changing scientific fields.

In the first phase, the analysis focused on key research surrounding the concept of "phygital" within the published literature. In the second phase, the scope was extended to explore the field of education, leveraging the robustness and reliability of WoS as a comprehensive and authoritative source for scientific publications.

The indicators considered in this analysis included key journals, key authors, and key articles, initially identified using the search term "phygital" alone and subsequently refined by adding the keyword "phygital learning." This dual approach was adopted to gain a comprehensive understanding of the potential interdisciplinary connections between the phygital environment and various academic fields, as well as to trace the evolution of the concept over time. It is

widely recognized that the concept of “phygital” has evolved in parallel with advancements in digital technologies, reflecting a seamless integration of physical and digital realms that has been fundamental to its development (González et al., 2020). By adopting this bifurcated search strategy, the study aimed to deepen the insights into how the phygital paradigm has progressively expanded in scope and application across different disciplines.

Subsequently, the focus shifted to a detailed exploration of the relationship between phygital learning — identified as the core subject of this research — through a thematic mapping process. This enabled the identification of the most frequently addressed aspects within this specific domain, providing a clearer picture of the current state of research, prevalent themes, and potential gaps. Such an approach aligns with existing bibliometric methodology used to assess the structuring of emergent fields (Archambault & Larivière, 2009), thereby offering a robust framework for understanding how the concept of phygital learning is positioned within the broader landscape of digital education and experiential learning.

The analytical procedures conducted using the bibliometrix software encompassed a systematic application of data techniques to analyze the corpus of scientific literature identified through the search strategies. Bibliometrix is an open-source R package (Aria & Cuccurullo, 2017) that facilitates comprehensive bibliometric analysis by providing a suite of tools for data preprocessing, descriptive statistics, network analysis, and visualization methods such as co-citation and co-authorship mapping. The adoption of bibliometric approaches is increasingly prevalent across various disciplines, serving as crucial instruments for science mapping—an endeavor that becomes particularly vital in an era characterized by a proliferation of empirical research streams that are often fragmented, voluminous, and sometimes controversial.

Science mapping is inherently complex and multifaceted, given its multi-step nature and the reliance on diverse software tools, many of which are not freely available. While emerging automated workflows aim to streamline and integrate these tools into cohesive data flows, this paper advocates for the use of a specialized open-source tool, Bibliometrix, designed by the authors specifically for comprehensive science mapping. Being programmed in R, Bibliometrix offers high flexibility,

allowing rapid updates and seamless integration with other R packages for advanced statistical analyses. This adaptability makes it especially suitable for the dynamic landscape of bibliometrics, where methodological agility is essential.

The process began with data collection, wherein relevant articles, authors, and journals were extracted from selected databases and imported into the Bibliometrix platform. Subsequent analyses included descriptive statistics to identify the most prolific authors, influential journals, and trending keywords over time. Network analysis techniques were employed to visualize collaborations among researchers and institutions, as well as to examine citation networks and thematic clusters through keyword co-occurrence analysis. Visualization tools embedded within Bibliometrix, such as strategic diagrams and thematic maps, facilitated a clearer understanding of the intellectual structure and emergent themes within the research field.

The value of Bibliometrix lies in its flexibility, transparency, and capacity to efficiently process large datasets. Its integration with R ensures that analyses are customizable and reproducible attributes that are particularly advantageous in doctoral research, where methodological rigor and transparency are paramount. The decision to utilize Bibliometrix was driven by its open-source nature, extensive analytical features, and active user community, making it an effective and reliable tool for conducting comprehensive bibliometric studies. Its widespread adoption in the scientific community underscores its efficacy in mapping knowledge domains and uncovering key research trends (Aria & Cuccurullo, 2017).

2.3 Results: research trends, thematic clusters, and knowledge evolution

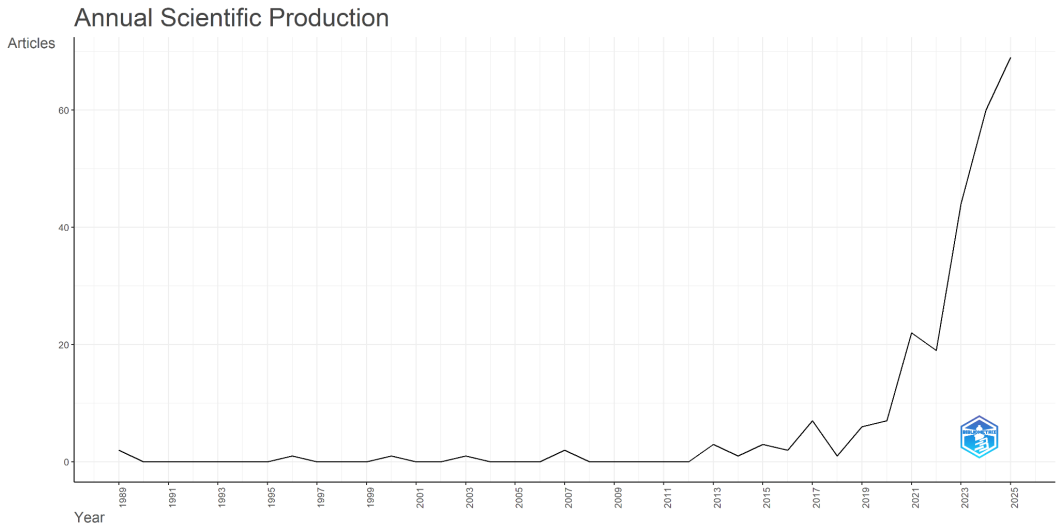
The analysis about publication with topic “phygital” is reported in Table 3 as the sample’s main descriptive information and statistics. The 252 publications were written by a total of 650 authors, with a mean of 0,38 publications per author, with an average citation count of 8,17 in the period 1989-2025.

Table 3: Key information regarding phygital sample

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	1989:2025
Sources (Journals, Books, etc)	184
Documents	251
Annual Growth Rate %	10,34
Document Average Age	2,81
Average citations per doc	8,167
References	11759
DOCUMENT CONTENTS	
Keywords Plus (ID)	422
Author's Keywords (DE)	1057
AUTHORS	
Authors	644
Authors of single-authored docs	36
AUTHORS COLLABORATION	
Single-authored docs	46
Co-Authors per Doc	3,04
International co-authorships %	22,31
DOCUMENT TYPES	
article	155
article; book chapter	4
article; early access	20
article; proceedings paper	1
biographical-item	1
book review	4
editorial material	6
editorial material; book chapter	1
fiction, creative prose	1
letter	1
music score review	1
poetry	1
proceedings paper	46
review	9

Source: own production

Figure 7: Temporal distribution of Phygital documents in 1989 -2025

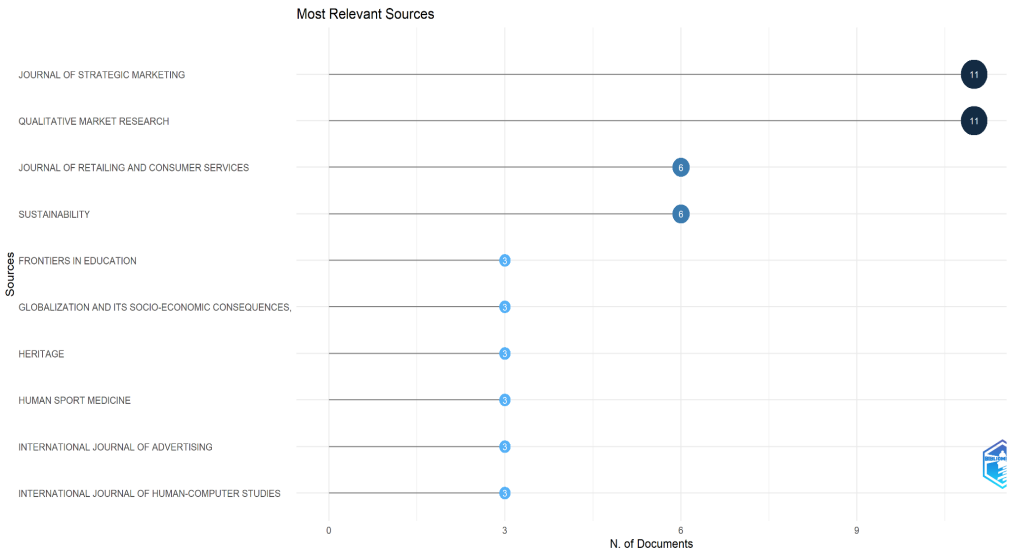


Source: own production

Figure 7 illustrates the progression of publications available in the WoS database over the period 1989-2025 which reveals an annual growth rate of, on average, 10,32%.

Key Journals

Figure 8: Top Phygital publishing journals (1989 – 2025)



Source: own production

Figure 8 presents an overview of the key phygital-publishing service journals dealing with, along with their respective impact factors. Specifically, the Journal of Strategic Marketing, Qualitative Market Research are the most productive, and influential, in their published phygital research. The distribution of publications across various disciplinary fields demonstrates the interdisciplinary nature of the topic; however, it is primarily associated with the areas of marketing, management, and services—considering that are almost half (66 papers) of the papers (155).

Key Authors

As noted, a total of 644 authors wrote the selected phygital publications. The average number of authors per paper is 3.25. As above, Table 4 shows the 17 most influential authors, sorted by their respective total number of phygital publications and their citations. The author Batat W. (Normandie Business School) has published 8 papers, as the author Mele C. affiliated at University of Naples Federico II, followed by Russo Spena T. from the same University. Matera M. and Morra D. (Polytechnic University of Milan) have both published 5 articles and then other authors published 4 or 5 articles respectively.

Table 4: Key phygital authors in terms of publications

	Authors	Latest Affiliation	TP	FTP
1	BATAT W	Normandie Business Sch	8	7,50
2	MELE C	University of Naples Federico II	8	2,52
3	RUSSO SPENA T	University of Naples Federico II	6	2,12
4	MATERA M	Polytechnic University of Milan	5	0,93
5	MORRA D	Polytechnic University of Milan	5	0,93
6	GENNARI R	Free University of Bozen-Bolzano	4	0,73
7	GRIB L	University of SS Cyril & Methodius Trnava	4	2,00
8	PRAJAPATI SP	Indian Institute of Technology (IIT)	4	2,50
9	ZAUSKOVA A	University of SS Cyril & Methodius Trnava	4	2,00
10	DAS S	Indian Institute of Technology (IIT)	3	1,50
11	DI BERNARDO I	University of Naples Federico II	3	0,65
12	GARZOTTO F	University of Milano-Bicocca	3	0,70
13	GRETZEL U	University of Southern California	3	1,17
14	LAMBERTI F	Polytechnic University of Turin	3	0,75
15	MIELI M	Lund University	3	2,33
16	RIZVI M	Heriot Watt University	3	0,53
17	ZANCANARO M	Fondazione Bruno Kessler	3	0,62

Source: own production

Key Articles

The number of total citations of a document represents its impact or influence. Table 5 presents the most cited articles with phygital topic in the period 1989 - 2025. The listed top five most cited documents were published between 2019 - 2024. All the articles were published in a journal, even if some journal didn't have Q1 evaluation. The most cited document is titled “Moving Forward and Making a Difference: Research Priorities for the Science of Service Tourism 4.0 technologies and tourist experiences: a human-centered design perspective.” by Stankov et al., (2020), which has amassed 149 total citations. In this article, the authors led the identification of a new framework for tourism. Second, the paper titled “Travelling the Metaverse: Potential Benefits and Main Challenges for Tourism Sectors and Research Applications.” (Monaco & Sacchi, 2023) has accumulated 90 total citations. Both articles are about the tourism management sector. The article “Phygital experience in the smart tourism destination” (Ballina et al., 2019) is about tourism too. Instead, the other most cited papers are about business innovation in retail.

Table 5:List of most important publications about "phygital" keyword in WOS

#	Author(s)/Year	Motivation	Journal	Total Citations	TC per Year	Normalized TC
1	Stankov, Ugljesa & Gretzel, Ulrike. (2020). Tourism 4.0 technologies and tourist experiences: a human-centered design perspective.	This conceptualization is then used to frame the importance of human-centered design for emerging Tourism 4.0 technologies.	Information Technology & Tourism	149	24,83	5,09
2	Monaco, S., & Sacchi, G. (2023). Travelling the Metaverse: Potential Benefits and Main Challenges for Tourism Sectors and Research Applications.	The paper focuses on analysing the potential benefits and challenges of the Metaverse, that has the potential to become a valuable tool for advancing tourism research through virtual collaboration and interdisciplinary research projects	Sustainability	90	30,00	6,67
3	Mancuso, Ilaria & Petruzzelli, Antonio & Panniello, Umberto. (2023). Digital business model innovation in metaverse: How to approach virtual economy opportunities.	A framework indicating how to innovate BMs in the metaverse is provided, by looking at both "phygital" transformations (i.e., transformations aimed at joining physical and digital worlds' realities) and completely virtual immersions shaping firms' internal processes and relationships with customers	Information Processing & Management	82	27,33	6,07
4	Pangarkar, Aniruddha & Arora, Vibha & Shukla, Yupal. (2022). Exploring phygital omnichannel luxury retailing for immersive customer experience: The role of rapport and social engagement.	Phygital is a new-age transformative form of omnichannel retailing that emphasizes combining the physical and digital elements, with a particular focus on the human touch to satisfy social and symbolic consumer needs.	Journal of Retailing and Consumer Services.	64	16,00	4,25
5	Ballina, Javier & Valdes, Luis & Del Valle, Eduardo. (2019). The Phygital experience in the smart tourism destination.	Purpose Information communication technologies (ICTs) of destination are not a mere mechanism of technical interaction; they are, above all, new mixed realities that integrate physical and digital resources. Using the utility of technology indicator, the purpose of this paper is to evaluate a new experiential model.	International Journal of Tourism Cities	63	9,00	3,50
6	Batat, Wided. (2022). What does phygital really mean? A conceptual introduction to the phygital customer experience (PH-CX) framework.	Although phygital is overly used across businesses, the construct lacks an academic conceptualization. This is done by fluidifying the journeys of customers from online to offline and inversely.	Journal of Strategic Marketing	55	27,50	9,32
	Mele, Cristina & Russo Spena, Tiziana. (2021). The architecture of the phygital customer journey: a dynamic interplay between systems of insights and systems of engagement.	Purpose This paper aims to focus on how companies shape the architecture of a phygital customer journey through the exploitation of smart technologies.	European Journal of Marketing	55	13,75	3,65
7	Mele, Cristina & Russo Spena, Tiziana & Tregua, Marco & Amitrano, Cristina. (2021). The millennial customer journey: a Phygital mapping of emotional, behavioural, and social experiences.	Purpose The wider possibility of connectivity offers additional opportunities for customers to experience value propositions. The online world is only one side of the customer experience. The integration of digital technologies, social presence and physical elements increases the complexity of customer journey.	Journal of Consumer Marketing	51	10,20	3,53
8	Del Vecchio, Pasquale & Secundo, Giustina & Garzoni, Antonello. (2023). Phygital technologies and environments for breakthrough innovation in customers' and citizens' journey. A critical literature review and future agenda.	Due the actuality of the issue, the literature on phygital is fragmented and far from a full understanding of its meaning and implications. Moving from these premises, our research attempts to analyse the current state of the debate about the promising role of phygital environment to identify how digital technologies are transforming physical world.	Technological Forecasting and Social Change	49	16,33	3,63
9	Särmäkari, N. (2021). Digital 3D Fashion Designers: Cases of Atacac and The Fabricant. F	In the increasingly virtual, or "phygital" space and a networked synergetic community of digital fashion, the professional, authorial, bodily and material boundaries of designers become fluid, transforming the traditional figure of fashion designer.	Fashion Theory	41	13,67	3,04
10	Barik, Sharita & Gao, Yongqiang. (2023). Exploring the hedonic factors affecting customer experiences in phygital retailing.	Phygital retailing connects physical and digital world to build unique customer experiences. Although the applications of phygital retailing are increasing, it is yet to understand what factors may influence customer experiences	Journal of Retailing and Consumer Services	40	13,33	2,96
11	Barik, Sharita. (2021). Exploring the involvement-patronage link in the phygital retail experiences.	This paper thus aims to make up this gap by examining the effects of customer involvement on their patronage intentions in the phygital retail context.	Journal of Retailing and Consumer Services	37	7,40	2,56
12	Mishra, Sita & Malhotra, Gunjan & Chatterjee, Ravi & Shukla, Yupal. (2021). Consumer retention through phygital experience in omnichannel retailing: role of consumer empowerment and satisfaction.	The purpose of this study is to understand the mechanism through which cross-channel integration (i.e., both physical and digital) influences consumer retention. The study also explores the impact of a retailer's unreliability on a consumer's phygital experience in retailing.	Journal of Strategic Marketing	37	12,33	2,74
13	Hyun, Hyowon & Park, Junglun & Hawkins, Matthew & Kim, Dongyoup. (2022). How luxury brands build customer-based brand equity through phygital experience	Digitization has significantly impacted the purchasing behavior of luxury consumers. Now, luxury brands are trying to maximize consumers' experiential value through 'phygital' marketing.	Journal of Strategic Marketing	36	9,00	2,39
14	Liu, Xuerui & Wang, Dan & Gretzel, Ulrike. (2022). On-site decision-making in smartphone-mediated contexts.	The findings suggest that smartphones create a complex phygital-social context that triggers and supports the development of new travel plans, re-examination of pre-trip plans, and cancellation of pre-trip plans.	Tourism Management	36	9,00	2,39
15	Batat, Wided. (2024). Phygital customer experience in the metaverse: A study of consumer sensory perception of sight, touch, sound, scent, and taste.	This study examines the integration of extended reality technologies (ERTs) to replicate sensory dimensions of the phygital customer experience in the metaverse.	Journal of Retailing and Consumer Services	34	17,00	5,76
16	Boudkouss, Hafida & Souad, Djelassi. (2021). Understanding in-store interactive technology use: a uses and gratifications theory (UGT) perspective	This research provides a deeper understanding of gratifications sought in using interactive technologies in a phygital store.	International Journal of Retail & Distribution Management	32	6,40	2,21
17	Batat, Wided & Hammedi, Wafa. (2022). The extended reality technology (ERT) framework for designing customer and service experiences in phygital settings: a service research agenda.	This article reviews prior works on the role technology plays in terms of customer experiences across various fields of research, including consumer, marketing and service literature	Journal of Service Management	31	10,33	2,30
18	Johnson, Matt & Barlow, Rob. (2021). Defining the Phygital Marketing Advantage.	Based on an extensive review of relevant literatures, we begin by considering a particularly important poten-tial source of phygital marketing's power.	Journal of Theoretical and Applied Electronic Commerce Research	30	6,00	2,08

Source: own production

This section seeks to depict the conceptual (or knowledge) framework by exploring the forefront of research in the phygital field (Callon et al., 1983). It is structured as follows: firstly, a thematic diagram (thematic map) showcasing a content analysis of key clusters is provided. Subsequently, a keyword analysis is conducted using an overlay visualization, illustrating the thematic development over time.

To map the conceptual structure of phygital in service and social science and to identify the main topics, a strategic diagram on the cleaned authors' keywords was employed. This diagram is also called a thematic map (Cobo et al., 2011) and it helps plot the themes identified through community detection in a bi-dimensional matrix in which the two axes are functions of centrality and density, respectively. Centrality refers to the importance of the theme in the research field, while density represents a measure of the theme's development. Thus, it allows defining of four typologies of themes according to the quadrant in which they are placed.

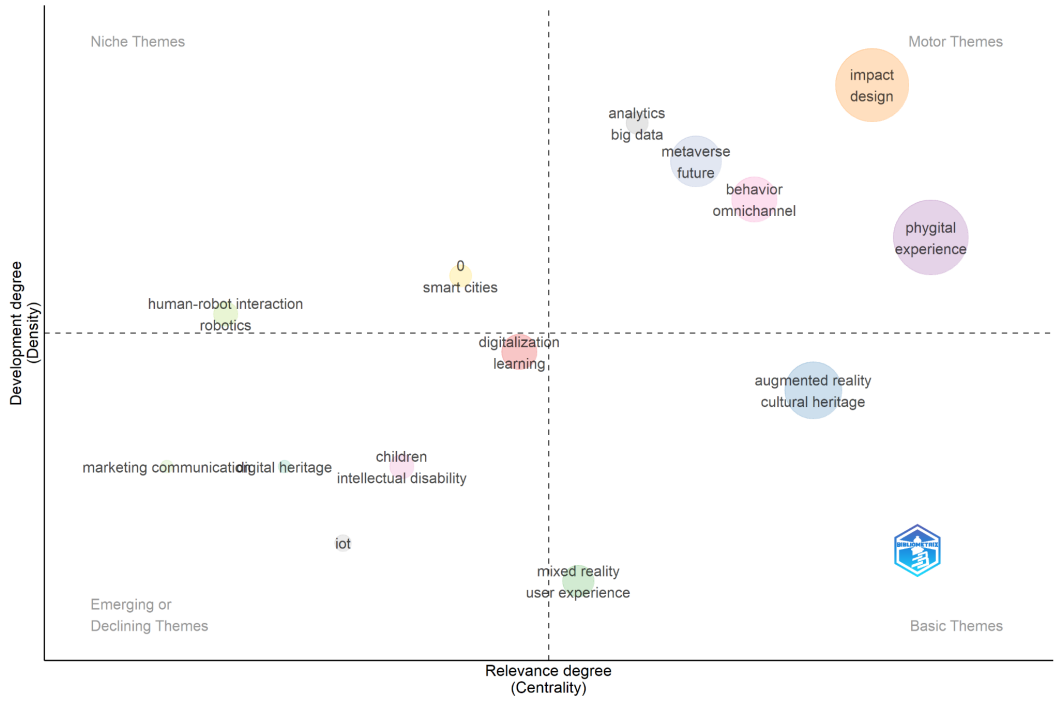
Themes in the upper-left-hand quadrant, such as robotics, are highly developed and isolated themes or niche themes. They have well-developed internal links (high density) but unimportant external links and less important for the field (low centrality). Themes in the lower-left-hand quadrant are emerging or declining themes, they have both low centrality and density, meaning that it is weakly developed or marginal. These themes are not consolidated in the literature and can develop in different directions.

