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TECHNOLOGY-
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Fostering Innovation Through Technology-Enhanced Learning Spaces: A Multiple Case Study

The current business landscape is characterised by complexity and uncertainty, provoked by rapid technological advancements and interconnected macro trends that pose challenges and opportunities for organisations.

In this scenario, spaces for learning and knowledge exchange, enhanced by advanced technologies, emerged as pivotal settings to foster innovation dynamics. Specifically, technology-enhanced learning spaces (TELS) are considered physical, virtual, or hybrid settings that support learning and knowledge processes.

However, despite the growing interest, there is still a need for a broader understanding of how to effectively design and manage these spaces to maximise their potential in driving organisational innovation capacity. Accordingly, this study aims to address the aforementioned gap by conducting a comprehensive examination of TELS, focusing on their design, management, and influence on innovation dynamics.

To achieve this purpose, the study adopts a multi-case study approach and analyses some TELSs across different organisational settings, such as public institutions, business accelerators and private organisations. Data triangulation of theoretical and empirical investigations are employed to derive key patterns and management phases.

The findings reveal that TELS are crucial in promoting innovation and knowledge exchange within organisations. They foster collaboration, experiential learning, and personalized exploration, empowering organisations to generate innovative solutions, driving progress. However, several barriers hinder their optimal utilization, including technological limitations and a lack of effective management strategies. Accordingly, this paper proposes a technology-enhanced learning space management framework that distinguishes key phases for managing those spaces, with the aim of enhancing innovation capacity.

Theoretical implications include validating and refining existing conceptual and theoretical frameworks related to TELS, testing them in real life settings. Practically, the study offers a framework and insights for managers to enhance the design and management of these spaces, addressing critical issues and maximizing their impact on organizational innovation and performance.

Introduction

In today's dynamic business landscape, organisations are confronted with a multitude of challenges driven by rapid technological advancements and intertwined macro trends. This has created an environment characterised by complexity and uncertainty. In response, organisations increasingly recognise the need to support and strengthen their learning capacity as a strategic imperative. At the heart of this imperative is the drive to innovate, a vital force that underpins organisational survival, competitiveness, and sustained growth (Hamidi et al., 2019).

The ability to innovate, which involves generating and implementing novel ideas, products, or processes, is then intricately linked to learning and knowledge processes (Nonaka & Takeuchi, 2019; Hamidi et al., 2019). Learning and knowledge processes and dynamics form the foundation for cultivating capabilities that are essential for navigating the contemporary business landscape (Yildiz et al., 2021). In this vein, learning spaces, encompassing physical, virtual, social, and cultural dimensions, serve as fertile ground for nurturing innovation and driving organisational success (Morris, 2020; Hamidi et al., 2019).

However, the evolution of these spaces has been significantly influenced by various factors, including a shift towards learner-centric approaches and the integration of innovative digital tools (Karam et al., 2021). The COVID-19 pandemic, for instance, has acted as a catalyst, accelerating the transformation of learning spaces into technology-enhanced learning spaces (TELS) to meet new challenges and fully leverage digital technologies for learning and knowledge exchange and dissemination (Lagrutta, 2023; Krishnamurthy, 2020).

This transformation, while challenging, holds the potential to inspire innovation and drive organisational success. A deep understanding of TELS' diverse applications and contextualisation necessitates delineating the tangible and intangible dimensions that impact learning and knowledge dynamics. As a result, the literature review has generated a working definition of technology-enhanced learning spaces (TELS) and a conceptual framework summarising critical dimensions for design and functionality (Lagrutta et al., 2023).

Yet, the management processes deserve deeper analysis to define and distinguish the management phases. While recent contributions have predominantly focused on specific management tools, software, or underlying logic unique to distinct learning spaces, the need persists for generalisable and distinctive phases (Al-Khanjari, 2021; Schobel & Scholey, 2012). Nonetheless, heightened attention towards the topic and its associated issues is evident because modern configurations of TELS, necessitating a comprehensive approach to management that necessitates consideration of all

MANAGING TELS

structural and dynamic dimensions, understanding their interplay, and their influence on the inclusion and utilisation of both basic and advanced technologies (Lagrutta et al., 2023).