The upper-right quadrant hosts themes that are both thoroughly developed, demonstrating strong internal coherence, and highly significant, exhibiting extensive external connections. These themes are characterized by resilient internal and external linkages. In contrast, the lower-right quadrant includes topics such as augmented reality, cultural heritage and mixed reality, which are marked by high centrality but relatively low density. These represent core, overarching themes that are influential across the research domain and address broad issues relevant to multiple disciplines. Each detected theme, identified through community analysis, can be visualized as a bubble on the thematic map (see Figure 9).

The most prominent terms within each cluster are those with the highest frequency of occurrence. The size of each bubble reflects the prevalence of these terms, while its spatial position on the map is determined by the cluster's centrality and density,

following the framework proposed by Callon (Callon et al., 1983). These groupings reveal specific subdomains within the wider research landscape (Pohlmann and Kaartemo, 2017). Finally, in line with the guidance provided by Mukherjee et al. (2022), a qualitative content analysis has been incorporated to deepen the scientific mapping process. As a result, each cluster is further elaborated based on its most frequently cited publications.

Figure 9: Thematic diagram about "Phygital" keywords in WOS



Source: own production

The thematic is organized in a matrix, a methodology often used in social sciences. This kind of visual organization is very explicative because a concept is composed of dimensions and indicators; a matrix of dimensions is the most direct way to visualize the logical structure of a concept (Goertz, 2006). In an explorative study like this, where the concept is common to different disciplines, it could be useful to apply a typological theorizing involving the cross-classification of variables in a matrix form to identify combinations that explain empirical outcomes (Goertz & Mahoney, 2012).

The matrix is organized into four quadrants, each representing different types of themes based on their development (density) and relevance (centrality).

- Upper-Right Quadrant (Motor Themes)

Impact Design:

Positioned as a well-developed and highly relevant theme. This indicates that research in this area is both advanced and influential within the broader field.

Phygital Experience:

Also located in this quadrant, suggesting strong development in the integration of physical and digital experiences, emphasizing its importance in research.

- Upper-Left Quadrant (Niche Themes)

Human-Robot Interaction and Robotics:

These are highly developed but more specialized themes. They are significant in their internal development but have less influence on broader research.

- Lower-Right Quadrant (Basic Themes)

Augmented Reality, Cultural Heritage:

These are central to the field and foundational, though not as deeply developed. They serve as key underpinnings across different research areas.

Mixed Reality, User Experience:

These themes are crucial in understanding and shaping user interactions in digital environments, foundational but still developing fully.

- Lower-Left Quadrant (Emerging or Declining Themes)

Marketing Communication, Digital Heritage, IoT:

These themes have not yet fully developed or may be declining. They currently have less impact and development but could evolve in new directions.

Children, Intellectual Disability:

These areas may reflect niche interests or emerging fields that have the potential to grow with further research focus.

Smart Cities:

Positioned here as potentially emerging, indicating an interest in integrating new technologies into urban planning and development.

Central Themes

Digitalization, Learning:

Centrally located, indicating a balance of development and relevance. These are integral themes likely impacting various aspects of research.

Overall, the map provides a comprehensive overview of the current state and potential directions in this research field, highlighting both established areas and those ripe for exploration.

The central themes of "Digitalization" and "Learning" occupy a pivotal position in the thematic map, indicating their balanced combination of development and influence within the research landscape. These central themes hold considerable potential for enriching research and fostering innovation, emphasizing their critical role in the academic and practical progression of the field. Their central location underscores their importance as they bridge multiple research areas, providing foundational insights while influencing diverse studies. By focusing research efforts on these central themes, one can enrich the understanding and scope of related studies. They serve as key pivot points for expanding and integrating new knowledge across disparate fields. As such, examining these core themes in greater depth can yield significant contributions to both theoretical and practical applications.

To further refine the research approach, the next stage will involve dissecting a research string focused on these central concepts. This will include exploring how digitalization and learning intersect and influence various domains, enabling a comprehensive examination of their roles in shaping future advancements.

2.4 Integration with the Phygital Learner Journey model

The initial bibliometric analysis on the term "phygital" revealed that "learning" indeed constitutes a central theme within the studies on phygital, although it remains insufficiently explored. The data sources considered for the study were the same collection of Web of Science (WOS), the world's leading database of published articles and citations (Goyal and Kumar, 2020). Consequently, a second analysis was conducted using the same tool, WOS, with the search query: "(phygital) AND (digitalization OR digital transformation OR digital innovation) AND (learning OR education OR training)." This query was designed to further investigate publications specifically focused on the various aspects of blended learning.

This further integration allows for the identification of what is present in the literature regarding the phygital learning model and complements quantitative data on the existing scientific output.

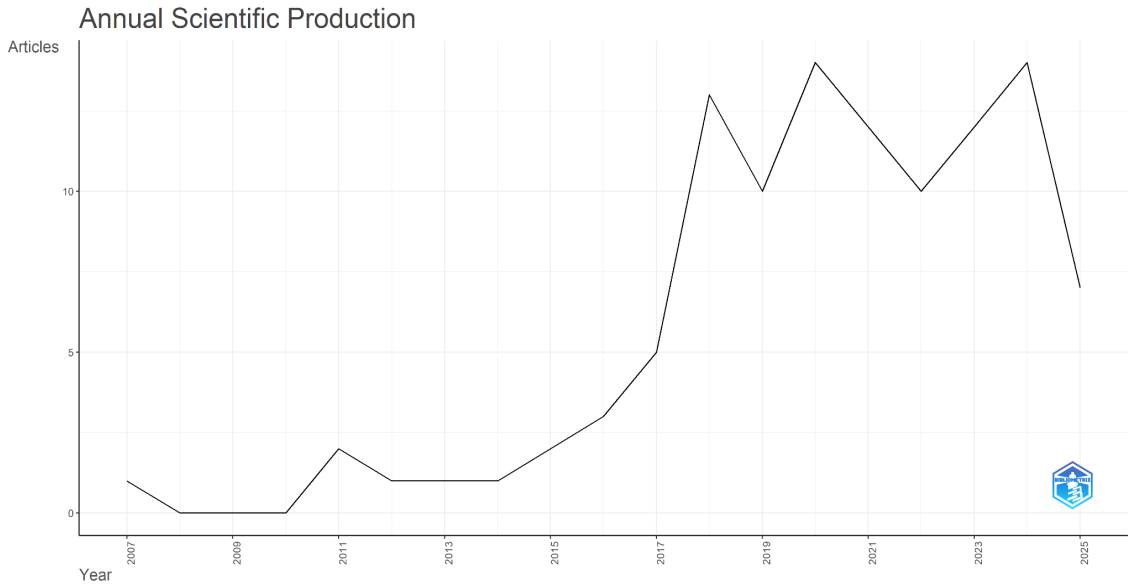
Table 6 reports on the sample's main descriptive information and statistics. The 108 publications were written by a total of 326 authors, with a mean of 0,3 publications per author, with an average citation count of 9,14 in the period 2007-2025.

Table 6: Key information regarding phygital learning publications

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2007:2025
Sources (Journals, Books, etc)	93
Documents	108
Annual Growth Rate %	11,42
Document Average Age	4,69
Average citations per doc	9,148
References	3107
DOCUMENT CONTENTS	
Keywords Plus (ID)	84
Author's Keywords (DE)	394
AUTHORS	
Authors	326
Authors of single-authored docs	21
AUTHORS COLLABORATION	
Single-authored docs	21
Co-Authors per Doc	3,13
International co-authorships %	13,89
DOCUMENT TYPES	
article	63
article; book chapter	1
article; early access	2
article; retracted publication	2
proceedings paper	37
review	3

Source: own production

Figure 10: Annual scientific Production



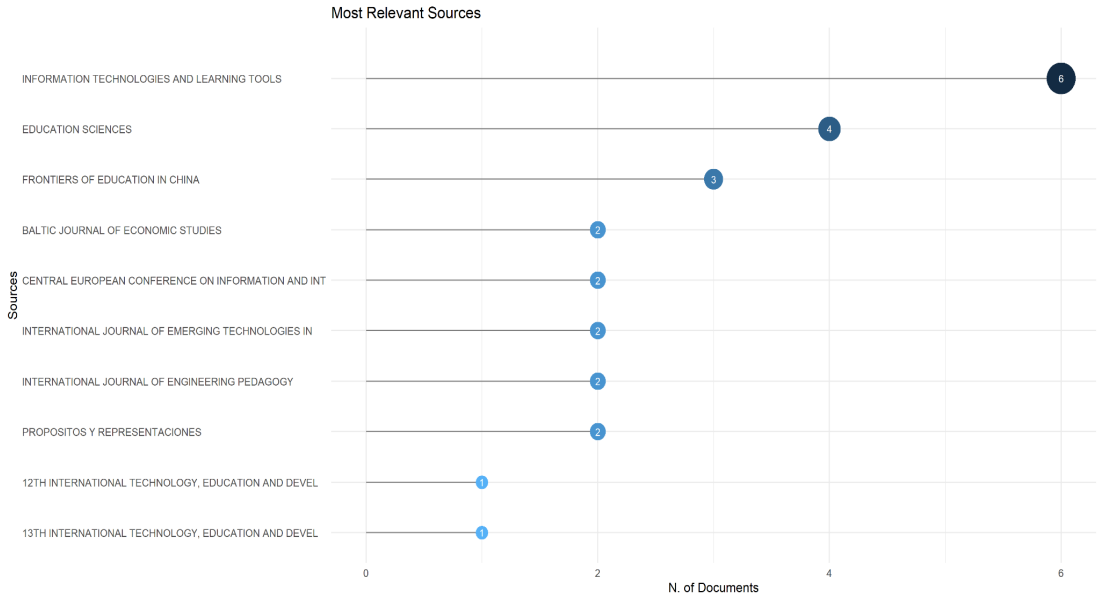
Source: own production

Figure 10 illustrates the progression of publications available in the WoS database over the period 2007-2025 which reveals a significant increase in publications has been observed since 2017.

Key Journals

Figure 11 presents an overview of the key phygital-publishing service journals dealing with, along with their respective impact factors. Specifically, the Journal of Information Technologies and Learning Tools is the most productive. The list of key journals also highlights a strong interest in various geographic contexts: both Frontiers of Education in China and Baltic Journal of Economic Studies are included. It is worth noting that some publications belong to the proceedings of conferences: this can be explained by the fact that the topics addressed in phygital learning are both emerging and specialized.

Figure 11: Top Phygital publishing journals (2007 -2025)



Source: own production

Key Authors

As noted, a total of 326 authors wrote the selected phygital learning publications. The average number of authors per paper is 2.

Table 7: Key phygital learning authors in terms of publications

Paper	**TC**	**TC per year**	**Normalized TC**
BYGSTAD B, 2022, COMPUT EDUC	145	36,25	7,97
PETTERSSON F, 2021, EDUC INF TECHNOL	88	17,60	4,76
ELSAYARY A, 2024, J COMPUT ASSIST LEARN	78	39,00	8,74
ALENEZI M, 2021, EDUC SCI	67	13,40	3,62
DEL VECCHIO P, 2023, TECHNOL FORECAST SOC CHANG	49	16,33	5,76
LIMANI Y, 2019, IFAC PAPERSONLINE	34	4,86	3,15

NGUYEN THI HUONG GIANG NTHG, 2021, INT J ENG PEDAGOG	32	6,40	1,73
LIANG W, 2019, MULTIMED TOOLS APPL	29	4,14	2,69
RODRIGUES LS, 2017, VISION 2020: SUSTAINABLE ECONOMIC DEVELOPMENT, INNOVATION MANAGEMENT, AND GLOBAL GROWTH, VOLS I-IX, 2017	24	2,67	3,24
MEI XY, 2019, J APPL RES HIGH EDUC	22	3,14	2,04
PUNIE Y, 2007, NORD J DIGIT LIT	21	1,11	1,00
RONZHINA N, 2021, INT J EMERG TECHNOL LEARN	19	3,80	1,03
AHMED MU, 2018, ELECTRON J E-LEARN	19	2,38	3,34
AREA MOREIRA M, 2018, RIED-REV IBEROAM EDUC DISTANCIA	19	2,38	3,34
MOHAMMED S, 2020, TURK ONLINE J DISTANCE EDUC	18	3,00	3,50

Source: own production

As above, Table 7 shows the 15 most influential authors, sorted by their respective total number of phygital learning publications and their citations. In terms of total citations, Bygstad B. (University of Oslo) leads with 145 citations, followed by Pettersson F., affiliated at University in Finland with 88 citations and Elsayary A., (Zayed University), cited 67 times. Nevertheless, this analysis noticed that most of the authors in selected database have a maximum of two phygital learning articles to their name, implying that younger or newer service researchers tended to pick phygital learning as an area of research interest.

Key Articles

In this section of the study, a deliberate choice was made to include not only articles published in journals but also those presented as proceedings at conferences. This

decision was informed by the innovative nature of the topic and its ongoing redefinition in accordance with the expanding technological landscape. For instance, the subject of AI is frequently addressed in more recent studies, often published after conference presentations. In the field of phygital learning, most of the emerging results pertain primarily to the higher education sector. However, museums are also considered part of the higher education ecosystem (Sabiescu & Charatzopoulou, 2024) and are increasingly involved in phygital educational strategies.

Table 8: List of most important publications about "phygital learning" in WOS

Author(s)/Y ear	Motivation	Journal	Total Citations	TC per Year	Normalize d TC
Bygstad, B., Øvrelid, E., Ludvigsen, S., & Dæhlen, M. (2022). From dual digitalization to digital learning space: Exploring the digital transformation of higher education	Inspired by the fast digitalization during the Covid-19 crisis, it investigates a key aspect of digital transformation of higher education – the emergence of a digital learning space.	Computers & Education	145	36,25	7,97
Pettersson, F. (2021) Understanding digitalization and educational change in school by means of activity theory and the levels of learning concept	In the study it is argued for a broader perspective on the concept of digitalization, viewing it as a process involving change and transformation in different stages and several organizational levels and elaborate the concept of digitalization as well as how schools are dealing with digital and educational change.	Education and Information Technologies	88	17,6	4,76
ElSayary, A. (2024). An investigation of teachers' perceptions of using ChatGPT as a supporting tool for teaching and learning in the digital era	Theresearch investigates teachers' perceptions of using ChatGPT as a digital supporting tool for teaching and learning practices. This includes lesson planning, teaching and learning activities, assessment and feedback and the challenges and benefits explored.	Journal of computer assisted learning	78	39	8,74
Alenezi, M. (2021). Deep Dive into Digital Transformation in Higher Education Institutions	Contemporary higher education institutions have been embracing new technologies and transforming their practices, business models and process though phygital aspects.	Education Sciences	67	13,4	3,62
Del Vecchio, P., Secundo, G., & Garzoni, A. (2023).Phygital technologies and environments for breakthrough innovation in customers' and citizens' journey. A critical literature review and future agenda	The research analyses the current state of the debate about the promising role of phygital environment to identify how digital technologies are transforming physical world.	Technological Forecasting and Social Change	49	16,33	5,76
Limani, Y., Hajrizi, E., Stapleton, L., & Retkoceri, M. (2019). Digital Transformation Readiness in Higher Education Institutions (HEI): The Case of Kosovo	The specific importance of this study relates to the level of use of digital technologies during the teaching process as well as administrative activities that enable advanced communication between institutions, students, academic and administrative staff, as well as other internal and external networking processes.	Ifac-papersonline	34	4,86	3,15
Giang, N. T. H., Hai, P. T. T., Tu, N. T. T., & Tan, P. X. (2021). Exploring the readiness for digital transformation in a higher education institution towards industrial revolution 4.0.	The study aims to analyze the characteristics of the digital university model to identify the criteria for assessing the availability of the digital transformation process and contributes to a better understanding of four basic facets of the digital university: Education Program, Learners, Training Services, and Governance.	International Journal of Engineering Pedagogy	32	6,4	1,73
Liang, W. (2019).Scene art design based on human-computer interaction and multimedia information system: an interactive perspective (Retracted article. See SEP, 2022)	The paper uses constructivist learning theory to construct a new teaching model, including innovative teaching content and methods of change. In conceptualizes phases and possibilities for hybird learning environment.	Multimedia Tools and Applications	29	4,14	2,69
Rodrigues, L. S. (2017).Challenges of digital transformation in higher education institutions: A brief discussion.	Although digital transformation is most often associated with business organizations, it is also an important issue for HEIs and presents some challenges that must be considered when defining digital policies and strategies. In the paper, as a starting point for our research, a brief discussion on the main challenges of digital transformation in HEIs is presented.	VISION 2020: Sustainable economic development, innovation management and global growth, Vols I-IX, 2017	24	2,67	3,24
Mei, X. Y., Aas, E., & Medgard, M. (2019). Teachers' use of digital learning tool for teaching in higher education: Exploring teaching practice and sharing culture.	The purpose of the paper is to explore teachers' use of digital learning tools for teaching in higher education. Moreover, it investigates how the use of digital tools affects educational practices and how teachers experience the culture of sharing among colleagues and within the organisation.	Journal of Applied research in Higher Education	22	3,14	2,04
Punie, Y., & Ala-Mutka, K. (2007). Digital competence for lifelong learning	This article discusses the elements of and requirements for digital competence for learning in a knowledge-based society, where Information and Communication Technologies (ICT) play a key role. Key challenges for future learning are both the need for new digital skills and the provision of new ways for learning and maintaining them.	Nordic Journal of Digital Literacy	21	1,11	1
Ronzhina, N., Kondyurina, I., Voronina, A., Igishev, K., & Loginova, N. (2021).Digitalization of modern education: problems and solutions. I	Digitalization in education is closely related to a new way of life in a digital environment and the emergence of generations who were born and study in the specific environment. The study was based on a survey assessing the quality of digitalization in education.	International Journal of Emerging Technologies in Learning	19	3,8	1,03
Ahmed, M. U., Hussain, S., & Farid, S. (2018). Factors influencing the adoption of e-learning in an open and distance learning institution of Pakistan.	Th paper engages the concept and aims of e-learning with regard to the issues in the developing countries and also elaborates major challenges of e-learning.	Electronic Journal of e-Learning	19	2,38	3,34
Moreira, M. A. (2018).Las aulas virtuales en la docencia de una universidad presencial: la visión del alumnado.	Universities are currently transitioning from a 19th-century teaching model based on knowledge transmission through printed cultural objects and lectures to a pedagogical model focused on active and constructive student learning through digital resources. The special issue analyzes the digital transformation of higher education.	RIED Revista Iberoamericana de Educación a Distancia	19	2,38	3,34
Mohammed, S., & Kınyo, L. (2020). Constructivist theory as a foundation for the utilization of digital technology in the lifelong learning process. T	The paper examines both the diverse approaches to lifelong learning and the digital tools available to promote these strategies and contains a review of some of the main articles pertaining to the fields of constructivism, digital technology, and the process of lifelong learning.	Turkish Online Journal of Distance Education	18	3	3,5
Xu, D., Zhang, W., Zhang, C., Mao, R., & Wang, C. (2024). Digitally enriched exhibitions: Perspectives from Museum professionals.	The analysis suggested the social representation is featured by 1) educational intent, 2) artefact -centred design, 3) complex visitor experience management, 4) critique of lacking cultural values, and 5) phygital strategy.	Tourism management	17	8,5	1,9
Rossi Cordero, A. S., & Barajas Frutos, M. (2017). Competencia digital e innovación pedagógica: Desafíos y oportunidades	The article presents the results of research on teaching practices related to digital competence and the perception of benefit and confidence in the use of ICTs.Teachers demand a training more consistent with their teaching needs.	Profesorado-Revista de Curriculum Y Formacion de profesorado	17	2,13	2,99
Beloev, H., Smrikarov, A., Voinohovska, V., & Ivanova, G. (2023). Determing the Degree of digitalization of a Higher Education Institution.	The article aims to explore and present a framework for determining the degree of digitalization within (higher) education institutions, considering both quality and quantity factors.	Strategies for Policy in Science & Education	15	5	1,76

Source: own production

Thematic map

The thematic map in Figure 12 is the graphic representation of bibliometric analyse about phygital learning: unlike the previous thematic map focused solely on the phygital concept, where we examined the intersection of multiple disciplines, this matrix presents the specific aspects associated with the concept of phygital learning. The concept of "phygital" is a neologism (Mele & Russo-Spena, 2025), and "learning journey" (Ayutthaya & Koomsap, 2022) is a broad and complex notion. This additional analysis of the relevant dimensions is therefore highly valuable in facilitating the development of a comprehensive model.

Also, this matrix is organized into four quadrants, each representing different types of themes based on their development (density) and relevance (centrality).

Upper-Right Quadrant (Motor Themes)

Phygital: Positioned in the center of the quadrant. This indicates that research in this area is both advanced and influential within the technical context.

Digital maturity: it might be in the early stages of exploration or relevant to niche areas.

Upper-Left Quadrant (Niche Themes)

E learning and blended learning:

stand out as key drivers with high development and centrality, suggesting they are established and influential topics.

Lower-Right Quadrant (Basic Themes)

Technology e ICT:

These are central to the field and foundational, at the center of the quadrant. They serve as key for infrastructure.

Higher Education, Digitalization:

These themes are crucial and have foundational topics essential for the framework.

Education and digital skill:They form the core knowledge or infrastructure people build upon

Lower-Left Quadrant (Emerging or Declining Themes)

Digital Transformation, Innovation:

Centrally located, indicating a balance of development and relevance. These could be in the early stages of potentially declining.

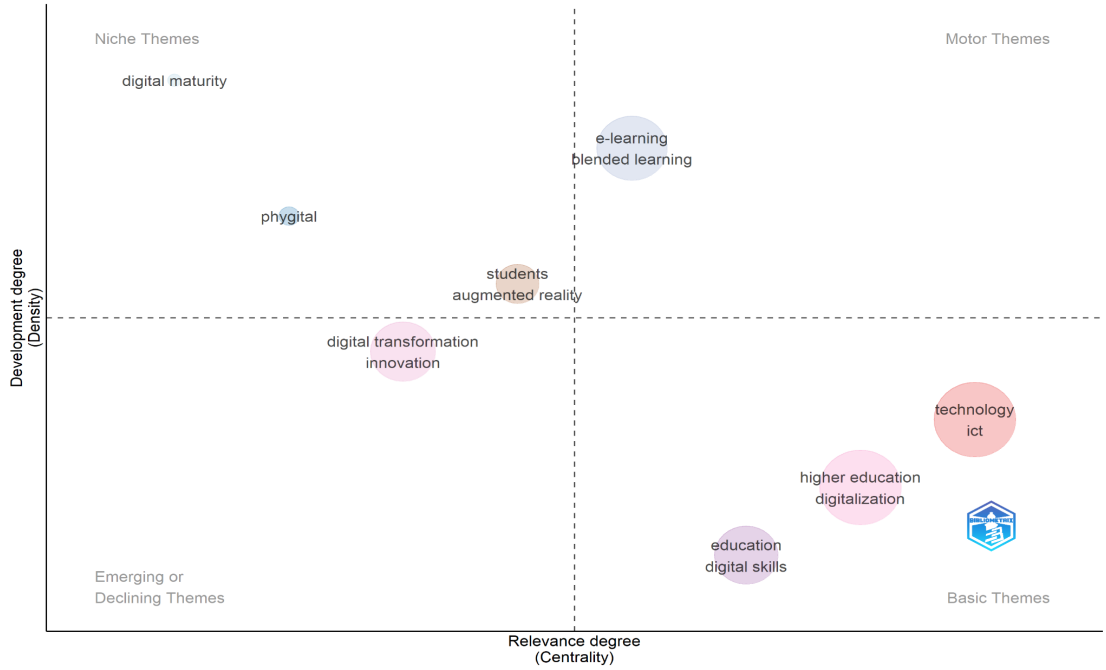
Central Themes

The central themes of "Student" and "Augmented reality" occupy a pivotal position in the thematic map, indicating the main actor and the main interesting technology. The student becomes central within the concept of the "phygital learning journey," similar to how the consumer is central in the "customer journey" (Mele et al., 2021). Additionally, there is a notable push toward augmented reality, which was already present in the previous matrix but now assumes a more central role. These observations highlight a shift towards more integrated and digitally advanced experiences.

The matrix indicates also a significant evolution: the concept of digital transformation is declining relative to "phygital," which is still developing but appears within the niche themes. Meanwhile, "phygital" itself remains an emerging area with potential for growth.

This matrix helps visualize where different themes stand in terms of their development and importance, guiding strategic decisions and research focus.

Figure 12: Thematic diagram about "Phygital learning" keyword in WOS



Source: own production

2.5 Implications for theoretical positioning of the qualitative study

This comprehensive quantitative analysis of the existing literature was undertaken to better delineate the theoretical framework of the phygital learning concept.

The initial focus was solely on the "phygital" dimension, a relatively nascent and still evolving construct, which necessitated an exploration of its developmental trajectory over time as well as an assessment of the key academic contributions in this domain. The foundational understanding that phygital encompasses the seamless integration of physical and digital environments, thereby constructing a hybrid reality (Mele and Russo Spena, 2022), provided a conceptual baseline. Building on this, it became crucial to contextualize the phenomenon within the sphere of higher education, specifically concentrating on the student journey through learning pathways within universities.

Bibliometric analysis revealed a nascent yet rapidly growing research interest in phygital learning, with publications emerging from 2008 and experiencing a marked increase post-2019. This upward trend aligns with broader societal and technological shifts, notably the impact of the COVID-19 pandemic, which acted as a catalyst for digital transformation in education (Batat, 2022), and the accelerated integration of advanced digital technologies, including artificial intelligence (AI), into pedagogical practices (Mele et al., 2023). Such developments have foregrounded the importance of understanding how phygital environments can foster more engaging, personalized, and effective learning experiences.

Despite this growth, the analysis of citation impacts reveals that only three of the fifteen most influential papers — based on citation counts — focus on empirical case studies. This highlights a significant gap in the literature regarding the transition from theoretical constructs to empirical investigation, underscoring the need for more grounded research that can inform practice. The gap emphasizes that, although the conceptual and technological foundations are increasingly articulated, there remains a lack of comprehensive understanding of how phygital learning journeys unfold in real-world higher education settings, especially from a service innovation perspective.

Building upon these insights, the subsequent phase of research will adopt a qualitative approach, complementing the bibliometric analysis with participatory observations of phygital learning initiatives within university consortia.

The qualitative study, initially conceptualized through a closed-ended questionnaire, evolved to include the administration of semi-structured, open-ended interviews. Semi-structured interviews are particularly valuable for capturing participants' experiences and viewpoints, providing a balance between guided inquiry and open dialogue (Kallio, et al. 2016). Interviews aimed to capture stakeholders' perceptions of the phygital learning journey beyond their formal roles, providing deeper insights into their experiences. Semi-structured interviews are a vital methodological tool for qualitative research, allowing researchers to probe participants lived experiences while retaining sufficient flexibility to pursue emerging themes (Smith, 1995). Additionally, the interviews sought to identify the key challenges faced in managing complex processes within phygital environments, particularly concerning resource allocation—both physical and human—and the strategies required to address these challenges effectively.

For both the interviews and the questionnaire, the key concepts emerging from the thematic map were considered: specifically, blended learning and higher education have become crucial elements in selecting the research context for the case studies. Qualitative research is an approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem (Denzin & Lincoln, 2018). Scholars underline that only qualitative research provides insights into how people make sense of their life worlds and the meanings they ascribe to their experiences (Creswell & Poth, 2018). According to this approach, qualitative investigation aims to articulate the detailed roles of involved actors—faculty, students, policymakers, and technology providers—and to identify the key process stages necessary to translate the theoretical framework into an operational model. Such a model should be designed as a replicable and scalable service framework that aligns with contemporary higher education challenges and innovations. This approach argue that service design thinking is essential for fostering innovative, user-centric educational models in digital contexts. Ultimately, the goal is to develop a pragmatic, evidence-based operational framework that enables higher

education institutions to systematically implement phygital strategies, thereby contributing to the ongoing digital transformation in higher education and enhancing the overall student experience.

CHAPTER III

METHODOLOGY

SUMMARY**:** 3.1 Qualitative research design rationale – 3.2 Context and sampling strategy – 3.3 Data collection methods (e.g., interviews, observations, analytics logs if included qualitatively) – 3.4 Data analysis procedures (coding, thematic analysis, validation strategies) – 3.5 Ethical considerations and research quality criteria

3.1 Qualitative research design rationale

This research employs a qualitative design to deeply examine the multifaceted phenomena of *phygital learning journey* in higher education institutions. Qualitative inquiry is chosen for its ability to explore complex social dynamics, interpret meanings, and offer rich, contextualized understandings of individual experiences (Creswell & Poth, 2017; Merriam & Tisdell, 2016). This part of study centers on gathering and analyzing detailed descriptive data—including semi-structured interview transcripts, institutional documents, participant observations, and reflective field notes—to uncover patterns, dynamics, and critical contextual factors that influence the creation and effectiveness of phygital ecosystems (Stake, 1995). The selection of qualitative methods, particularly face-to-face interviews, has traditionally been preferred in research on students' quality of life because it offers an in-depth approach to understanding campus life. Through qualitative research, information completely unanticipated by students soliciting input about the quality of campus life – or learning process- can be collected (Manning, 1992). This approach was generally used also for check effectiveness of online courses by instructional designer and learning stakeholders (Griffith, 2013). The selection of a qualitative approach allows for a nuanced exploration of the research questions, granting flexibility to adapt data collection and analysis techniques as new themes and insights emerge (Miles, Huberman, & Saldaña, 2014).

This is particularly relevant given the emergent nature of phygital learning, where the intersection of physical and digital spaces is constantly evolving. Qualitative research, in this context, serves to provide an interpretive framework for understanding how various actors—including students, faculty, and administrators—perceive the experience, and interact within these hybrid learning environments (Denzin & Lincoln, 2011). Furthermore, the chosen qualitative methodology aligns with the study's emphasis on generating in-depth, holistic understandings of the specific contexts and perspectives of the case studies. Qualitative case study research is particularly well-suited for exploring complex phenomena within real-life settings.

The research design is based on face-to-face interview with a semi-structured questions and empowered thought observant participation. The interviews were structured based on the thematic map derived from the quantitative analysis of publications, as examined through the bibliometric analysis presented in the previous chapter. Consequently, particular focus was given to aspects related to augmented reality—although not present in the case studies, it is notably relevant within the reference literature. Regarding institutional components (coordinators, faculty members, technical staff, and administrative staff), both the technological aspects and digital skills were addressed, in accordance with the themes identified in the thematic matrix shown in Figure 6 from the previous chapter.

The questionnaire, on the other hand, considered the clusters identified in the co-occurrence analysis related to digital skills and techniques, in addition to learning management systems.

This design rationale aims to move beyond surface-level descriptions, seeking to illuminate the underlying mechanisms and intricate relationships that contribute to successful—or unsuccessful—phygital learning pathways. Ultimately, this approach enables a deeper, more meaningful contribution to the theoretical and practical understanding of how to design, implement, and manage phygital learning ecosystems in higher education. The triangulated approach, integrating semi-structured interviews, the questionnaire, the participant observations, and document analysis to achieve a comprehensive and multi-layered understanding of the phygital learning ecosystems within are the two case studies. Methodological triangulation enhances the depth and validity of qualitative research by exploring phenomena from multiple perspectives (Wolff et al., 2019), which is particularly crucial when investigating complex, emergent educational practices that span physical and digital domains.

3.2 Context and sampling strategy

The research context encompasses two distinct higher education projects serving as case studies, each actively engaged in the development and implementation of phygital learning environments.

In every phygital learning pathway, there are key stakeholders: teachers, students, staff (both financial and administrative), project coordinators, and department directors.

A phygital learning process is based on a hybrid learning -onsite and online- and includes a series of technological innovations, including the integration of digital platforms that support in-class lessons, which often take place in innovative formats. Therefore, while the questionnaire was distributed to the entire pool involved in the projects, the interviews were conducted by selecting privileged representatives from each category, with staff members playing a particularly important role. The selected projects feature extensive digital delivery, both synchronously and asynchronously, along with various technological tools that make the organizational aspects of the project challenging. Management challenges in such complex pathways are numerous, involving not only bureaucratic procedures and technological infrastructure—such as technical resources—but also human resource management, often complicated by physical distance, geographical dispersion, and diverse backgrounds among stakeholders.

The case studies were selected from two excellence projects at the University of Federico II and were chosen due to the unique phygital features of their design.

The selected Phygital learning projects are European Inclusive Education for Digital Society and Global Citizenship (EURIDICE) and Science Hubs for Advanced Research & Education Africa (SHARE), along with a bachelor's degree program, and involve partnerships not only with the Federico II University but also with a variety of both Italian and international prestigious institutions.

The selection of these two case studies responds to the need to identify projects capable of significantly representing the evolution and current state of higher

education models within both the European and international contexts. Specifically, the selection was based on three main criteria:

- Educational and Technological Innovation:

Both projects incorporate hybrid learning modalities, advanced digital tools, and innovative pedagogical approaches centered on novel methods of engagement.

- Relevance to the Transformation of the Higher Education Ecosystem:

Both Eurydice and SHARE Africa aim to foster open, flexible, and interconnected learning environments where the traditional distinction between in-person and online education is reinterpreted in a complementary manner.

- Diversity of Context and Target Audience:

The projects operate within different geographical, socio-cultural, and institutional settings, allowing for a particularly rich and multidimensional comparative analysis.

The presence of these elements makes the two projects emblematic cases for understanding how educational practices can evolve towards more inclusive, transdisciplinary, and digitally integrated formats. Their comparison highlights how phygital experience can adapt to vastly different contexts, emphasizing its versatility as an innovative educational model.

EURIDICE, is the acronym for EUROpean Inclusive Education for Digital Society, Social Innovation, and Global Citizenship, is a European initiative aimed at training a new generation of professionals capable of operating at the intersection of digital technologies, social innovation, and public communication. The core objective of the project is to develop interdisciplinary training pathways targeted at students, educators, and professionals, with the goal of fostering advanced digital skills and a systemic understanding of ongoing social transformations. The initiative is grounded in the fundamental values of the European Union—namely inclusion, democratic participation, equity, and active citizenship—and seeks to relate these principles to the challenges posed by contemporary digital societies. EURIDICE project reflects a large-scale initiative characterized by substantial infrastructural investments in digital technologies integrated seamlessly with innovative pedagogical approaches. This case aims to explore the deployment of advanced

digital ecosystems in well-resourced settings, highlighting scalability, technological innovation, and institutional strategies.

Strategically, EURIDICE aims to promote an education model that integrates technological, pedagogical, and socio-cultural aspects, overcoming the disciplinary fragmentation typical of traditional university systems. Other aim is developing digitally competent citizens capable of understanding, contributing to social innovation processes and prepare professional profiles able to work within sectors such as information, public communication, and cultural mediation; at the end foster the dissemination of a hybrid educational ecosystem, where in-person and online teaching are integrated into a continuum of meaningful learning experiences.

The EURIDICE consortium involves three partner universities and is structured into three distinct programs, designed to respond to different educational needs:

- Student Program (Joint European Master's Program, 120 ECTS):

An innovative course combining interdisciplinary instruction, digital laboratories, international mobility, and social innovation projects.

- Faculty Program:

A set of capacity-building activities aimed at developing digital pedagogical competencies to support the creation and dissemination of hybrid and inclusive teaching practices.

- Professional Program:

A modular lifelong learning offer designed to update professionals operating in sectors such as education, culture, communication, and the third sector, through flexible and adaptable pathways tailored to work-related needs. In this part are also scheduled MOOC courses for teachers and experts.

EURIDICE thus represents an advanced model of educational innovation, capable of integrating curricular, technological, and social dimensions within a unified training framework.

Within this educational architecture, a particularly significant role is played by the master's program DIGISOC (Digital Society, Social Innovation, and Global Citizenship), which constitutes the cornerstone of the joint European program for students and has been my first context of research for this part of the study.

The master's program is designed to train professionals capable of operating within digital society in a critical, responsible, and interdisciplinary manner. The curriculum design of the Master's integrates technical, digital, social, and ethical skills to prepare professionals capable of recognizing socio-technological transformations and contributing to their sustainable and inclusive governance. Overall, DIGISOC exemplifies educational innovation within the EURIDICE framework, as it concretizes the phygital, intercultural, and social innovation-oriented dimension that constitutes the distinctive hallmark of the project.

Alongside the European experience of EURIDICE, the SHARE AFRICA project offers an alternative and complementary perspective by situated in a profoundly different geographical and institutional context. While EURIDICE operates within a well-established political and academic framework, SHARE AFRICA is embedded in a reality characterized by infrastructural challenges, disparities in access, and the imperative to develop new forms of intercontinental cooperation. This case emphasizes innovative, community-oriented, and personalized phygital strategies designed to address infrastructural challenges and leverage mobile technology and community engagement models. This contrast allows the study to examine the influence of resource availability, infrastructural constraints, and contextual adaptation on phygital learning practices (Yin, 2018; Keengwe & Kidd, 2010).

SHARE is instead the acronym of Science Hubs for Advanced Research and Education with Africa; it was launched with the aim of strengthening scientific and educational collaboration between Italy and Africa, fostering professional development opportunities, cultural exchange, and international cooperation. The project aligns with Italy's national strategies for higher education internationalization, as outlined in PNRR and with the European Union's strategies on science diplomacy. The project is coordinated by the Fondazione IHEA (Italian Higher Education with Africa), which has been working since 2020 to establish a network connecting leading Italian academic institutions with African higher education entities. SHARE Africa is structured to empower peer-to-peer scientific cooperation between 6 Italian Universities associated in Italian Higher Education with Africa (IHEA) Foundation (University of Bologna, University of Florence,

University of Naples “Federico II”, University of Padua, “Sapienza” University of Rome and Polytechnic of Milano) and 50 African Higher Education Institutions. The track record of IHEA Foundation boasts a Specializing Master in Ethiopia (60 ECTS) and 5 Intensive Advanced Courses in Tunisia and Ethiopia targeting more than 130 young academicians in 2 years. The asset of the existing relationships and the current records of activities, combined with considerations strategic for Italy in terms of foreign affairs policy, international cooperation strategies, migration policies and industrial interest, led IHEA Foundation to identify the Middle East & North Africa Region (MENA), with focal Hubs in Tunisia and Ethiopia, as the target regions. From the same analysis, Early Career Academicians are the target group since they are already part of the academic system, yet young enough to grantee the best exploitation of the projects’ results along their career since they, being alumni of SHARE Africa will act as the Italy Africa Education and Research Ambassadors. SHARE Africa will coordinate with other consortia funded under the same call to maximize the benefit for the Italian academic system in term of networking and alumni. The consortium is responsible for both in presence courses and MOOCs. Distinctive for its phygital approach, SHARE Africa combines in-person lessons, practical activities on the ground, and digital tools such as MOOCs and online exercises. Unlike a mere transfer of European course content, the training pathways are conceived from the outset as hybrid and purposefully designed to function as a circular university ecosystem: each module, whether online or face-to-face, is preparatory for subsequent ones, with strategic touchpoints linking physical and digital learning spaces. In this model, students undertake a comprehensive learning journey, where the online preparatory phase introduces core concepts, which are then reinforced through in-class activities involving practical exercises and direct interaction. The teaching approach is not limited to replicating online content but aims to create an integrated experience wherein digital and physical modalities complement each other, fostering a virtuous cycle of learning.

The analysis of the two projects, EURIDICE and SHARE AFRICA, highlights how educational innovation can take different forms while pursuing shared objectives: developing hybrid, inclusive, and functional university ecosystems capable of

integrating in-class experiences with digital learning. With an in deep research the project enables an exploration of how the hybrid educational ecosystem paradigm can be adapted across diverse contexts, highlighting both its potentials and limitations in different settings.

Cases are a model of phygital learning for innovative and integrated pedagogy: the training pathways combine in-person lectures with online activities, digital laboratories, and MOOCs, creating an educational continuum where each phase is preparatory for the subsequent one. The programs are not limited to transferring existing content in digital formats; instead, they are conceived from the outset as integrated ecosystems, with strategic touchpoints linking classroom experiences and online tools. Both initiatives aim to cultivate citizens and professionals capable of operating within complex contexts, possessing transversal skills that encompass digital competence and cultural awareness. The approach is circular: the structure of these pathways is designed as a virtuous learning cycle, where each module prepares and reinforces the next, strengthening the continuity between theory and practice.

Despite these similarities, significant differences emerge between the two cases. In terms of operational context, EURIDICE is firmly rooted within the European environment, operating within well-established academic institutions of the European Union, whereas SHARE Africa functions within diverse African settings, each characterized by specific infrastructural, cultural, and technological challenges. Concerning the target beneficiaries, EURIDICE primarily involves master's students, university educators, and sector professionals, whereas SHARE Africa predominantly targets African students and institutions, with a strong emphasis on fostering international cooperation. Strategically, EURIDICE aims to cultivate digitally literate European citizens and social innovators, promoting interdisciplinarity and social innovation as key pillars. Conversely, SHARE Africa focuses on building international networks, facilitating knowledge exchange, and strengthening the scientific and educational capacity of African institutions. These distinctions highlight the different strategic priorities and contextual realities underpinning the two initiatives, despite their shared commitment to educational innovation through hybrid models. Methodologically and pedagogically, both cases

confirm that a Phygital learning journey is as circular ecosystems (Garcia-Saravia Ortiz-de-Montellano, Ghannadzadeh & van der Meer, 2023) more effective than strategies limited to merely replicating traditional content through digital means. The integration of face-to-face and digital modalities not only enhances the learning process but also creates new opportunities for interaction, collaboration, and cultural exchange, aligning with the challenges posed by the global digital society. This approach reflects the broader shift towards hybrid learning models, which have been shown to improve engagement and foster inclusive, flexible, and adaptive educational environments (Garrison & Kanuka, 2004; Hofmann, Bonk & Graham, 2006). By adopting such integrated structures, educational programs can better respond to the complexities of contemporary knowledge societies, supporting the development of transversal skills necessary for active participation in an increasingly interconnected world (OECD, 2018).

The selection of these cases was guided by purposive sampling, targeting projects that exemplify different resource levels, infrastructural frameworks, and management opportunity. The sampling strategy involved distributing the questionnaire to the entire population involved in the project: this strategic choice aims to capture a broad spectrum of practices and challenges, enhancing analytical richness and comparative insights. Within each case, participants were deliberately chosen to represent a variety of roles—including project managers, curriculum designers, technological support staff, and students—facilitating a multidimensional understanding of the implementation process. This aligns with stakeholder theory (Freeman, 1984), emphasizing the importance of diverse perspectives in organizational change processes. To deepen the understanding as new themes and emergent phenomena surface, the study employs iterative, theoretical sampling, consistent with grounded theory methodology (Strauss & Corbin, 1998). For example, if initial data reveal that faculty training significantly influences project success, subsequent sampling targets faculty involved in early pilot projects to explore training modalities, resistance factors, and engagement levels. Similarly, if infrastructural limitations emerge as barriers in the African project, follow-up interviews focus on local context, technology adaptation, and

community involvement, ensuring the analysis remains grounded and context-sensitive (Creswell et al., 2018).