In line with this research's objectives, it is essential to gain a deep understanding of the managerial phases of TELS that aim to drive innovation dynamics. This study aims to fill this gap by answering to the following research question: "*How can organisations effectively design and manage TELS to foster innovation?*" This question holds theoretical and practical implications for organisations seeking to enhance their learning capacity and innovation potential.

To comprehensively address this question, the study aims to enrich insights from the literature and develop a management framework through an empirical approach that can serve as a valuable resource for academics and practitioners in creating and effectively managing such spaces. Given the novelty and the fragmented literature results in the management field, a shift towards empirical research is not only warranted but also crucial (Lagrutta et al., 2023).

This approach will facilitate a clearer understanding of the phenomenon within the management context, contributing to the existing body of knowledge (Reyes-Mercado, 2022; Pawlowsky et al., 2020). To achieve this, the analysis first validates theoretical patterns and insights derived from the literature before adopting an inductive approach to develop a managerial framework.

In this vein, the study adopts a multi-case study approach, focusing on TELS developed across diverse organisational settings in Finland and Italy, all aimed at fostering innovation pathways in alignment with the research. Through a rigorous examination of these cases, the research aims to unearth the dimensions and management phases that differentiate effective TELS in nurturing innovation capacity.

The structure of this paper is as follows: after this introduction, the paper provides a comprehensive theoretical background on the concept of TELS and its evolution, particularly in management literature, derived from an extensive literature review. The methodology section outlines the multiple case study approach employed in this research.

Then, the findings of the multiple case study are presented.

Finally, the paper concludes with a discussion of the theoretical and practical implications of the findings, highlighting the unique contribution of this research to the field of TELS management and offering directions for future research.

Theoretical background

Organisations must embrace innovation as a fundamental driver of survival, growth and success to thrive in today's rapidly changing business landscape. However, in this digital Era, innovation takes on a broader perspective, fueled by advanced technologies of Industry 4.0 and 5.0.

However, the innovation process goes beyond merely adopting advanced technologies but it encompasses embracing digital transformation and organisational change, fueling mindsets and approaches that foster creativity, adaptability, and dynamic problem-solving. Essentially, it is about continuously seeking new ways to add value to products, services, and processes (Scuotto et al., 2023; Hamidi et al., 2019).

In a world where disruptive technologies and market forces constantly reshape industries, organisations that fail to innovate risk falling behind their competitors and becoming obsolete. This requires agility and adaptability to keep pace with rapid change and emerging trends. Here, knowledge plays a pivotal role. It is not just a byproduct of innovation; it is a catalyst. In fact, effective knowledge management is essential for any organization to adapt to changing market dynamics, drive long-term growth, and maintain a competitive edge in today's digital Era.

By implementing systematic efforts to expand personal knowledge and facilitating the creation, dissemination, transfer, and storage of knowledge within and outside the organization, businesses can foster a culture of innovation and enhance their innovation capacity. This, in turn, promotes an environment that stimulates innovativeness and innovation climate within the organization, ultimately leading to successful innovation (Yildiz et al., 2021; Nonaka & Takeuchi, 2019).

Consequently, to support innovation processes in the digital age, organisations must focus on enhancing knowledge management, fostering a learning culture, and creating spaces that enable innovation and knowledge sharing.

In this scenario, learning spaces have emerged as crucial environments for fostering knowledge dynamics and promoting innovation within organisations, both in the public and private sectors (Csizmadia et al., 2022).

The evolution of learning spaces is a transformative journey influenced by technological advancements, pedagogical theories, and societal needs. Traditionally, learning spaces were confined to physical classrooms with rows of desks facing the teacher, fostering a passive learning environment. However, with the emergence of digital technologies and evolving educational philosophies, the concept of learning spaces has undergone a profound transformation.