In particular, within the Share project, it was possible to follow more directly the production of twelve MOOCs from the six Italian universities involved in the online segment: University of Padua, Alma Mater Studiorum University of Bologna, University Federico II of Naples, Polytechnic of Milan, University of Florence, and Sapienza University of Rome. Each university was responsible for producing three ECTS[1] (European Credit Transfer System) credits delivered in MOOC format via the Federica Eu platform—initially targeted solely at project students, later opened to all network users to ensure long-term sustainability. This operation had a dual purpose: firstly, to support the pedagogical development of a phygital learning environment for the participating students; secondly, in line with the requirements of the PNRR funding that underpins the project, to create a scientific contribution accessible to the community of learners within the network beyond the project's conclusion. The MOOCs were divided into an entry-level segment covering transversal themes of research (such as paper writing, international publication systems, research project management, research ethics) and a section focused on the geopolitical context of Africa. Successively, the utilization and engagement with the first six MOOCs developed for the Phygital journey were further explored through a participant observation during a week of in-person courses in Africa. Subsequently, an additional six specialized MOOCs, called in the project as "Blended E-learning Program" (BEP), were developed, addressing core disciplines at an intermediate difficulty level. In agreement with the scientific coordinators of the SHARE project, it was decided to synchronize the MOOCs with classroom lessons to create a dual touchpoint system: in-person lectures with instructors from both Italian and African universities, complemented by online sessions conducted remotely by the instructors. This convergence of the touchpoints has been interesting: during the interviews, it was clearly evident from both students and

[1] ECTS, an acronym for the European Credit Transfer and Accumulation System, is a European framework that measures and transfers academic credits to facilitate student mobility and the recognition of studies abroad. One year of full-time study is equivalent to 60 ECTS credits, which are distributed among individual learning activities such as courses, examinations, and internships based on the required workload, including lectures and independent study. A single ECTS credit corresponds to approximately 25-30 hours of student work.

faculty that having access to both resources simultaneously was highly valuable. The digital component, although delivered asynchronously, was also considered beneficial for in-person learning, aligning with the flipped classroom approach (Tucker, 2012), whereby concepts are introduced in advance and reinforced through an integrated interplay between the online and onsite phases.

3.3 Data collection

The data collection models implemented, in sequential order, were as follows: analysis of project documentation, the distribution of an online questionnaire to all participants involved in the two projects, development and administration of in-person interviews with various project stakeholders and participant observation during certain phases of the projects themselves. Data collection includes therefore document analysis, semi-structured interviews, the questionnaire and participant observations within each project.

Document analysis

Document analysis constitutes a fundamental component of the data collection process, providing contextualization and triangulation. Analyzing institutional documents—including strategic plans, technical guidelines, curricula, progress reports, and project documentation—offers insights into the formal frameworks guiding each initiative (Bachiochi & Weiner, 2004). The examination of the institutional documents — such as project reports, strategic frameworks, curricula, and technical guidelines — was essential for constructing interview and questionnaire texts, thereby aiding in triangulating data and contextualizing findings. Triangulation across sources enhances the validity and reliability of the results, facilitating the identification of converging themes and mitigating potential biases (Denzin, 1978). Additionally, cross-case analysis enables the exploration of contextual factors—such as infrastructural maturity, policy environment, cultural attitudes, and technological acceptance—that influence the trajectory and effectiveness of phygital ecosystems (Baxter & Jack, 2008; Eisenhardt & Graebner, 2007).

The documentation of the two projects was fundamentally different: in the case of EURIDICE, a project in collaboration with the European Union, the documents pertain to the development of a master's degree program jointly managed by three different universities, with a two-year enrollment process, a fee payment, and a curriculum designed to lead to the formal acquisition of a master's degree recognized across three European countries. The European Joint master’s in digital

Society, Social Innovation, and Global Citizenship (DIGISOC) is an interdisciplinary study program designed to equip you with the comprehensive expertise needed to address pressing global challenges in a rapidly digitalizing world.

Offered as part of the EURIDICE Project, DIGISOC is a collaborative and international initiative grounded in academic excellence and practical relevance. Bringing together the resources and expertise of multiple European universities, the program is designed to train a new generation of highly qualified socio-digital innovators capable of leading and managing digital transformation processes in diverse societal contexts (EURIDICE project, 2024).

The Share project, funded by PNRR resources and with a duration of 18 months, was supported by documentation prepared by the Ministry of University and shared across all projects financed under Mission 4 of the Plan. Mission 4 of the PNRR allocated a total of €33.81 billion with the aim of strengthening conditions for the development of a high-knowledge, competitive, and resilient economy. The allocated resources were specifically directed towards improving and expanding education and research for enterprises, addressing gaps in educational service offerings, closing the skills gap between basic competencies and labor market demand, and increasing R&D expenditure. In particular, the project fell under Investment 3.4 "Advanced University Teaching and Skills," Sub-investment T4 "Transnational Education Initiatives," which is financed by the European Union – Next Generation EU (MUR, 2024).

The study of the documents quickly highlighted both differences and commonalities between the two projects, which originated within the same context of technological advancement and the development of good practices among academic institutions. The shared features involved the collaboration of multiple universities in a joint educational initiative, implemented through a phygital approach that alternated between classroom phases and digital touchpoints, not only within the educational activities but also extending to administrative procedures such as enrollment. In both cases, a fixed number of students was observed in contrast to a substantial involvement of faculty members: there were 90 students in the EURIDICE project and 130 students in the SHARE project, with study

programs based on 60 ECTS credits annually. The SHARE project involves also a limited-time educational activity targeted at a specific student audience—primarily PhD or post-PhD candidates—who become recipients of a scholarship for highly specialized research.

Questionnaire

Structured questionnaires, when appropriately designed and tested, can provide reliable and valid data, assuming that the questions are clear, unbiased, and encompass the construct being investigated (DeVellis, 2016). Following the review of the documentation, an anonymous questionnaire was prepared and distributed online via a link sent to the email addresses of participants provided by the project coordinators—full details of which are included in the appendix. The questionnaire consists of 16 closed-ended questions that aimed to cover various aspects of the learning journey. The first 4 questions are Sociographic: since it was distributed anonymously, a question was included to identify the respondent's role. There were 45 responses: 30 from students, 8 from administrative and technical staff, and 7 from teaching staff, including project coordinators. The questionnaire was analyzed using SPSS.

Table 9: Questionnaire

Question Number	Question	Response Options
1	How did you learn about the project?	A) Through official communications from the institution B) By participating in informative events or webinars C) Via colleagues, students, or teachers D) Through social media or online platforms E) Other channel
2	Have you previously participated in similar integrated teaching projects or initiatives?	A) Yes, I have participated in multiple such initiatives B) Yes, but only in a specific previous project

Question Number	Question	Response Options
		C) No, this is my first experience D) I don't recall participating in similar projects
3	Sociodemographic data: Gender	A) Male B) Female C) Prefer not to answer
	Location (geographical area)	A) Urban region/area B) Provincial/rural area C) Other (please specify) _____
	Age (age groups)	A) 18-25 B) 26-35 C) 36-45 D) 46-55 E) 56+
4	Role within the project	A) Student B) Teacher/professor C) Administrative staff D) Instructional designer or content developer E) Other (please specify) _____
5	How would you describe your initial awareness of the concept of phygital learning?	A) I was highly familiar with it before participating B) I had a general idea but lacked detailed knowledge C) I had heard the term but didn't understand its implications D) I was entirely unaware of the concept before exposure
6	How should an integrated pathway between the classroom and digital platforms be developed to improve learning?	A) Through seamless synchronization of physical and digital activities B) By offering flexible access to both classroom and online resources C) Via personalized learning experiences that adapt to student needs D) By ensuring consistent communication and feedback across both environments

Question Number	Question	Response Options
7	What challenges have you encountered or observed in accessing or enrolling in phygital learning programs?	A) Technical barriers, such as slow internet or lack of devices B) Lack of clear information about the enrollment process C) Limited availability of courses or programs D) No significant challenges encountered
8	How would you describe your experience with enrolling in the digital platform and online courses?	A) Very smooth and straightforward B) Generally easy, with some minor issues C) Difficult, with significant challenges or obstacles D) Very complicated and frustrating
9	What strategies or tools within the phygital environment most effectively foster active engagement?	A) Interactive digital platforms and gamification B) Synchronous live sessions with real-time interaction C) Collaborative group projects and peer interaction D) Asynchronous materials with self-paced learning
10	How do you perceive the effectiveness of assessment methods used in phygital settings?	A) Highly effective, providing an accurate measure of performance B) Moderately effective but still has some limitations C) Less effective compared to traditional assessments D) Not effective at all in measuring true learning outcomes
11	In your experience, how does the classroom environment affect your engagement during phygital learning sessions?	A) It significantly enhances engagement through direct interaction B) It has little impact, as engagement depends mostly on digital tools C) It can sometimes distract from online activities D) It negatively impacts

Question Number	Question	Response Options
		engagement due to distractions or discomfort
12	In your experience, how effective are the multiple-choice quizzes as a form of assessment in MOOCs?	A) Very effective in measuring my understanding B) Moderately effective, with some limitations C) Not very effective, as they don't fully reflect my knowledge D) Not effective at all, I prefer other forms of assessment
13	Would you have preferred open-ended responses or other types of assessments instead of multiple-choice quizzes?	A) Yes, open-ended questions allow for better expression of understanding B) No, I find multiple-choice quizzes sufficient and efficient C) I prefer a mix of different assessment types, including essays and projects D) I don't have a preference
14	Would you have preferred open-ended responses or other types of assessments instead of multiple-choice quizzes?	A) Yes, I noticed characteristics that suggested AI generation B) No, I didn't realize or suspect the questions were AI-generated C) I am not sure whether the questions were generated by AI or not D) I didn't pay attention to that aspect
15	What forms of support are most accessible or helpful in the phygital learning environment?	A) Technical support, such as help desks and IT assistance B) Academic advising and mentoring programs C) Peer support groups and online communities D) No specific support currently available
16	How do you evaluate the impact of phygital learning on long-term progression?	A) Significantly positive, enhancing career and academic opportunities

Question Number	Question	Response Options
		B) Somewhat positive, with noticeable but limited effects C) Neutral, no clear impact on progression D) Negative or inconclusive effects on long-term outcomes

Source: authors elaboration

Semi-structured interviews

Semi-structured interviews serve as a secondary data collection tool (after questionnaire), allowing access to participants' perceptions, attitudes, and subjective experiences; this kind of interviews facilitate detailed data collection by combining the consistency of a guided interview with the flexibility to probe emergent themes and deepen understanding (Creswell, 2013).

The interview sample comprises professors, educators, technical support staff, and learners, providing insight into both strategic and grassroots perspectives. These interviews enable a flexible yet systematic exploration of key themes such as technological adoption, pedagogical strategies, infrastructural challenges, and stakeholder engagement. This approach balances consistency with openness, facilitating the emergence of new insights (Bachiochi & Weiner, 2004). In the case studies, approximately 10 interviews were conducted until data saturation was reached: scholars suggest approximately 15–20 interviews per case are sufficient to achieve data saturation (Guest, Bunce, & Johnson, 2006).

The semi-structured interviews were conducted using an interview outline that included a set of questions common to all participants, relating to their pre- and in-progress personal evaluations of the project (since the projects were not yet completed, it was not possible to solicit ex-post evaluations) and the main critical issues encountered during the integration into the project.

The subsequent questions are about each participant's specific role: faculty members were encouraged to talk about the challenges and opportunities they encountered in designing the pedagogical structure of the innovative initiative; the

administrative staff to discuss the differences compared to traditional processes regarding enrollments and competency certifications; the technical staff involved in the digital components to describe the differences compared to purely digital pathways; students were asked about their relationships with peers and instructors; and the scientific coordinators reflected on the main organizational challenges and the key insights that emerged from the process itself. The responses were comprehensive, demonstrating that the innovative elements of the projects, even when faced with criticism and challenges, nevertheless generated high levels of engagement among the various stakeholders involved. This ensures data richness and captures diverse perspectives, supporting the validity and reliability of subsequent analyses.

Table 10: Guiding questions and interview framework

Interview Topics	**Interview Questions**	**Interviewees**
Expectations and anticipations	What were your expectations prior to the initiation of this project, and how did you anticipate it might influence your activities or your role	Number 1 – Student Number 2 – Student Number 3 – Student Number 4 -Teacher Number 5- Teacher Number 6 - Administrative Number 7 Student Number 8 Student Number 9- Coordinator Number 10 - Instructional
Progress and functioning	Could you describe how the project has been progressing so far, and what are the key challenges or strengths you have observed?	
Main characteristics	Which features or aspects of the project do you consider most significant or innovative compared to traditional methodologies?	
Relationships among participants	How would you characterize the relationships and collaboration among colleagues, students,	

	and staff during the project's activities?	
Evaluation of innovations	Among the innovations implemented (e.g., digital platforms, MOOCs, advanced classroom methodologies), which do you believe are most effective, and why?	
Impact and suggested improvements	What improvements or modifications would you recommend to enhance the effectiveness of the innovative methods adopted?	

Source: authors elaboration

Participatory observation

Participatory observation complements interviews by providing an immersive perspective into the lived realities of the projects. Participatory data analysis refers to a process in which individuals or groups actively engage in the analysis and interpretation of data, as opposed to having data analyzed and interpreted solely by experts or analysts (Reason and Bradbury, 2008). In the EURIDICE case, it was possible to participate through direct involvement from the project coordinator in a two-day collaborative workshop involving multiple universities, organized to analyze successes and challenges from the initial project phase. This active participation allowed direct observation of stakeholder interactions, negotiation processes, and organizational dynamics, offering insights into tacit practices, power relations, and decision-making mechanisms (Wolff et al., 2019). Directly participation included also presence in a class typical day as an auditor, observing the integration of physical and digital spaces, pedagogical practices, student engagement patterns, and the use of technological tools, with the goal of documenting real-time pedagogical practices and operational procedures.

For the SHARE Africa project, fieldwork was even more immersive. The direct involvement in a full week of in-person classes at the African hub in Tunis allowed personal observation and interaction directly with students, faculty, and local organizers. This experience provided a privileged vantage point to observe practical challenges, cultural nuances, infrastructural limitations, and innovative adaptations needed for implementing phygital learning in resource-constrained settings. In conjunction with this, the professional experience as instructional designer enabled the collection of detailed data regarding technological use, connectivity issues, and adaptive strategies. Combining interviews with digital analytics—such as platform engagement logs, attendance records, and certification data—emphasizing that mixed qualitative-quantitative data sources produce a more holistic understanding of user behaviors and perceptions (McCusker et al., 2015).

These records allow for cross-validation of findings and help uncover alignment or discrepancies between intended policies and actual practices. They also facilitate understanding of the historical development and normative frameworks shaping implementation.

In the SHARE Africa case, additional data sources such as platform logs, usage statistics, and final certification records were examined. These digital traces provide quantitative evidence regarding participant engagement, technological acceptance, and successful completion rates, offering an extra layer of understanding relevant to evaluating the impact and effectiveness of the phygital interventions.

Similar to SHARE Africa, MOOC courses have also been developed for EURIDICE, which are yet to be launched, by the University's Center for Educational Innovation at the University of Naples Federico II. However, these MOOCs are aimed not at students, but at teachers and instructors.

A multi-method approach aligns with best practices outlined by Wolff et al. (2019), fostering rigorous, contextualized, and nuanced analysis of the complex dynamics underpinning hybrid education ecosystems. It enables a comprehensive examination that integrates subjective experiences, observable behaviors, and institutional data, supporting a holistic interpretation of the phenomena under study.

3.4 Data analysis procedures

The current research expands upon the bibliometric analysis presented in Chapter 2, which employed specialized software, specifically Bibliometrix, to systematically investigate the conceptual landscape surrounding the topics of "phygital" and "phygital learning" (Wolff et al., 2019). This analytical approach enabled the identification of key themes and theoretical constructs that serve as foundational elements for the design of research instruments in this study.

By systematically linking theoretical constructs to research instrument design, this study aims to enhance the validity and reliability of the data collected, facilitating a comprehensive exploration of the factors that contribute to effective phygital learning experiences.

The bibliometric mapping conducted revealed a complex and interconnected network of concepts that are essential to understanding effective phygital learning environments. Among these concepts are engagement, accessibility, assessment, and social integration, which collectively represent the core dimensions through which phygital learning can be understood and evaluated.

These insights not only provide a solid theoretical foundation for the research but also would play a crucial role in guiding the development of the instruments used for data collection. Specifically, they informed the structuring of questionnaire items, ensuring that they are aligned with the identified key themes. Additionally, these insights helped shape the focus of the observational analysis conducted as part of the research, allowing for a more targeted examination of the interactions and dynamics present within phygital learning contexts.

The questionnaire items and interview questions were carefully crafted to reflect these core themes, serving a dual purpose as validation tools that strengthen content validity across both qualitative and quantitative strands of analysis.

Regarding data analysis, each component required tailored methodologies to extract meaningful insights. Quantitative responses, particularly from closed-ended questions, were analyzed through Statistical Package for Social Sciences (SPSS) — a software very popular for descriptive statistics, frequency distributions, and inferential tests—to identify patterns, correlations, and trends that underpin

statistical validation of results. Conversely, open-ended responses, along with the rich narratives obtained from the 10 in-depth interviews, were analyzed in deep with a sentiment analysis. Through iterative refinement, answers were grouped into broader themes and relationships, enabling the identification of overarching patterns and deeper meanings within participants' narratives.

The analysis process was further enriched by cross-case analysis, which involved comparing theme patterns across different projects and contexts to highlight similarities and divergences. This technique allowed for the synthesis of higher-order insights about factors that either facilitate or hinder effective implementation of phygital ecosystems, considering institutional, cultural, and technological variations.

Trustworthiness and validity were prioritized through multiple validation strategies. Triangulation reinforced internal consistency by cross-verifying findings across questionnaires, interview transcripts, and documentary sources. Member checking involved sharing interview summaries with participants to confirm the accuracy of interpretations, thereby ensuring credibility. Peer debriefing sessions facilitated critical feedback and external validation, strengthening the reliability of the findings. Throughout the analysis, reflexivity was maintained, with the researcher consciously reflecting on their own influence on the interpretative process. This iterative process of revisiting codes and themes in light of new data helped refine and sharpen analytical insights, ultimately contributing to a comprehensive, credible, and integrative understanding of how stakeholder groups navigate and shape complex, transnational phygital learning pathways.

Each question and interviews encapsulate a distinct facet of the student experience, which unfolds across both onsite and online modalities, involving multiple universities across different countries that share responsibilities for pedagogical delivery, technological support, and institutional coordination.

3.5 Ethical considerations and research quality criteria

The empirical research in the case studies was made possible and authorized by the scientific coordinators from the University of Federico II[2]. During this study, strict adherence to fundamental ethical principles was maintained to safeguard the rights, dignity, and well-being of all participants. Informed consent was obtained from each participant, accompanied by detailed explanations regarding the study's purpose, data use, and their right to withdraw at any time, thus respecting their autonomy and ensuring voluntary participation (Khan et al., 2022). Confidentiality and anonymity were rigorously protected; all identifiers were anonymized during data transcription and reporting, in accordance with best practices for data protection and privacy regulations (Guba & Lincoln, 1994). Consistent with the ethical standards outlined by Hammersley (2017), the research design explicitly committed to beneficence—aiming to generate knowledge that benefits both the academic community and society while minimizing risks or harm to participants. The principle of justice guided careful consideration of equitable treatment, ensuring that all participant groups—spanning diverse cultural, institutional, and disciplinary backgrounds—were treated with respect and provided equal opportunities to contribute. Transparency in the research procedures was secured through meticulous documentation of methodological decisions, data collection strategies, and analytical processes, creating an audit trail that strengthened dependability and confirmability (Shenton, 2004). An ongoing reflexive stance characterized the entire process, with the researcher maintaining critical self-awareness to minimize bias. The keeping of a reflexive journal and engagement in peer debriefings allowed continuous self-examination and external critique, ensuring interpretations faithfully represented participants' perspectives and reducing subjective bias (Berger, 2015; Lincoln & Guba, 1985). Additionally,

[2] I would like to thank Professors Fortunato Musella, Director of Federica Web Learning Center; professor Salvatore Manfreda, UNINA scientific coordinator for SHARE Africa and professor Emiliano Grimaldi, UNINA scientific coordinator for EURIDICE for their substantial support and availability and to professor.

member checking—sharing preliminary findings with participants for validation—further enhanced the credibility of results, confirming that representations accurately reflected their experiences (Birt et al., 2016). Building on the work of Guba and Lincoln (2005), the study emphasized the importance of establishing trustworthiness through rigorous triangulation, detailed description, and transparent documentation. These strategies not only support methodological rigor but also fulfill the ethical obligation to produce valid, credible, and socially responsible knowledge. Recognizing that qualitative research necessarily operates within specific contexts and relies on subjective narratives, these measures serve as safeguards to ensure findings are both ethically sound and substantively meaningful.

The participant observation, conducted with the collaboration and endorsement of the scientific coordinators of both projects, allowed for an in-depth exploration and further clarification of the intention to integrate the collected data within a rigorous research framework. Nevertheless, this methodology has inherent limitations: notably, students may have been influenced by the requests of project leaders to participate in interviews, which could have affected the spontaneity and authenticity of their responses (Spradley, 1980). Concerning face-to-face interviews, only three students from the Naples site of the SHARE project were interviewed, while for the students involved in SHARE, only a subset of the 25 participants in the BEP "Innovative Technologies for Sustainable Water Management" held in Tunisia was selected. Furthermore, some colleagues from the administrative and technical staff may have minimized or concealed critical aspects, perceiving a certain familiarity with the interviewer, thus potentially generating social desirability bias (de Camp & Nisbett, 1978). Lastly, prior professional relationships with certain faculty members could have further influenced the spontaneity and objectivity of their responses during the interviews. This constitutes a known risk in participant observation, as highlighted by the literature (Angrosino & Mays de Pérez, 2000), which points out that researcher influence and existing relationships can compromise the authenticity of collected data. In conclusion, although this methodology allows for a deeper understanding of observed dynamics, it is essential to remain aware of these limitations and implement triangulation and

validation strategies to enhance overall credibility. The qualitative data were supplemented by quantitative measures related to the completion of the digital component of the SHARE project— specifically, the achievement of six attendance certificates by a class of 25 students enrolled in the "Innovative Technologies for Sustainable Water Management" course— although these responses were limited to the participating students and represent only a small fraction of the total MOOC attendance associated with the project.

CHAPTER IV

FINDINGS AND DISCUSSION

SUMMARY: 4.1 AI-enabled touchpoints throughout the learner journey – 4.2 Emergent themes and mechanisms of value co-creation – 4.3 Actor roles (students, faculty, administrative staff, institutions) – 4.4 Refinement of the Phygital Learner Journey conceptual model – 4.5 Cross-analysis with literature and bibliometric insights –

4.1 AI-enabled touchpoints throughout the learner journey

In creating a user-centric experience, the concept of user journey mapping, also known as customer experience mapping, can be a cornerstone for projects in higher education (Walter, 2022). For this reason, every touchpoint was considered in this study, and particularly the AI enabled one.

The research revealed clear findings: a phygital learning journey has a strong component driven by technological resources, which can no longer disregard AI, as well as a component of human resources that necessitates a new conceptual paradigm in which learning becomes a distributed value rather than a mere transfer of knowledge.

From a technological standpoint, students did not perceive any technological barriers (only 8% of questionnaire respondents reported seeing them as a challenge), and faculty members reacted positively to the development of the digital components of their teaching materials. This was evidenced by their active involvement in every phase of the MOOC creation process, as observed at the Federica Web Learning Center. The development of digital content was guided by instructional designers who also utilized AI tools to implement the learning materials. Only 27% of students reported noticing this (in response to question 13 of the questionnaire): this suggests that a reasoned use of AI by instructional designer in learning journey can be an opportunity for both educators and students, as outlined by UNESCO (UNESCO, 2023).

The integration of artificial intelligence (AI) extends the scope of student journey mapping by enabling continuous data processing, pattern discovery, predictive analytics, and personalized action recommendations (bin Salem, 2024). AI is an umbrella term encompassing an array of technologies, such as computer vision, goal-driven systems, pattern recognition, autonomous systems and natural language processing (Russell and Norvig, 2022). AI integrates behavioral analytics, machine learning algorithms, natural language processing, recommendation engines, and real-time orchestration to develop each student's individualized pathway within a constantly evolving digital ecosystem. Instead of remaining a static schematic, the

mapping process evolves into a dynamic, responsive environment. At its foundation lies a cohesive data architecture: disparate systems—such as learning management systems (LMS), web analytics, support ticketing solutions, e-learning content, social listening tools, and mobile analytics—must converge into a unified data layer or dedicated student data platform.

In phygital learning projects, the chatbot therefore assumes an important role (Nee, et al., 2023). However, in the case studies, chatbots were not originally included in the program design and were not developed. In the interviews, both students and administrative staff expressed a desire for a tool that could provide support primarily during the enrollment phase and in clarifying doubts related to the organization of teaching activities. In this regard, two students (Interview 3 and 4) explicitly mentioned the possibility of introducing a chatbot as an additional touchpoint alongside the technical and administrative staff. Chatbots within the digital components of blended pathways are becoming increasingly widespread, and MOOC platforms are progressively adopting them. Recently, the Federica Web Learning platform—which delivered the MOOCs for the two case studies—has launched experimental chatbot functionalities within several online courses.

Another result that emerged clearly from the research is the importance of having various assessment and self-assessment mechanisms throughout the learning experience. Evaluation, often considered only as a summative assessment in traditional teaching, becomes a dialogic element within the phygital learning journey. Empirical results demonstrate that both self-assessment tests and exercises were perceived positively: present in both case studies, both in the digital component and in experiential learning as project work, they received positive feedback in both interviews and response percentages to question 12 of the questionnaire. Notably, 66.7% of respondents indicated that the multiple-choice quizzes were "*very effective in measuring their understanding"*.

Automated assessment and feedback tools[3] expedite grading and provide rapid, diagnostic feedback, enabling educators to focus on higher-order qualitative guidance. AI can also detect persistent misconceptions, offering targeted remediation that strengthens conceptual understanding. Chatbots and virtual

[3] Turnitin's GradeMark, Grammarly are some Educational tools.

advisors support scalability of communication and early detection of disengagement by flagging low participation or collaboration issues for instructor intervention. AI further supports inclusive access through transcription, immersive readers, and translation tools that reduce linguistic and sensory barriers[4].

The AI touchpoints within the learning journey appeared different from the perspective of the instructors. In innovative contexts—both those described in the case studies and others developed during the pandemic (Chaturvedi, Purohit, & Verma, 2021)—collaboration among instructors from different academic institutions and even from different geographical areas posed an additional challenge, both in terms of resource management and in the implementation of best practices. The innovative teaching approaches proposed in the frameworks of the case studies were strongly supported by AI. In the EURIDICE case study, in particular, AI was integrated into many courses as a subject of study, and the controlled use of generative artificial intelligence tools was promoted as part of the practical activities. In the case of the DIGISOC degree program, digital society and, consequently, AI serve as multifaceted touchpoints involving both faculty and students. The curriculum is designed to facilitate simultaneous lectures across multiple geographic locations, which encourages the use of integrated, including generative, technologies. These technologies are utilized not only in the online digital components but also during in-person sessions.

In the case of SHARE Africa, the classroom component was primarily implemented through collaborative tools, though with a more traditional lecture-based structure. Infrastructure limitations across the universities in African countries prompted the adoption of a more structured and innovative approach to the digital aspect. Consequently, AI was predominantly utilized in the development of MOOCs. These online courses were designed to be accessible not only to students actively involved in the project, who integrated them into their learning pathways, but also at later stages. This represented a distinctive aspect of the design: the MOOCs were conceived, from a third mission perspective, as an intangible asset of the project itself, thereby making them accessible to a broader online audience. Their massiveness facilitates access to MOOCs even without prior knowledge, which

[4] Otter.ai; Microsoft Immersive Reader are some accessibility tools.

makes the assessment phase—particularly self-assessment—crucial for their success (Fauvel & Yu, 2016). During the production of the MOOCs, instructors were engaged in creating various formats of educational content, including texts, videos, images, simulations, and assessment/self-evaluation tests for students. In a MOOC, an assessment phase is always present (Calise, & Weblearning, 2018), typically involving self-assessment for learners. To enable both students and broader network users to benefit from the MOOCs, the assessment was conceived as a series of multiple-choice tests, with a limited number of attempts and a pass threshold set at 70% correct answers. This transforms assessment into a tool for self-evaluation and learning verification (Sancassani & Casiraghi, 2025). For the Share AFRICA MOOCs, a set of over 10 questions per lesson was required, from which the Learning Management System (LMS) randomly extracts a smaller subset. In learning pathways involving instructors from different academic institutions—who are involved simultaneously in the same disciplines—the standardization of assessments remains a recurring challenge, frequently cited in the literature (Limone, Pace, Rita Mangione, 2016). To harmonize these differences and create a cohesive phygital learning functioning as a unified ecosystem, the touchpoint among the different instructors involved the use of AI as a tool to generate the required assessments (multiple-choice quizzes). Under the guidance of instructional designers and technical staff, and starting from the educational materials, these quizzes were developed. As highlighted in the interviews (Interviews 6, administrative staff and 10, technical staff), this procedure was innovative for the instructors themselves and activated a new touchpoint: the use of AI as a tool for educational innovation and for eliminating conceptual biases, bringing innovation into their teaching practices. For professors AI was a support: "*It was the first time I prepared a MOOC, and I was struck by how many procedures were entrusted to AI, allowing the instructor to shift from content creator to validator of AI-generated content based on a reliable source.*" (Interview 4, SHARE professor). *"Before this experience, I had never worked in an extended classroom with students connected from different parts of the world, and I was concerned about replicating what had happened during COVID-19, when we had remote learning. However, the experience was engaging, and I often did not*

perceive the physical distance, tanks to AI tools too. Furthermore, the number of students was small, which fostered a climate of great collaboration" (Interview 5, EURIDICE professor). Another innovative aspect that emerged, also thanks to artificial intelligence tools, is the ability to adapt teaching materials for students with diverse backgrounds. In the system of Italian universities, this is not very common, and faculty members are often not accustomed to heterogeneous classes in terms of academic origins. For this reason, they noted a positive response to AI as an enhancement of educational materials, which were constructed as building blocks for various types of learning. "*I found it innovative to combine different disciplinary backgrounds—compared to other classes, there is a significantly heterogeneous mix of students in terms of both geographic origin and preparedness. Additionally, working extensively on project work and assignments with tight deadlines facilitates continuous engagement and collaboration thanks to Ai tools too, presented us by instructional designer involved in project staff*" (Interview 4, SHARE professor).

4.2 Emergent themes and mechanisms of value co-creation

The ability of digital technologies to transcend physical environments by projecting complex systems of intuition and involvement within a network of educational and digital contexts (Mele & Russo-Spena, 2021) reflects a new architecture of interactions between educational systems and their target learners, shaping how value is created and delivered within these contexts. The integration of phygital learning as an innovative amalgamation of physical and digital educational modalities in higher education settings reveals a complex landscape of value co-creation driven by evolving interactive dynamics among institutional stakeholders. Instead of viewing physical and digital actors, resources or contexts as inherently separate and pre-existing entities that merely interact; we stress the reciprocal transformation they undergo in response to their intra-actions. In this holistic perspective, all elements emerge, coalesce and co-evolve, collectively shaping the emerging landscape of value co-creation and service innovation possibilities (Mele & Russo-Spena, 2025) .

A central emergent theme is the shifting role of students from passive recipients to active co-constructors of their learning experience, facilitated by collaborative digital platforms and in-person engagement (Vargo & Lusch, 2008; Prahalad & Ramaswamy, 2004).

As in the interview: "*Phygital learning can improve long-term development by building strong digital skills, increasing adaptability, and encouraging more independent learning. For students, it usually makes the learning experience more flexible and engaging, helping them learn how to use technology confidently while still benefiting from in-person support"* (Interview 1, student).

This participatory paradigm fosters a shared sense of ownership and agency, cultivating experiential learning that transcends traditional pedagogical boundaries (Carù & Cova, 2015). Underlying these transformations are mechanisms such as technological affordances—such as AI-supported assessments and virtual collaboration tools—that enable personalized, adaptive, and accessible learning pathways (Gretzel et al., 2020; Sashi, 2012).

Additionally, the iterative feedback loops among students, faculty, and administrative staff serve as critical processes for refining the learning ecosystem, ensuring that value is continually co-produced and redefined in real-time (Grönroos & Voima, 2013).

For the EURIDICE project, it was possible to participate in a two-day workshop for the design of the second intake of degree; were involved not only the scientific coordinator but also the administrative staff of the three partner universities, which serve as the host sites for the DIGISOC degree program. The participants, coming from three different countries, engaged in discussions not only about practices and procedures, comparing the various bureaucratic dynamics within their universities but also collaboratively seeking solutions to ease students' difficulties. During the participation to a BEP in Tunisi, for SHARE Africa, the collaboration between the administrative staff and the faculty of ENIT – Ecole Nationale d'Ingénieurs de Tunis, where in-person courses took place, was particularly evident. Additionally, the administrative staff and faculty of the University of Federico II were present to oversee and facilitate the student reception procedures, demonstrating a strong cooperative effort between the two institutions. "*The registration process was a nightmare for us Italians! But we often talked about our issues, and we're confident they'll get sorted out soon!*" (Interview 3, student) is recorded in a different time of this other interview to a staff member: "*We have understood the needs regarding the student enrollment procedures, and although there are bureaucratic limitations beyond our control due to the embassies, we will make every effort to streamline these processes further"* (Interview 6 - administrative staff). This comparison between interviews demonstrates that the touchpoints established through the integrated system enable a closer connection between the different components of the university's educational process, making it possible to share problems and seek potential solutions in a context of continuous improvement and service innovation. As Mele and Russo Spena (2021) emphasize service innovation is fundamentally about creating value through the reconfiguration of resources and processes to better meet the evolving needs of stakeholders. The phygital approach fosters a culture of ongoing innovation, essential for adapting educational services to the demands of a digital and interconnected environment. Community-building

practices—both online and offline—further reinforce collective identity and commitment, amplifying intrinsic motivation and supporting institutional goals of inclusivity and innovation (Williams-Duncan, 2020). These themes and mechanisms underpin a shift towards more democratized and responsive higher education systems, emphasizing stakeholder engagement and mutual value creation as cornerstone principles in phygital learning ecosystems (Payne et al., 2008).

4.3 Actor roles

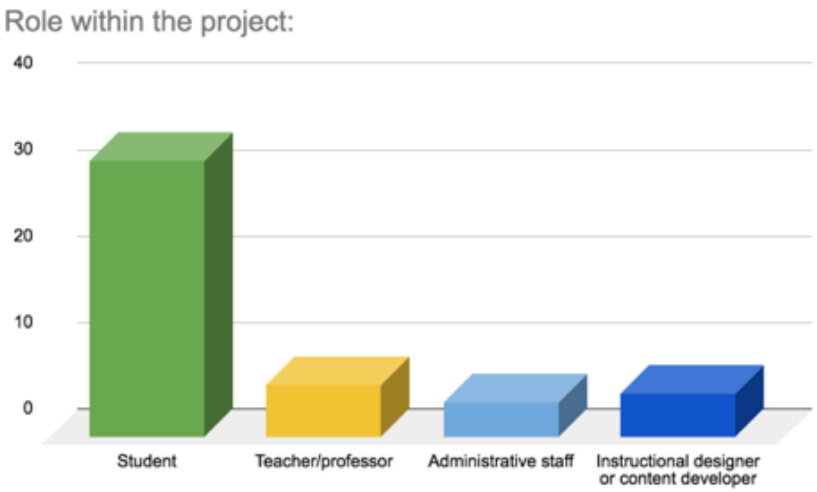
In exploring the actor roles within the phygital learning journey, a comprehensive approach was employed to capture both quantitative and qualitative perspectives. The quantitative component consisted of a structured questionnaire in which respondents—explicitly indicating their roles as students, faculty members, administrative staff, or institutional representatives—provided valuable data on their perceptions, experiences, and engagement within the hybrid educational environment.

The findings highlight significant variations in perceptions among the different actor groups, emphasizing the multifaceted nature of implementing phygital learning models. Conversely, faculty members expressed concerns about pedagogical adjustments, technological competence, and maintaining student engagement across blended settings, echoing challenges identified in current studies on faculty adaptation to digital tools (Kirkwood & Price, 2014). Administrative staff emphasized logistical and infrastructural considerations, including the need for technical support and streamlined processes to manage the hybrid educational ecosystem effectively.

This diversity of perceptions underscores the importance of role-specific strategies to optimize the phygital experience, fostering collaboration and shared understanding among all actors involved. As Garrison and Vaughan (2013) argue, the success of blended and hybrid educational models depends on recognizing and aligning the distinct roles and responsibilities of students, educators, administrators, and institutions. Creating a cohesive environment that nurtures mutual support and continuous dialogue is essential for realizing the full potential of the phygital learning journey.

Students responded significantly more to the questionnaire, as highlighted by the figure.

Figure 13: Graph depicting the responses to question 4 of the questionnaire



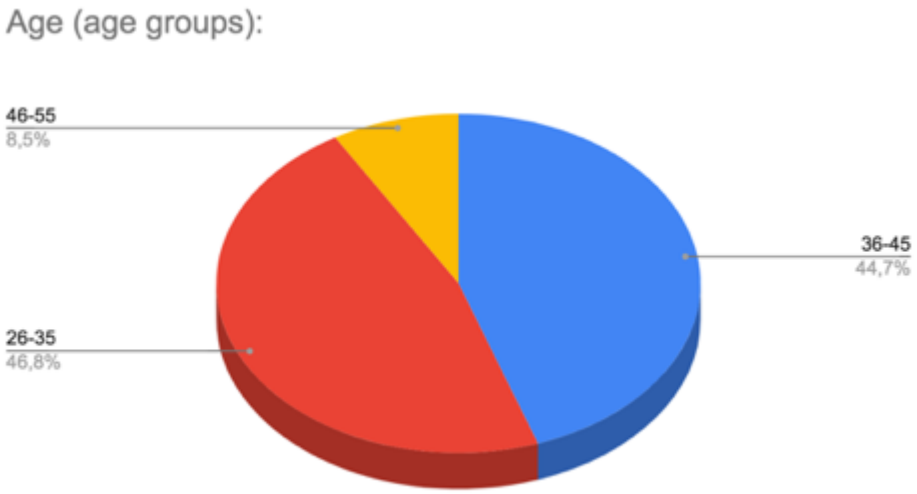
Source: authors elaboration

This is also evident in the subsequent graphs related to the socio-demographic profile of the participants.

Figure 14:Graph depiction the responses to question 3 of the questionnaire

Source: authors elaboration

Figure 15: Graph depictiong the responses to question 3 of the questionnaire

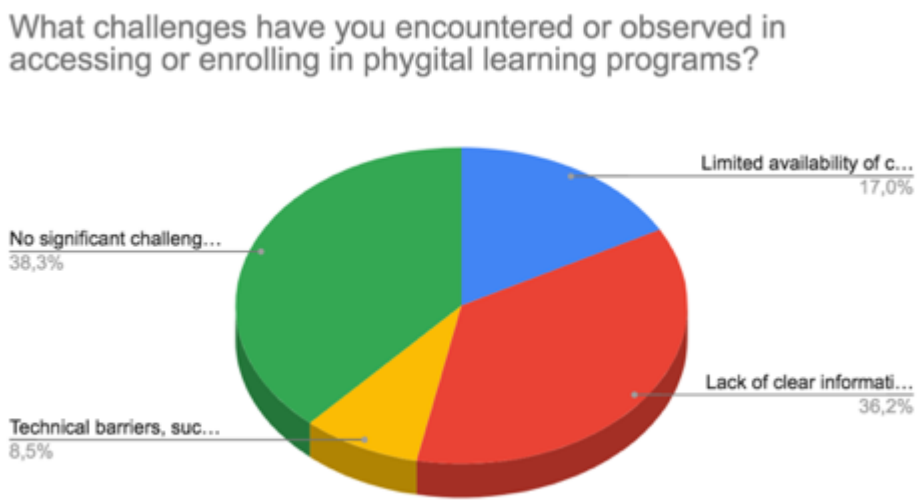


Source: authors elaboration

The lack of difficulties in accessing and enrolling into the phygital system of the two projects analyzed may reflect, precisely, the high percentage of questionnaire

respondents who are Millennials. This group tends to have a more proximal and integrated perception of services, as they are generally more accustomed to and comfortable with digital and hybrid environments. Online and offline interactions blur the boundaries between the physical and digital world through phygital: millennials move back-and-forth or jump from one action to another according to the evolving path of emotions and interactions (Mele, Russo-Spena, Tregua & Amitrano, 2021).

Figure 16: Graph depicting the responses to question 7 of the questionnaire

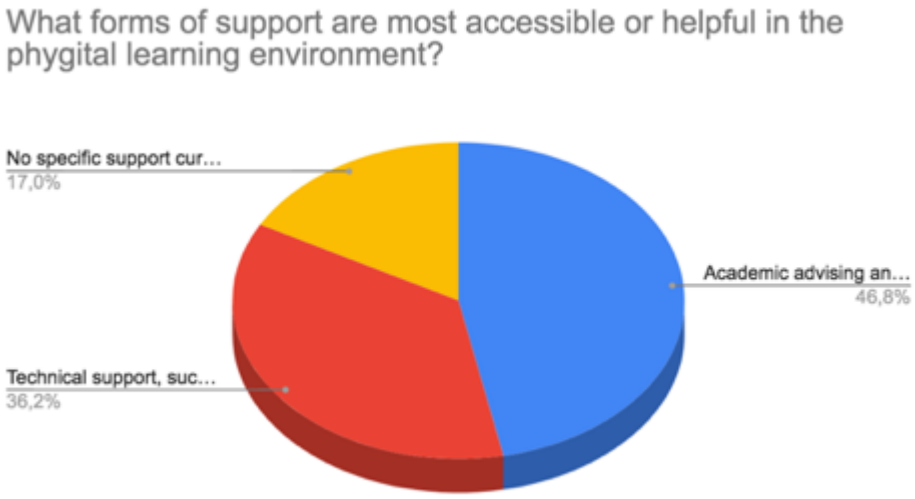


Source: authors elaboration

In this perspective, it is also possible to interpret the responses to question 15 of the questionnaire, "*What forms of support are most accessible or helpful in the phygital learning environment?*" where the majority of respondents indicate "*Academic advising and mentoring programs.*" However, a significant percentage also highlights the importance of "*Technical support, such as help desks and IT assistance*." Notably, no respondent identified peer support groups or online communities as a form of support, reflected in the absence of the response "*Peer support groups and online communities.*" This suggests that, within the context of the phygital learning environment, students primarily focus on formal academic and

technical support mechanisms, while peer-based support channels seem to be underutilized or less recognized as helpful.