Flexible learning spaces (e.g. maker spaces and innovation labs), for example, provide learners with opportunities for hands-on experimentation, creativity, and interdisciplinary collaboration (Lee and Tan, 2022)

Moreover, the proliferation of basic and advanced digital technologies profoundly changes learning spaces' design, functioning and management. In this vein, the technological revolution paved the way for the creation of technology-enhanced learning space (TELS), where learners could engage with content and interact with peers and instructors in virtual or physical spaces, supported by basic and advanced technologies.

It follows that a TELS is "the physical, virtual and hybrid space, of formal or informal nature, characterised by action and interactions among different actors and their capabilities, which promotes cognitive processes and influences knowledge and learning dynamics, through its tangible and intangible components and with a strong technological component" (Lagrutta et al., 2023).

Against this backdrop of evolution and transformation TELS have emerged as dynamic and multifaceted environments that integrate physical, virtual, social, and organisational dimensions. By understanding and managing the various dimensions of learning spaces, organisations can create innovative environments that support continuous learning and adaptation. TELS encompasses tangible and intangible dimensions facilitating knowledge creation and learning dynamics (Delgado et al., 2020).

CRITICAL ANALYSIS

A critical analysis of the literature reveals several distinguishing dimensions of learning spaces, including actors, settings, technologies, relationships, and organisational culture (Khandelwal et al., 2022; Illeris, 2004).

These dimensions are interrelated and complement each other, contributing to the overall effectiveness of the learning environment (Mulligan, S. 2016). These dimensions are presented in Fig. 1 and discussed in the following. Each dimension offers unique insights into learning spaces' design, implementation, and functioning, reflecting the interconnectedness of diverse dimensions.

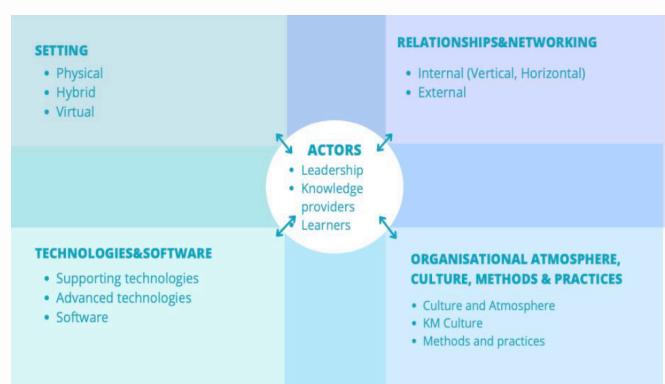


Figure 1. TELS Conceptual framework

Actors

At the heart of TELS are those who participate in the learning process, including learners, instructors, facilitators, mentors, administrators, and other stakeholders. The diverse roles and perspectives of these actors contribute to the richness and complexity of the learning environment, shaping interactions, collaboration, and knowledge exchange (Lee and Tan, 2023; Lancaster and Milia, 2015).

Setting

A TELS's setting encompasses physical and virtual elements that provide the context for learning activities. Physical settings include classrooms, laboratories, workplaces and collaborative spaces designed to facilitate face-to-face interactions and hands-on experiences. Virtual settings encompass online platforms, digital resources, and interactive tools that support remote learning, collaboration, and access to information (Jens and Gregg, 2022).

Technologies & Software

Technology is central to TELS, enabling access to contents and resources, facilitating communication and collaboration, and enhancing the learning experience. Basic technologies such as computers, tablets, and projectors provide essential content delivery and interaction tools. Advanced technologies, including artificial intelligence, augmented reality, and simulation tools, offer innovative approaches to personalised learning, adaptive feedback, and immersive experiences (Lee and Tan, 2022; Reyes-Mercado et al., 2022)

Relationships & Networking

Learning is inherently social, and relationships between learners, instructors, and peers play a crucial role in shaping the learning experience. Positive relationships foster collaboration, knowledge sharing, and a sense of community within TELS (Abuhassna et al., 2022). Networking extends beyond immediate interactions to include broader connections and collaborations that enable access to diverse perspectives, expertise, and resources (Ching Lee and Yian Tan, 2022; Müller and Wulf, 2022).