Figure 17: Graph depicting the responses to question 15 of the questionnaire

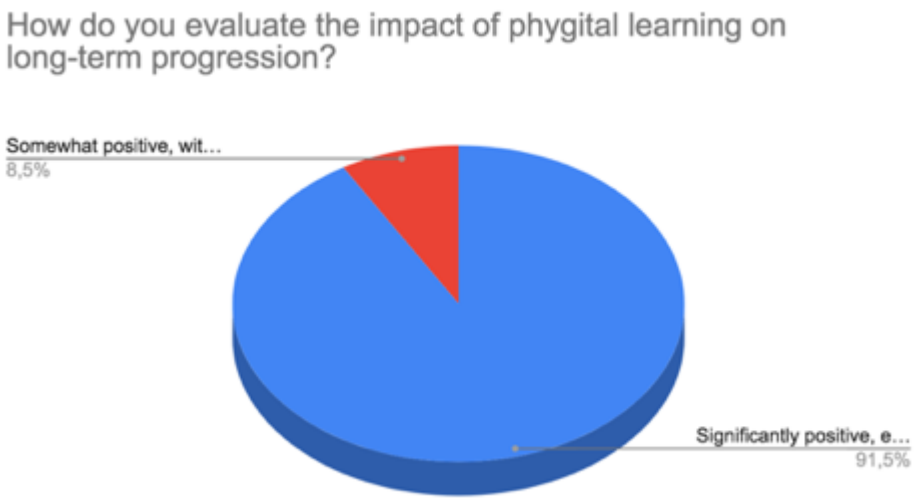


Source: authors elaboration

This was also confirmed by responses in several interviews: "*The most helpful support in a phygital environment is clear guidance from the teacher, quick technical help when tools don't work, and easy-to-access online resources (like notes, videos, or examples). Having space to ask questions—both in person and online—also makes learning much easier.*" (Interviewee 3, student). Similarly, another participant stated, "*In a phygital learning environment, I find teacher guidance and timely feedback most helpful. Technical support and peer collaboration also make learning smoother and more accessible.*" (Interviewee 8, student). These qualitative insights reinforce the observed emphasis on formal academic support and technical assistance while highlighting the importance of accessible communication channels, both in-person and virtual, for facilitating an effective phygital learning experience.

Beyond the actors' roles, the majority of respondents agree that the experience is positive and holds promise for the future.

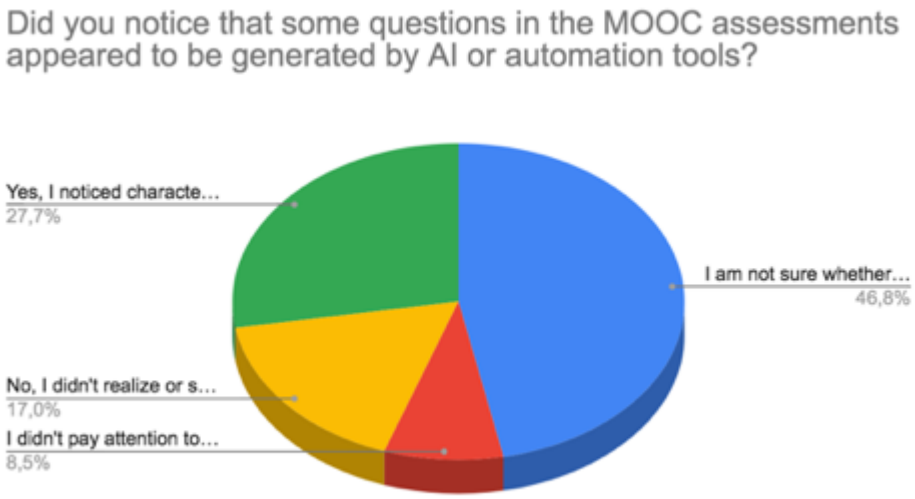
Figure 18: Graph depicting the responses to question 16 of the questionnaire



Source: authors elaboration

The guiding role of the teacher and the importance of the co-presence relationship between instructor and student are not questioned by the responses: the phygital model does not alter the complementary relationship between professors and learners but rather evolves it through the multiplication of multiple touchpoints. Online lessons—synchronous, as in the case of EURIDICE, or asynchronous, as in SHARE Africa—did not undermine the trust in the teaching staff, to the extent that AI-powered touchpoints activated during the assessment phase of MOOCs—representing a new mode of evaluation that involves both teachers and students as active participants—were not perceived by students as artificial elements. They did not notice a significant difference compared to assessments conducted solely by teachers, except in a few cases.

Figure 19: Graph depicting the responses to question 13 of the questionnaire



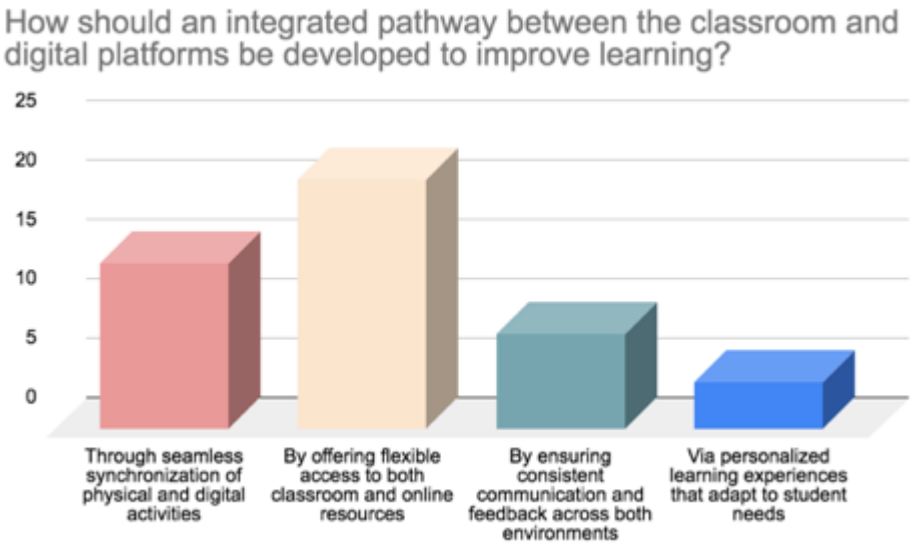
Source: authors elaboration

Indeed, students seem to perceive the phygital learning journey as placing their role at the center and as fundamental in shaping the learning experience: *"Phygital learning enriches my learning experience by blending online flexibility with classroom interaction, helping me stay engaged and build additional skills."* (Interview 7, student) and *"Phygital learning positively influences my academic development by combining the flexibility of digital tools with the interaction of in-person learning. It improves my autonomy, adaptability, and digital skills, which are essential for long-term professional growth in a constantly evolving world."* (Interview 2, student) or "*Phygital learning can improve long-term development by building strong digital skills, increasing adaptability, and encouraging more independent learning. For students, it usually makes the learning experience more flexible and engaging, helping them learn how to use technology confidently while still benefiting from in-person support."* (Interview 8, student).

However, analyzing the questionnaire responses — even from actors who are not students — highlights that the most sought-after attribute is not so much personalized learning, as often advocated in the literature (Murtaza, et al., 2022;

Marienko et al., 2020), but rather the flexibility provided by the dual access both onsite and online.

Figure 20: Graph depicting the responses to question 6 of the questionnaire



Source: authors elaboration

The role of various actors within the phygital learning journey is likely more evident: teachers, for instance, in the interviews, expressed feeling significantly supported by the technical and administrative staff "*Compared to traditional courses, I felt genuine support from the staff in the preparation of learning materials within this type of pathway*" (Interview 4, professor).

The roles of instructional designers, media experts, and technical profiles become crucial in a phygital learning path. This is reflected in the response to question 9, "*What strategies or tools within the phygital environment most effectively foster active engagement?*" where the answers included "*Interactive digital platforms and gamification*"; "*Synchronous live sessions with real-time interaction*"; "*Collaborative group projects and peer interaction*" and "*Asynchronous materials with self-paced learning*." The first option was chosen by over 40% of respondents, emphasizing the importance of interactive and engaging digital tools in fostering active participation, in accordance with the thematic map of bibliometric analyses

which demonstrates how the theme of the most innovative technologies, such as augmented reality, is central to the evolution of the concept of "phygital learning."

4.4 Refinement of the Phygital Learner Journey conceptual model

Phygital refers to an increasingly apparent universe in which physical and digital artifacts intersect one another, holding out the promise of substantive new ways to reconsider the materiality and ontology of objects (Reilly and Dawson, 2021).

The analysis of the questionnaire responses, combined with the more detailed insights obtained from the interviews, led to the development of a multi-phase model for a phygital learning pathway. The two case studies of phygital learning, both intra-university educational projects, exhibit a six-phase structure that has emerged as a result of prior research (Sartori, Maga, Tosi & Varallo, 2024; Chaturvedi, Purohit & Verma, 2021). The two case studies of phygital learning, both intra-university educational projects, exhibit a six-phase structure that has emerged as a result of prior research (Sartori, Maga, Tosi & Varallo, 2024; Chaturvedi, Purohit & Verma, 2021). These six phases are identified as:

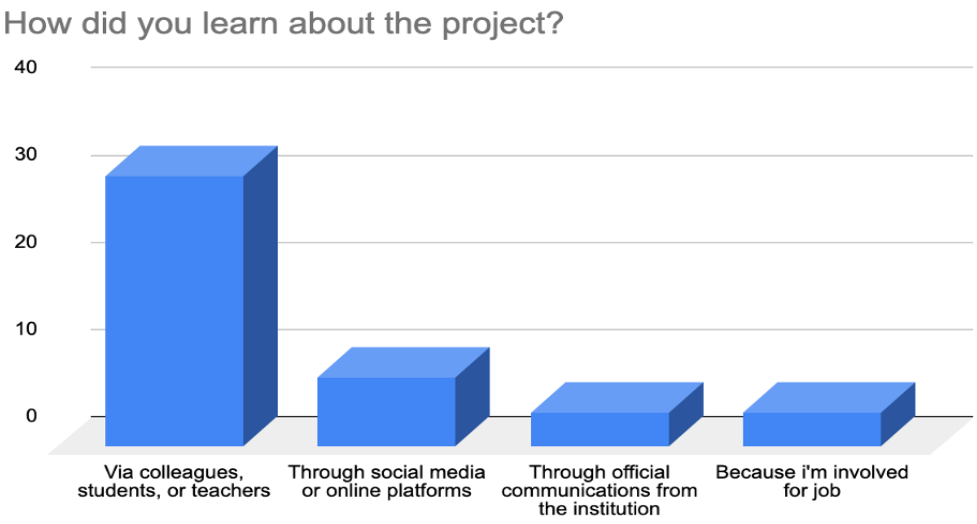
1) Awareness & Orientation,
2) Access & Enrollment,
3) Learning Engagement,
4) Performance & Assessment,
5) Support & Social Integration,
6) Progression & Value Realization.

The six core dimensions were operationalized to dissect critical stages within the student learning pathway, especially in the context of cross-border, hybrid educational models involving multiple universities sharing pedagogical, technological, and administrative responsibilities.

1) Awareness & Orientation reflects how students initially become informed about the available learning pathways—through institutional communication, guidance, and orientation activities—serving as the foundational step in social and cognitive onboarding. Compared to this phase, it is important to note that communication efforts still appear to be insufficient concerning phygital learning projects: the majority of respondents indicate that they became aware of the program through

informal channels (colleagues, educators) rather than through official institutional communication.

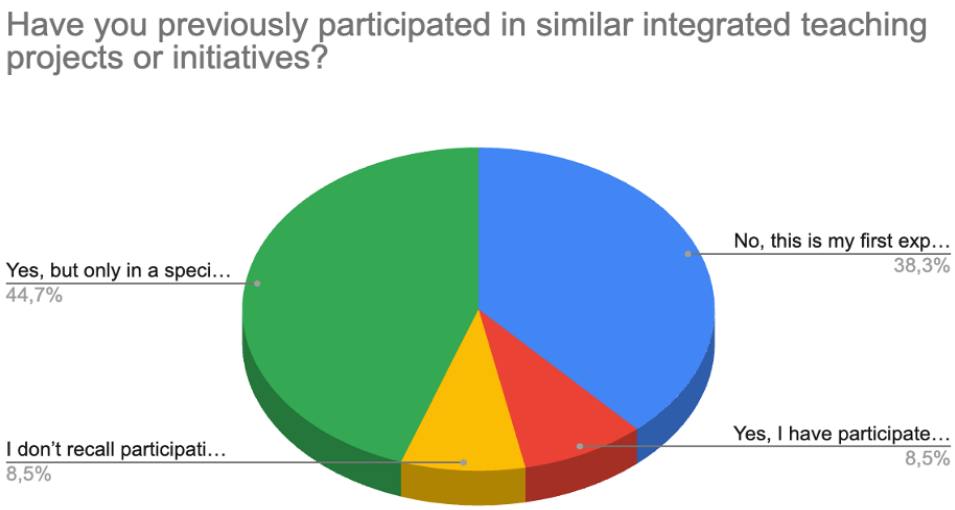
Figure 21: Graph depicting to question 1 of the questionnaire



Source: authors elaboration

However, it is noteworthy that 44.7% of respondents report having a good understanding of phygital projects because they have already participated in specific initiatives related to integrated teaching.

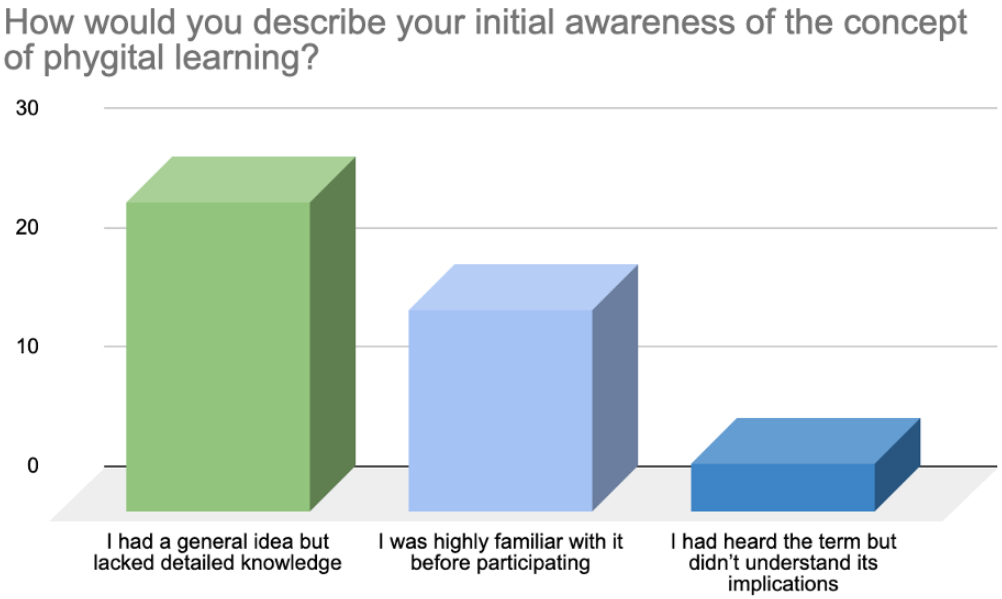
Figure 22: Graph depicting to question 2 of the questionnaire



Source: authors elaboration

Despite these previous experiences, awareness of the characteristics of a phygital learning model is perceived as inadequate, as evidenced by the responses to question 5 of the questionnaire, *"How would you describe your initial awareness of the concept of phygital learning?"* where the majority of responses indicate *"I had a general idea but lacked detailed knowledge."*

Figure 23: Graph depicting the responses to question 5 of the questionnaire



Source: authors elaboration

2) *Access & Enrollment* phase pertains to the technical and administrative processes enabling participation, including registration procedures, digital login systems, and platform interoperability, often requiring seamless integration across diverse institutional systems.

The most challenging phase in the cases analyzed was precisely this: as emerged from the interviews, the registration process within innovative, globally oriented initiatives is still hindered by an inadequate bureaucratic system. The procedures for obtaining visas for non-EU students occur after the enrollment, which cannot be completed without the visa itself. This has led, for example, some students from Central Africa to withdraw from Share activities. Similarly, the registration procedures for the DIGISOC master's degree, managed by the University of Innsbruck, proved cumbersome for students from other countries.

The access and enrollment phase remain a critical and sometimes problematic stage: in the case studies, the response percentages to question 7 do not indicate that participants encountered technological barriers (only 8.5% select "*Technical barriers, such as slow internet or lack of devices*"), but rather a lack of clear

information during the process, with 36.2% citing "*Lack of clear information about the enrollment process*." This response is particularly noteworthy because it suggests that technological access issues are less significant than initially assumed: in the case of EURIDICE, access to the DIGISOC degree program occurs within a technologically advanced context, such as European and Northern European countries, making such access relatively predictable. Conversely, for Share AFRICA, where the target students come from the African continent, the absence of technological barriers was less obvious, highlighting the importance of clear communication in diverse regional contexts.

3) *Learning Engagement* captures active participation, collaboration, and social presence within both physical classrooms and digital environments, facilitated through digital platforms, discussion forums, and collaborative tools.

The Learning Engagement phase was extensively examined through interviews with educators, students, and technical staff. When asked, "*Which strategies or tools do you find most effective in maintaining engagement during phygital learning*?", responses varied. A technical staff member described "*effective, safe, and teen-friendly strategies commonly used to keep learners engaged in phygital learning as a blend of physical and digital environments)*" (Interview 9, project coordinator). A student highlighted that "*interactive tools like polls, quizzes, breakout rooms, and collaborative platforms, combined with a clear structure and active instructor involvement, are most effective in maintaining engagement during phygital learning*" (Interview 7, student) and another one suggests how specific tools he appreciated "*The tools I find more effective are Miro (for workshops, as it facilitates real-time visual collaboration) and Mentimeter (for boosting engagement during the frontal lecture)*" (Interview 8, student). Additionally, a professor noted that "*blending interactive digital tools like polls, quizzes, and collaborative platforms with active in-class participation keeps learners engaged in phygital settings*" (Interview 4, professor).

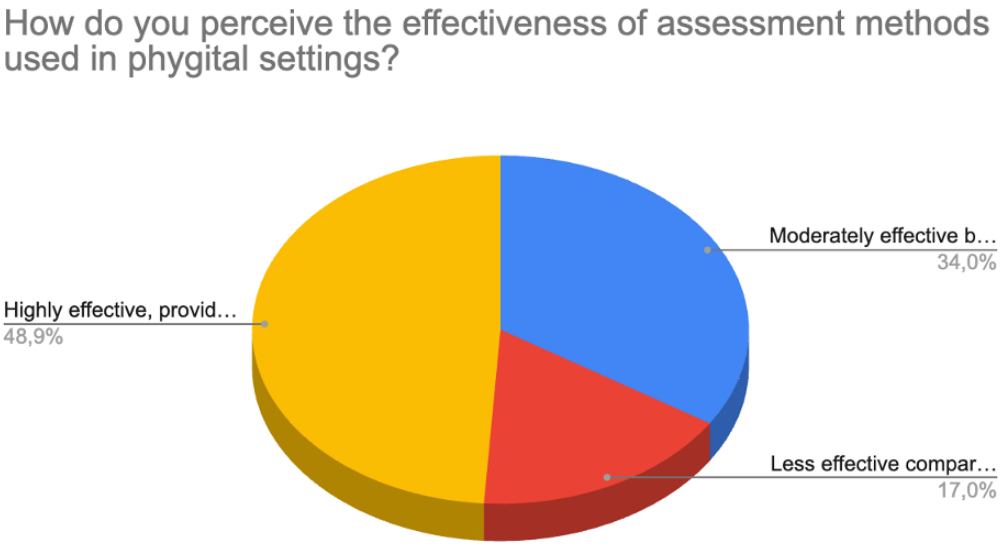
The virtual lecture sessions presented both the theoretical and practical material, which was subsequently reinforced during the hybrid laboratory sessions through weekly exercises, serving both formative and summative purposes (Gamage, et al.

2022). In both educational processes, the innovative pedagogical approach, as well as the emphasis on socialization among students and the promotion of collaborative teaching—both peer-to-peer and between educators—were integral components outlined in the foundational project proposals underlying the study programs (SHARE Africa Project, EURIDICE Project).

4) *Performance & Assessment* encompasses varied evaluation methods—ranging from onsite exams and presentations to online quizzes and peer assessments—necessitating adaptable and equitable assessment strategies across modalities (Gikandi, 2021).

Effective assessment practices are essential for identifying students' needs, guiding instructional decisions, and enhancing overall educational outcomes (Wiliam, 2011). In the context of a phygital learning journey, the assessment phase, although recognized as critical, does not prominently emerge from interview responses; instead, it was shaped by a broader pedagogical orientation. An analysis of the project documentation clearly indicates an intent to align this phase more closely with students' needs. Nonetheless, in the two case study projects, the formal examination procedures for EURIDICE have yet to be implemented, and the study and assessment activities for SHARE Africa are still in progress. As a result, examining this fundamental aspect of learning — performance and assessment — has proven to be particularly complex. For this reason, the analysis of the assessment component primarily focuses on project work, assignments, and quizzes present in the MOOCs. Nonetheless, the level of satisfaction remains generally positive, with about half of the respondent's expressing contentment with these assessment methods.

Figure 24: Graph depicting the responses to question 10 of the questionnaire

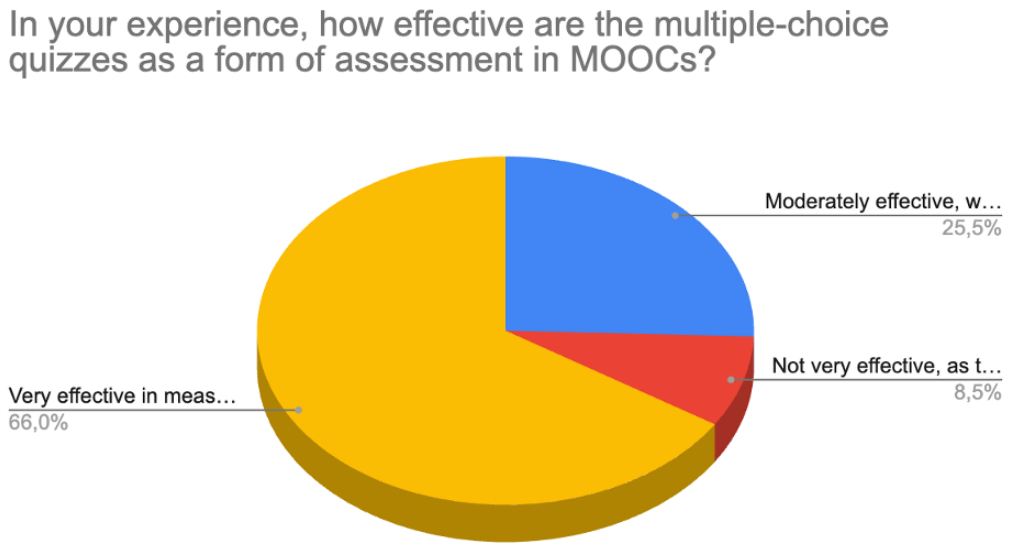


Source: authors elaboration

The effectiveness of assessment systems, both digital and in-class, is also highlighted by educators during the interviews. One teacher stated, "*From my perspective, phygital assessment methods are effective because they give the flexibility of digital while still allowing me to benefit from in-person evaluations that capture collaboration, communication, and practical skills*" (Interview 4, professor). Another educator noted, "*I find that assessment methods in phygital settings are most effective when they combine real-time feedback, interactive quizzes, and practical tasks that reflect both online and in-class learning*" (interview 5, professor).

The MOOC assessment component was regarded as effective, with very high percentage ratings.

Figure 25: Graph depicting the responses to question 12 of the questionnaire



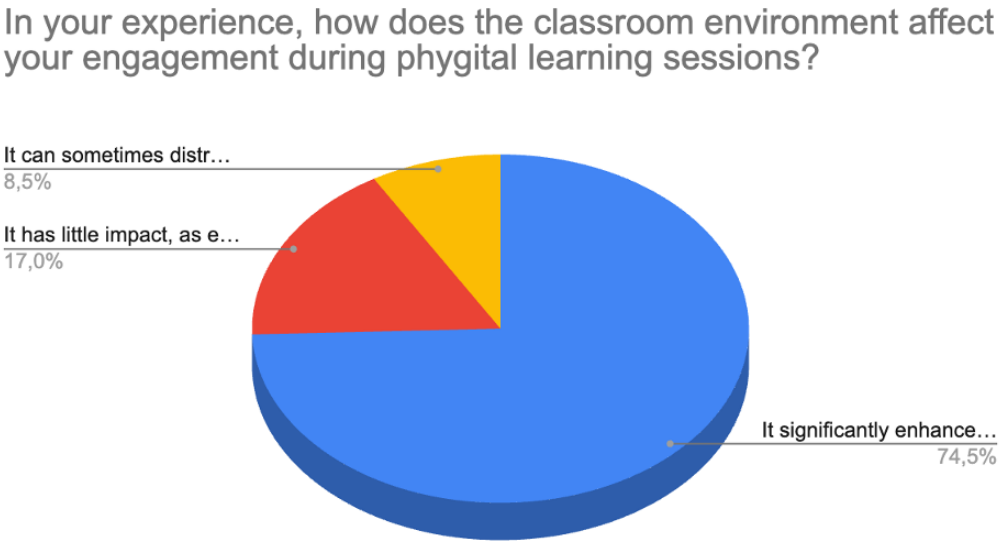
Source: authors elaboration

Student responses to the interviews reveal some concern regarding final exams and group projects, as they feel they have not received sufficient information about these assessments. One student mentioned, "*I haven't experienced any assessments in this phygital setting yet, as our exams are scheduled to start in January*" (interview 7, student). Another added, "*I find assessment methods in phygital settings effective when they mix quick digital checks (like quizzes) with practical in-class tasks. This combination provides a clearer picture of learning, though poor tech or unclear instructions can make assessments less reliable*" (interview 3, student). Finally, one student expressed a preference saying, "*I would have preferred that the exams were scheduled earlier, before spending entire weeks of lessons, so I could better understand how they are structured, especially considering that evaluations can vary between professors from different universities*" (interview 2, student).

5) *Support & Social Integration* underscores the importance of fostering community, peer interaction, mentorship, and social cohesion, which support student retention and motivation within multi-institutional networks.

Classic studies in educational psychology, such as those by Vygotskij (1978) and Lewin (1943) emphasize the fundamental importance of the group climate within the classroom for the learning process. Vygotskij highlights how social interaction and cultural context form the basis of cognitive development, asserting that learning occurs through meaningful interactions among individuals, where strong relationships create a supportive environment that stimulates intellectual growth. Lewin emphasizes how social groups significantly influence behaviors and attitudes, suggesting that a positive group environment fosters motivation and cognitive improvement. Johnson and Johnson (2008) demonstrate that collaborative learning, driven by positive and cooperative relationships among students, enhances motivation and academic achievement. For this reason, recent educational programs increasingly recognize the importance of integrating social collaboration activities. In the analyzed case studies, this component was indeed present: in the EURIDICE project, a knowledge-based collaborative approach and peer exchange among students from different countries were prioritized, strengthening intercultural relationships; in the SHARE Africa project, social activities such as guided visits and explorations of local sites were always scheduled at the end of onsite study weeks, aimed at consolidating relationships among participating students. Responses to question 11, "I*n your experience, how does the classroom environment affect your engagement during phygital learning sessions?*" 72,7% indicate that participants—not only students—consider the importance of the classroom group dynamic in the learning process.

Figure 26: Graph depicting the responses to question 11 of the questionnaire



Source: authors elaboration

6) *Progression & Value Realization:* examines student progression through academic milestones, credential recognition, and the perceived value of their degrees in labor markets, often complicated by differing academic calendars and cross-border accreditations (Kennedy et al., 2021). This final dimension, although essential for assessing the impact of any learning intervention, was not sufficiently examined within the case studies, as neither of the two projects was completed, thus preventing a retrospective investigation of the learning journey's effectiveness in terms of placement and progression. The realization of value through learning is a dynamic process, where progression indicates ongoing development and increased capacity to apply new skills in real-world contexts (Merriam & Bierema, 2013): this aspect is only conceptualized based on theoretical foundations, as outlined in the relevant scientific literature (Kirkpatrick, 1996; Holton & Swanson et al., 2001).

Each dimension encapsulates a distinct facet of the student experience, which unfolds across both onsite and online modalities, involving multiple universities

across different countries that share responsibilities for pedagogical delivery, technological support, and institutional coordination.

In the table below, based on a review of the literature and analyses conducted within the case studies, I have summarized the characteristics, objectives, touchpoints, and expected values for each phase of the phygital learning process.

Table 11: Pathway of the 6 Phygital Learning Journey Phases

Dimensions	Purpose	Illustrative Touchpoints (Physical–Digital)	Expected Value Outcomes
1. Awareness & Orientation	Students discover and familiarize themselves with the hybrid learning offering	University open days + digital onboarding platforms	Clear expectations; reduced uncertainty
2. Access & Enrollment	Administrative and technological access to the ecosystem	Enrollment offices + student portals + identity verification systems	Service accessibility; empowerment
3. Learning Engagement	Active participation in hybrid instructional activities	Classroom sessions + LMS + XR simulations + AI tutors	Knowledge acquisition; engagement; satisfaction
4. Performance & Assessment	Demonstration of competence through hybrid evaluation	In-person exams + online assessments + analytics dashboards	Achievement; competence recognition
5. Support & Social Integration	Academic, emotional, and peer support	Mentoring offices + community platforms + chatbots	Belonging; well-being; persistence
6. Progression & Value Realization	Transformation into long-term outcomes	Career services + alumni networks + e-portfolios	Employability; lifelong learning orientation

Source: authors elaboration

4.5 Cross-analysis with literature and bibliometric insights

The analysis of the research findings reveals several key insights that underscore the complexity and richness of the phygital learning experience. For instance, the thematic map developed from the bibliometric analysis of "phygital learning" clearly indicates that in the upper-right quadrant (Figure 9), themes related to the integration of digital and physical experiences emerged as pivotal. This integration resonates with the responses collected from the participants involved in the case studies. For example, when asked, "In your experience, how does the classroom environment affect your engagement during phygital learning sessions?" (Question 11 of the questionnaire), the majority response was that "It significantly enhances engagement through direct interaction." This finding highlights that even Millennials, often perceived as digital natives, strongly value face-to-face learning experiences.

Additionally, the bibliometric analysis revealed another key theme related to digital skills, which are understood both as actual competencies in the digital domain and as a portfolio of skills. Within the case studies and findings, this aspect appears to be particularly problematic. Interviews with coordinators and professors indicated that the role of technical staff in guiding the learning process through technology was crucial to the success of the phygital learning journey from the educators' perspective. Conversely, student feedback highlighted that despite their generational advantage as digital natives, the guiding role of instructors remains essential—not only in traditional teaching but also throughout the entire phygital experience, including the selection of the most suitable technologies.

Cross-analysis with existing literature and bibliometric insights provides a valuable framework for situating these research findings within the broader academic discourse. This approach facilitates the identification of convergences and divergences between empirical results and established theories, thus enriching data interpretation through a theoretically informed lens. For example, the emphasis on flexibility within the phygital learning environment aligns with recent bibliometric trends that underscore the growing importance of adaptable and hybrid educational models (Mele & Russo Spena, 2021). Furthermore, this cross-analysis aids in

recognizing emerging themes and research gaps, guiding future investigations into areas of strategic significance in the evolving landscape of education.

By integrating bibliometric metrics—such as citation analyses and publication trends—the research underscores the evolution of ideas within the field and their impact across various academic communities. This ensures that contributions remain contextually relevant and scientifically rigorous. Emerging themes notably include advancements in technologies, particularly regarding AI and immersive realities. These themes also emphasize the necessary pedagogical shift that must accompany technological transitions. Several articles draw parallels between Education 4.0 and Industry 4.0, indicating that this change encompasses not just structural and infrastructural modifications but also necessitates a transformation in the roles of all stakeholders involved.

As observed, the touchpoints of a phygital learning journey are numerous and extend beyond traditional interactions between students and teachers, creating a more multifaceted holistic experience. This concept is well-established in service literature concerning the customer journey. The customer journey encompasses various touchpoints, including brand-owned, partner-owned, customer-owned, and social touchpoints (Lemon and Verhoef, 2016). These touchpoints are influenced by technological advancements and ultimately change the dynamics of the entire customer journey (Nam and Kannan, 2020).

Similarly, the learner's journey consists of a complex series of interconnected interactions, characterized not as isolated activities but as a sequence of experiences that are intrinsically linked. These encompass stages such as awareness, research, evaluation, enrollment, onboarding, participation, support, advocacy, and ultimately re-engagement. Traditional journey mapping typically involves tracking these stages across various channels, such as online platforms, mobile applications, social media, support chat, email communication, in-person visits, and events (Bajpai, Jha, Shukla, 2025).

The phygital learning journey notably repositions the student as a central element; however, this shift requires mutual recognition of the complementarity and interconnectedness of all stakeholders. These stakeholders extend beyond the teacher-student dynamic to include technical staff, administrative personnel, and

instructional designers, reflecting a comprehensive transformation of the educational ecosystem.

The higher education context predominates in the key articles analyzed bibliometrically, reinforcing the selection of case studies within the university setting. However, the presence of a study on phygital experiences in museums among the most cited articles (Xu, Zhang, Zhang, Mao & Wang, 2024) indicates that the phygital learning journey is expanding beyond traditional educational institutions and embracing a more global perspective within the broader concept of "learning."

Overall, this multidimensional approach enhances the study's robustness while positioning it within a dynamic and interconnected scholarly landscape, paving the way for future explorations in this evolving field. This comprehensive understanding underscores the necessity for a collaborative effort among all stakeholders to maximize the benefits of phygital learning environments. As educational institutions continue to adapt to the demands of a rapidly evolving digital landscape, the insights from this research can inform strategic initiatives aimed at enhancing student engagement, improving pedagogical practices, and effectively leveraging technology.

The emphasis on digital skills, for instance, highlights the need for ongoing professional development among educators to support their roles in guiding students through increasingly complex learning experiences. Furthermore, recognizing the various touchpoints within the phygital learning journey underscores the importance of designing holistic educational experiences that consider all aspects of student interaction, both online and offline. As institutions strive to foster inclusive learning environments, integrating feedback mechanisms and supportive technologies, such as AI, can play a pivotal role in enhancing the overall educational experience.

In conclusion, the findings from this research not only contribute to the academic discourse surrounding phygital learning but also offer practical implications for the design and implementation of educational programs across diverse contexts. By acknowledging the complexities of the learner’s journey and embracing an

integrative approach, higher education institutions can better prepare for the challenges and opportunities that lie ahead in the realm of phygital education.

CHAPTER V

CONCLUSION AND IMPLICATIONS

SUMMARY: 5.1 Theoretical contributions to Service Research and Phygital Learning – 5.2 Managerial and policy implications for higher education institutions – 5.3 Practical guidelines for designing AI-enhanced phygital experiences – 5.4 Limitations – 5.5 Future research directions

5.1 Theoretical contributions to Service Research

The core service in a university experience is a learning experience that is co-created, and that the value is emergent, unstructured, interactive, uncertain, with a hedonic dimension (Ng & Forbes, 2009). As numerous studies have highlighted, many universities are often perceived as being in a state of crisis (Pievatolo, 2012), yet at the same time they represent crucial stakeholders for bridging the gap between services, businesses, and other institutions—an effort encapsulated in their "third mission" (Levchenko, Kuzmenko & Tsarenko, 2018; Compagnucci & Spigarelli, 2020). Furthermore, the concept of a "fourth mission" has also been proposed for HEIs, emphasizing their role in fostering ecosystems of services that support the creation of spin-offs and startups (Boffo & Cocorullo, 2019). The Covid-19 pandemic has accelerated digitalization within education, and a redefinition of HEI systems, leading to a new type of real-time interaction that revolutionizes student and instructor behavior. To address these changes, a blended/hybrid model of education, also known as a Phygital mode of education, is necessary (Chaturvedi et al., 2021). The phygital transformation within higher education institutions is not merely a technological shift; rather, it represents a rethinking of the experiential dimension of learning and service delivery in light of new technologies, similar to how the phygital customer journey has been reconceptualized in the context of purchasing and service experiences (Mele & Russo-Spena, 2022).

Service literature tends to adopt a broad perspective on services, while education literature primarily focuses on the learning component of higher education. As a result, there has been no comprehensive framework that integrates the various aspects of the university experience, addressing key issues in education while also providing an understanding of its value to students (Ng & Forbes, 2009). Within the field of services, it is widely recognized that perceived value is challenging to define although it generally refers to the difference between the benefits received and the costs incurred by the customer (McDougall and Levesque, 2000). The difficulty in precisely capturing the true value of higher education services has created a necessity to develop innovative approaches and establish models relevant

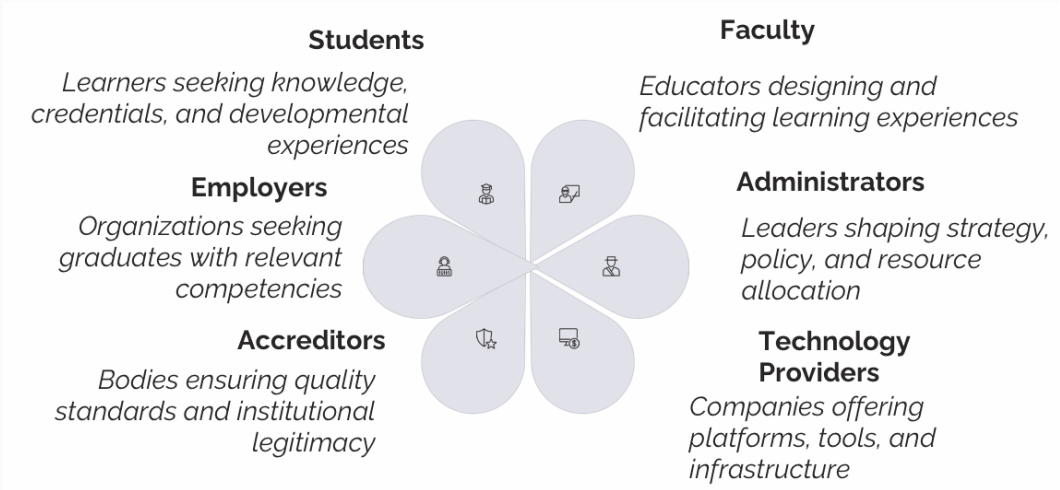
to the university context. Despite the numerous innovation-driven initiatives characteristic of the university ecosystem, HEIs have markedly lagged behind in their approach to students. This primarily results from the assessment parameters employed for evaluating universities, which rely heavily on government funding criteria centered on strict indicators of student recruitment, retention, and terminal proficiency. Consequently, universities tend to prioritize attracting, retaining, and graduating as many students as possible (Zamora-Ramos, Chamorro-Mera & Diaz-Mendez, 2023). In this regard, academic institutions still function as a service system where the "learner" is not yet at the center of the experience Unlike other service contexts, where the "customer" is typically in a purchasing role, such as in health care (Yeung, 2018), and even in hospitality, where the expected value is comfort and relaxation (Harris & Reynolds, 2004; Finney, 2019; Kim & Baker, 2020). It is no longer sufficient to regard formal certifications—such as degrees, master's, and doctoral programs—as the sole indicators of value, as studies demonstrated some decades ago when higher education was universally regarded as a sound investment (Marcus, 2008).

Instead, the learning experience needs to be reconceptualized within a broader framework that includes additional skills—ranging from relational and communication abilities (Ferrera, & Celentin, 2025) to linguistic competencies—as well as the crucial objectives of fostering mobility and enhancing collaboration among institutions. In this perspective, where the learning experience extends beyond merely attaining a final certification, the learning journey becomes a complex process, which can be associated with the concept of value co-creation. If value co-creation is the collaborative process whereby value is mutually created by the provider and the consumer through interactive, resource-integrating activities (Vargo & Lusch, 2008) in the universities, learning is a process built by multiple actors, always including the student as an agent of the ecosystem (Zamora-Ramos, Chamorro-Mera & Diaz-Mendez, 2023). The Service-Dominant Logic (SDL) emphasizes the idea of value co-creation, which has driven a shift in how customers engage in the exchange of value. Instead of adopting a passive role as recipients of value, customers are now understood to share responsibility in shaping and producing the service, recognizing that they actively develop and generate their

own experiences (Grönroos, 2011; Vargo & Lusch, 2017). In the context of education, value co-creation entails a multidirectional and dynamic exchange of knowledge that involves not only professors and students but also all other participants—both internal and external—within the broader network of relationships (Ranjan & Read, 2016; Dollinger et al., 2018). In this way providers refer to the various actors within the higher education system, which is increasingly addressing different facets of economic and social life, while consumers encompass all students, who, from a lifelong learning perspective, become potentially infinite in number. A recognized point of failure in the university ecosystem, which is intended to ensure a comprehensive learning experience, is identified in the poor integration among the various actors and their shared awareness (Bacevic, 2017). Typically, the diverse participants within the university—such as academics, administrators, students, patrons, and other stakeholders—tend to hold different conceptions of what constitutes a university experience, each influenced by distinct ideologies and motivations (Ng & Forbes, 2009).

For this reason, phygital learning enriches service research as a concept that shifts the perspective of stakeholders and creates a comprehensive learning experience, rich in touchpoints and structured according to principles of flexibility and personalization for the learners through the actions of all the actors involved.

Figure 27: Actors rule in Phygital Learner Journey



Source: authors elaboration

The concept of the "phygital learner journey" is highly relevant within the context of innovation and transformation in HEIs. Considering them as a system of services, it allows for a paradigm shift—already identified in other sectors—that promotes shared participation among diverse actors. This shift is facilitated by the integration of digital technologies as tools for implementing management and instructional processes.

The advancement of pedagogical, administrative, and technological practices connected to the phygital process can reposition the learner at the center of the learning experience, conceptualized as an emotional journey (Mele & Russo Spena, 2022) that goes beyond the mere attainment of a final certification. Adopting phygital learning models can significantly contribute to the requalification and innovation of educational services, transforming the learning experience into a more immersive, personalized, and effective process aligned with contemporary challenges (Vate-U-Lan, Quigley & Masouras 2016).

5.2 Managerial and policy implications for higher education institutions

To implement the described change, a series of managerial and policy implications must be addressed. In a complex system like higher education, awareness of one's role and a willingness to act from the student's perspective are not sufficient by themselves. These characteristics rather constitute the fundamental for building a system capable of meeting learners' needs, which, however, risks not functioning effectively due to structural deficiencies. In this regard, the guidelines outlined in the 2030 Agenda for Goal 4 "Quality Education" and the Missions aimed at universities and research for European funding through the PNRR are particularly relevant.

The need to invest in the training of technical and administrative staff is one of the guiding principles of several initiatives, which also involve faculty members. In the Italian context, within the National Recovery and Resilience Plan (PNRR), Mission 4 involves, in component C1, "Strengthening the offer of education services: from nurseries to universities." Among the targets set in Research Mission number Four, the expansion of skills and infrastructure enhancement is identified, emphasizing that "the quality of teaching and learning depends heavily on the requalification and innovation of learning environments (Italian Government, 2021). Other planned investments include measure 3.4, focused on Advanced University Teaching and Skills. The project aims to qualify and innovate university (and doctoral) pathways through a set of measures, including funding for initiatives such as the creation of three Teaching and Learning Centers to improve teaching skills (including digital skills) of university faculty and school teachers across all disciplines, including those traditionally less oriented toward digital integration Creation of three Digital Education Hubs (DEH) to enhance the higher education system's capacity to deliver digital education to students and workers (Italian Government, 2021). These initiatives, which also include the empirical cases analyzed in this study, aim to support two critical aspects for managerial implications: pedagogical innovation and the training of personnel at all levels to leverage the opportunities offered by digital technologies.

While institutions are attempting to address management challenges through funding and initiatives that enable the implementation of some of the process innovations necessary to make universities more open to technological change, the same cannot be said for policies. Transnational policy interventions for the management of Higher Education Institutions (HEIs) within contexts of technological integration are outlined in the European Universities Strategy (EU, 2022), which provides a series of directives applicable to all member states of the European Union regarding policies to support innovation challenges. The sustainability aspect of digital transformation for universities involves high fixed costs, the complexities of managing rapid technological changes, and the necessity to sustain digital transformation solutions over time while maximizing beneficial outcomes (Mohamed Hashim, Tlemsani & Duncan Matthews, 2022). With this vision the European Commission adopted in 2022 The European Universities Strategy that underscores the crucial role that higher education must play in tackling urgent societal challenges, including climate change, biodiversity loss, digital transformation, and demographic aging. Acknowledging that universities are key drivers of Europe's post-pandemic recovery and fundamental to shaping inclusive, democratic, and sustainable societies, the strategy aims to support higher education institutions in adapting to these dynamic conditions, fostering their ability to innovate, thrive, and enhance resilience. It emphasizes the importance of strengthening transnational cooperation and implementing innovation-led policies, urging member states to effectively leverage European funds in combination with national resources to amplify the social and economic impact of higher education. The European strategy also reaffirms the urgency of substantial investments in faculty and staff development, digital infrastructure, and learning capabilities—essential for nurturing pedagogical innovation and ensuring universities remain resilient and future-ready (European Commission, 2021). Key initiatives focus on bolstering the European dimension of higher education and research through programs such as Erasmus+ and Horizon Europe, establishing formal frameworks for inter-university collaboration, creating legal statutes for university alliances, and introducing a European degree and student card to facilitate mobility and recognition.

As evidenced both in the literature analyzed and through case studies, technological advancements are accompanied by improvements in mobility for both students and faculty. The support of digital tools enables synchronous lessons among students enrolled in integrated degree programs across multiple universities in different countries—such as in the case of EURIDICE—and the delivery of asynchronous MOOCs allows a cohort of 130 African students, dispersed across various North African universities, to receive training on the same subjects—as exemplified by Share AFRICA. Far from discouraging physical mobility, these technologies actually promote it: all actors within higher education institutions have participated in in-person exchange weeks at the partner campuses involved in the projects. Digital technologies thus evolve from mere digital twins—tools designed solely to replicate real structures (Campos Fialho, Codinhoto & Minto Fabricio, 2024)—to serve as instruments for constructing integrated mobility processes that facilitate collaboration across multiple institutions.

Policy implications are different for European universities: European higher education institutions are fundamentally distinct from their counterparts in the American and Anglo-Saxon contexts, making direct comparisons challenging. In Europe, universities have been primarily publicly funded and institutionally autonomous for over eight centuries, rooted in a predominantly secular tradition that emphasizes academic independence and public service (Garrido, 2002). Conversely, in the United States and the United Kingdom, the dominant model revolves around privately managed colleges and universities, which shape different policy priorities and governance structures (Altbach, 2016). As a result, the political implications of phygital transformations vary significantly across these contexts, necessitating diverse strategic responses. Interestingly, many countries within the same regional or cultural sphere often develop shared frameworks to guide these strategies, highlighting the importance of coordinated policy approaches that recognize their distinct institutional landscapes (European Commission, 2021).

The European Strategies highlights the central role of universities in addressing skills mismatches, promoting critical thinking, and fostering lifelong learning through innovative approaches like micro-credentials. The Commission has therefore proposed a European Skill Agenda and has indicated continuity between

school, university and job world through microcredentials as a tool for the flexibilisation of learning processes and professional updating (Bruschi, Repetto, & Talarico, 2022).

Micro-credentials, that is, certifications for non-traditional learning pathways (Gallagher, 2016; Brown et al., 2021b), can range from micro-learning—found primarily in the context of training, distinct from higher education teaching—and represent a rapidly expanding potential within digital platforms (Calise, Reda, 2021). These credentials can be easily integrated into university curricula through blended systems, such as phygital approaches, which combine physical and digital learning environments. Political strategies for addressing phenomena such as cutting-edge technologies, linked to phygital processes, cloud computing, artificial intelligence, big data, and virtual reality (Alavi and Habel, 2021) are still relatively underdeveloped and lack detailed frameworks.

5.3 Practical guidelines for designing phygital experiences

Phygital experience can be a radical change for value co-creation and how this can happen has not yet been investigated (Mele, Russo Spena, Marzullo & Di Bernardo, 2023, p.336). In this thesis, the research objective was to understand how a phygital learning experience could generate value co-creation. The analysis began with an investigation of the current state of research on the topic of phygital, and more specifically, on phygital learning. This was followed by an in-depth theoretical study through case studies aimed at identifying common and replicable characteristics that could inform guidelines. The first finding is that, similar to the phygital customer journey, this type of experience must be user-centered and thus tailored to the needs of the student. However, in an educational context, compared to phygital models related to customer experiences (Mele, Di Bernardo, Ranieri & Russo Spena, 2024; Barile, Secundo, & Del Vecchio, 2025), cultural consumption (Ballina, et al., 2019; (Chai-Arayalert, et al., 2025), or the provision of health services (Gaggioli, Cerasa & Barresi, 2023; Ganji & Afshan, 2024), the network of actors involved is more extensive and interconnected. The interplay among the actors involved in the learning process is the distinctive characteristic of the phygital model in education.

1 - Hybrid touchpoint Structure

A phygital learner journey model is not merely the integration of one of the many existing e-learning models (blended, hybrid, open) with classroom lessons, but the construction of a hybrid environment where there is no perception of transition between the digital and physical realms, as both proceed together. Within the studied cases, the digital learning component was developed both synchronously and asynchronously: in the case of synchronous learning (EURIDICE), it allowed students from different countries to attend classes without this- as revealed in the interviews-being perceived by them. In the case of asynchronous learning (Share Africa), the activities were still scheduled within the residential periods and acted as a catalyst for flipped classroom teaching methods.

2 - Technology enhanced personalized

Technology in a learning project should serve to create a personal learning environment (Van Harmelen, 2006), which is not always feasible in traditional learning settings. This involves selecting study paths and providing a range of educational materials readily available to the student, in order to adapt to their learning pace. Such an approach, which requires structured instructional design from the beginning of the process, is made possible by digital platforms, but most importantly, by the awareness of educators, who must reconsider teaching as a set of overlapping building blocks. It is not about creating an online repository of materials-often already present in educational institutions at all levels-but about envisioning materials with heterogeneous difficulty that allow students to position and reposition themselves according to their level of preparation and their learning objectives. In this sense, establishing a set of contextual guidelines and undertaking an organizational as well as pedagogical effort is of fundamental importance. AI can further assist in studying, but it can especially support the access and enrollment phases, which have proven to be the most problematic for students in the case studies, leading to feelings of disorientation and confusion. Conversational chatbots, already successfully used in guidance contexts, such as the Sofia chatbot from the DIses Department of Federico II University, or the avatars used during orientation days by LUISS University in Rome, can enrich the process by bridging an informational gap and generating greater well-being among students.

3- Expanded Actor Network

As already specified in several points, value co-creation in a learning experience not only aims at the value generated for the student at the center of the process but also in the interactions within the network of actors. Technological investment, alongside educational investment, cannot be separated from the presence of instructional designers (Koszalka et al., 2013) who support educators in the preparation of multi-platform teaching materials. Additionally, there is a need for administrative staff who have the delicate task of translating a series of innovations into procedures that are not yet standardized, either in terms of accreditation or

bureaucratically. A technical team, especially in cases where augmented reality is used, is another indispensable component of the network. Lastly, the educators themselves are essential, as there can be no educational relationship without their presence: as expressed clearly by the interviewees, the role of mentoring remains fundamental even in advanced contexts. However, in challenging pathways that involve both physical and digital mobility, the training of educators and their willingness to embrace innovation must be strong. In the analyzed cases, educators reported a good degree of satisfaction with the phygital experience, despite emphasizing that it had been more demanding than a traditional experience (Interview 2, educator).

4 - Multimodal engagement

The involvement of all actors is made possible precisely by the multimodal approach: such an extensive network of individuals does not exist in traditional learning experiences, largely due to obvious logistical and geographical limitations, which digital technologies make possible. An even closer interaction between educators and students can occur through the mediation of specific roles-instructional designers and tutors-who focus on making the learning process continuous and always keeping the needs of the student as a priority.

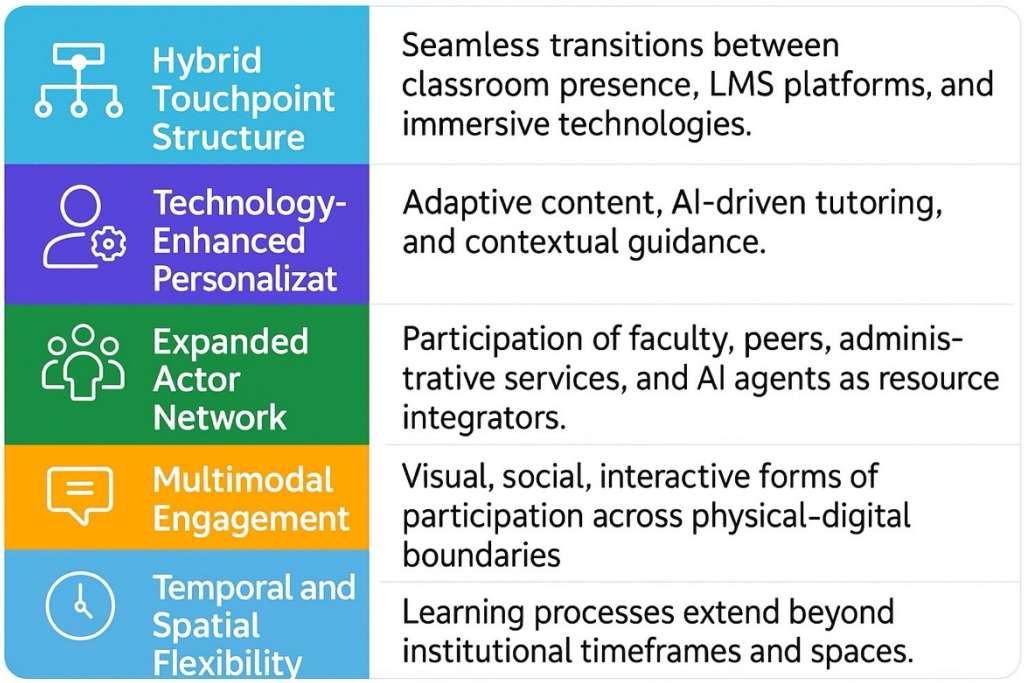
5 - Temporal and Spatial Flexibility

Phygital learning processes enable the overcoming of both physical and geographical barriers, as evidenced by both the literature and the case studies. Moreover, they allow for a temporal extension of the process: the availability of video lectures, content, quizzes, and exercises prepared by educators, accessible at any time, enables study that aligns with individual rhythms. Furthermore, unlike a path consisting solely of scheduled face-to-face lectures, digital courses facilitate access to a potentially infinite audience. MOOCs, present in both projects, provide access to a vast array of materials designed for large-scale consumption. Unlike the video recording of a traditional classroom lecture, MOOCs allow for interaction among participants through collaborative tools such as forums, chats, or groups connected to the courses (Downes, 2015), creating a learning environment that

maximizes the efforts made in the preparation of the course from a long-term sustainability perspective. This is also an added element of value co-creation, as it allows for the inclusion of users-who may not be traditional students-who wish to engage in lifelong learning and contribute to the third mission of higher education.

These five points thus serve as a practical guide to the essential elements of a phygital learner journey, which can then be adapted to specific needs and contexts. The design of these interventions is a fundamental aspect that must engage not only key figures such as rectors, department heads, or coordinators of specific projects, but the entire network of actors.

Figure 28:Exemplary schema of the elements of a phygital learning journey



Source: authors elaboration with AI support

5.4 Limitations

The limitations of this work are various, some acknowledged and others encountered during the analysis.

The first, which is acknowledged, is the choice to confine the scope of investigation to the university context: the guidelines may not be applicable to contexts outside of higher education institutions and therefore are not a replicable model for all levels of education, considering both school education and adult education, including professional training. This choice was made for two reasons: the existing literature on phygital learning favored this context, and due to the role of universities as centers of innovation that are currently recipients of strategic and financial resources to implement a series of interventions. Both analyzed projects are based on European funding and fall within a broad framework of reforms presented by national and supranational government bodies to improve academic competitiveness.

The limitations encountered during the analysis included following projects that were still minimally AI-enhanced, where the possibilities of artificial intelligence were seen as optional or supplementary rather than foundational. For example, the introduction of chatbots within phygital training projects could further support both students and, to some extent, the educators involved. Students could benefit during the initial onboarding phases, which empirical results have shown to be the most complex for them, while educators could receive assistance during the preparation of digital teaching materials, an activity that is not commonly practiced by some. Conversational agents (chatbot) are profoundly changing the marketing landscape and the marketing communications strategies of HEIs: prospective students can now communicate with potential universities through the medium of chatbots on websites. HEIs are adapting student recruitment activities by utilizing the new channel to capture the attention of prospective students at the information searching stage of their student journey (Ohanians, 2024). The chatbot integration into an e-learning system can provide replies suited to each learner's specific needs, allowing them to study at their own pace and this is an emergent touchpoint in the learner journey. Traditional e-learning often lacks personalized support and real-time

interactions with teachers, which can limit student engagement and limit effective learning experiences (Al Rawashdeh et al., 2021). Without the presence of teachers or educational professionals, learners are often left with static content and limited opportunities for immediate feedback, individualized assistance, and tailored learning experiences (Ait Baha et al., 2024).

In a phygital learning model chatbots can improve the enrollment and administrative processes, engage students more effectively in teaching activities, and assist in the assessment process, thereby functioning both as a service tool and as an educational agent (Hien, et al. 2018).

The aspect of geographical mobility and globalization of the learning journey delivered through university consortia—therefore a way to make the phygital learner journey also a physical journey of individuals across multiple academic contexts—was predominant compared to the possibility of integrating advanced technologies such as augmented reality and AI. This presents a significant empirical limitation, also considering the analyzed literature: in Figure 10, the thematic map for phygital learning clearly shows that a central topic of study is augmented reality, which was scarcely mentioned in the empirical part of this study.

Another limitation was that both phygital projects examined to detail a real phygital learner journey are still ongoing, making it impossible to investigate the final and ex-post phase of the process. While surveys, interviews, and participant observation followed all key points—from enrollment to dissemination, from teaching to student interaction—it was not possible to explore the impact on the faculty's portfolio and the students' curriculum regarding such actions. Additionally, a portion of the MOOCs in both projects has not yet been delivered, which limited the investigation of perceptions regarding the digital aspect.

In this research another intrinsic limitation was presented by the moderately small sample size: a student sample confined to 155 cases, divided into 25 students (EURIDICE Project) and 130 young researchers (SHARE Africa). This does not allow us to understand whether the guidelines are applicable to larger groups and in what ways.

The final limitation is that the two projects could not be compared, not only in terms of results but also in terms of exchanging best practices. Both adhered to the

guidelines for phygital projects but with different missions and setups that made them very distinct. A timely comparison, involving discussions between coordinators and actors, could have enhanced both this research and the execution of the projects themselves, but such a comparison was not conducted.

5.5 Future research directions

Future research directions on the phygital learner journey are numerous.

Given that the extended network is so important and capable of generating value co-creation (Vargo et al., 2008), it should be investigated more thoroughly, role by role, and also within the various relationships between the actors. In particular, students should be more actively involved from the design phase of phygital experiences: this would allow for analyzing the contributions that students, as in the phygital customer journey dynamic interplay (Mele & Russo Spena, 2022), in term of value can add to the learning process. Considered so far as the final recipients of the pathway rather than primary actors, learners are treated as passive, while in a phygital experience, they are central. Reconsidering roles and recipients is as fundamental as the technologies used. The latter should be examined more closely; the edtech market is steadily growing (Ravichandran et al., 2024), but this is not yet perceived by HEIs, which tend to develop innovative solutions in-house or purchase pre-packaged products—software and equipment—from major digital providers and networks for large-scale dissemination. A detailed study on innovative technologies in the learning sector, their customization, and the possibilities for integrating them through pre-established university pathways could provide further insights.

Although research on the topic is increasing, even though scholars have been studying the phenomenon for year (Haug, 2003) European HEIs are still lagging behind on the various accreditation possibilities: the skills acquired in a phygital pathway go far beyond simply passing exams or obtaining certificates. They encompass both students and staff acquiring digital, transversal, and relational (soft) skills (Jasim et al., 2023) that in the current university system rarely translate into open badges and micro-credentials (Clements et al., 2020), effectively creating a "system gap" where final results do not reflect the full value of the experience but identify only one part.

Implementation strategies should include phased pilots with rigorous evaluation to iterate designs; modular technology stacks adhering to open standards and APIs to ensure interoperability among LMS, CRM, assessment tools, AR/VR platforms, and analytics engines; governance frameworks embedding ethical data practices

and inclusive-access policies; and faculty development programs centered on pedagogy-first design, co-creation with learners, and assessment literacy for analytics-informed teaching (Verhoef et al., 2015; Calise & Musella, 2019). Cross-functional governance bodies (academic leaders, IT, student services, and learners) should align incentives, Key Performance Indicators, and resourcing with pedagogical aims rather than commercial metrics, while research agendas prioritize longitudinal studies on learning outcomes, equity impacts, and cost-effectiveness of phygital interventions as well as design-based research refining learner-journey mapping and experience-centered curricula (Pine & Gilmore, 1999; Mele & Russo Spena, 2022).

Finally, it would be beneficial to examine the faculty component from a perspective other than the pedagogical one: innovative teaching and experimental pedagogy are certainly prerequisites for ambitious innovation projects in terms of rethinking roles and models as well as funding and resources. However, it would be more pertinent to analyze teachers' relational and technological practices: specifically, their ability to build relationships with all actors in the system and their capacity to seize opportunities presented by new technologies, not only as educators but as part of an ecosystem of innovative services that HEIs can become within a service innovation perspective.

Researchers could undertake a similar investigation focusing on students, particularly regarding value co-creation and the psychological, emotional, and financial challenges that individuals may face during learning experiences. In this context, the study would explore how phygital learning facilitates the achievement of academic objectives, not only in terms of ECTS credits and academic careers but also by fostering a personalized learning environment.

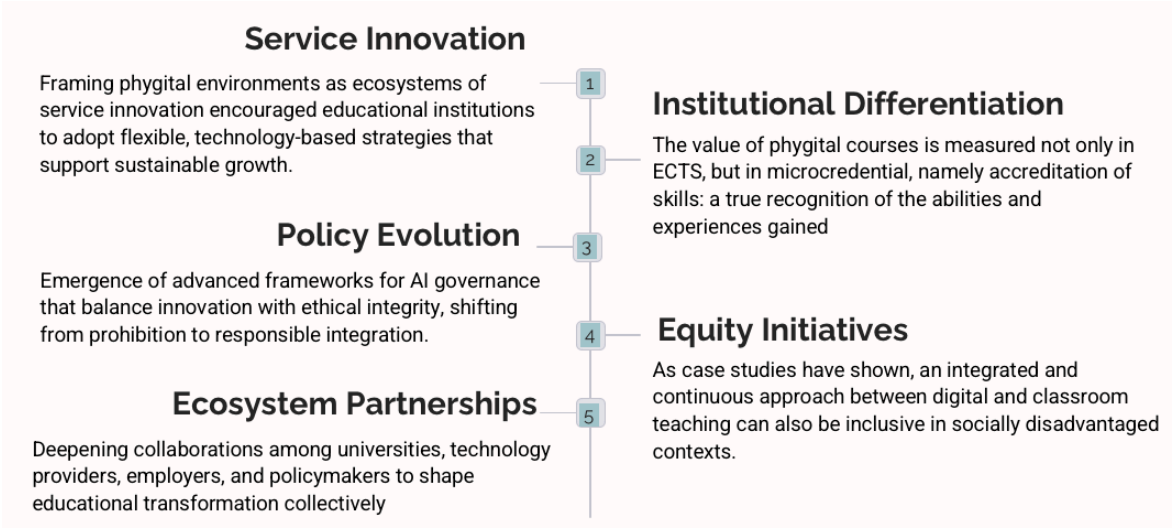
The influence of the phygital learner journey as a service-oriented process within a lifelong learning society remains an area that requires further exploration both in service research and related fields. The effectiveness of its implementation and the long-term implications for students could have a significant impact on the entire university ecosystem. This represents a valuable opportunity for scholars, researchers, and managers to delve into these fundamental issues.

Table 12: Topics Further Research Questions

Topic	Questions
Educational context	• Is it possible to replicate phygital experiences in non-university contexts? • Is it possible to adapt phygital experiences to corporate training contexts? • Will the costs of phygital experiences be sustainable for HEIs in the long term?
Interplay	• How can the relationships between teachers and technical and administrative staff be strengthened? • What could be the conditions to allow students to participate in the co-design phase of the phygital learner journey with other stakeholders? • How have the relationships between teachers participating in phygital learning experiences changed?
Technological framework	• What skills will be needed to more seamlessly integrate edtech into the process? • How can AI touchpoints be strengthened within the experience? • How can augmented reality intervene in the process?

Source: authors elaboration

Figure 29:Topics outline and future research



Source: author elaboration

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