Organisational Atmosphere, Culture, Methods & Practices

The organisational context significantly influences TELS's design, implementation, and outcomes. Atmosphere refers to the learning space's overall climate and culture which can impact motivation, engagement, and satisfaction. Organisational culture encompasses shared values, beliefs, and norms that shape behaviours and interactions within the organisation. Methods and practices encompass instructional strategies, pedagogical approaches, and assessment methods that guide teaching and learning activities within TELS (Lee and Tan, 2023; Lazzari, 2023)

QUALITATIVE APPROACH

Research methodology

From a methodological point of view, according to the aim of the study, a multiple case study approach (Yin, 2009) has been rigorously elaborated and developed to provide empirical insights supporting the evidence emerging from the above proposed conceptual model.

Generally, a qualitative management research allows to capture intangible factors that create higher value for the literature. Furthermore, according to Yin (2009; 2013), the conducted case studies aim to gather valuable insights, through literal replication of real-life situations and allow cross-comparisons between different realities by identifying and defining critical learning points related to the fields of analysis that will result in helpful empirical guidelines for both scholars and practitioners. At its core, the multiple case study approach is a qualitative research methodology aimed at generating and testing theory, particularly in management, when dealing with broad, undefined concepts.

It allows for the exploration of complex phenomena within their natural contexts and facilitates the discovery of new variables and insights (Yin, 2009; 2013). To develop the study, careful consideration was given to ensuring a diverse and representative sample of cases encompassing various geographical locations, organizational settings, and types of TELS.

Then, data collection involved a multifaceted and iterative approach, incorporating both primary and secondary sources to ensure the findings' reliability, validity, and comprehensiveness. Document analysis, participant observation, and in-depth semi-structured interviews with key stakeholders, such as space managers, practitioners, and users, were conducted over an extended research period. All the interviews were recorded and transcribed. This allowed to have a reliable information base that perfectly reflected the interviewees' thoughts and follows requirements to ensure rigour and validity.

DATA ANALYSIS

The data analysis process was rigorous and systematic, involving the identification of emerging patterns, themes, and relationships within each case. Data were organised, coded, and analysed using qualitative analysis software (e.g., NVivo), allowing for efficient management and synthesis of large volumes of data. The findings derived from the data analysis were used to validate, refine, and extend existing conceptual framework (figure 1) and develop new insights and conceptual models' specific to the management of TELS for innovation. The study's outcomes aim to contribute to both academic knowledge and practical applications in innovation management, organisational development, and learning.

CHOOSING CASE STUDIES

The selection of nine TELS for innovation, spanning across Finland and Italy, was strategically chosen and each learning space, denoted as Tx, Hx, Dx, Kx, Ax, Cx, Digx, Dihx, and Ox (names changed for confidentiality reasons), was carefully curated to represent diverse perspectives and approaches to fostering innovation dynamics and capacity.

The choice of this sample is indeed focused on TELS, which aims to promote innovation dynamics and capacity, providing different perspectives of innovation that are stressed in the following. Moreover, the selection of the cases aims to provide insights into different organisational contexts and approaches to innovation management.

This diversity ensures a comprehensive analysis and a nuanced understanding of the processes and dimensions characterising real learning spaces for innovation.

Some of the learning spaces in this multiple case study, in particular, aim to support the development of new ideas and solutions, and thus are involved with startup and entrepreneurial ecosystems; others aim to support individuals and organisations on the path of digital innovation, while others aim to strengthen networking and social innovation.

In consequence, these TELS serve various purposes, ranging from digital literacy and social innovation to supporting organisations' digital transformation journey. Despite the diversity in their objectives, these learning spaces share a common goal: to facilitate innovation, knowledge exchange, and collaboration within their respective ecosystems.

They act as facilitators, offering a range of initiatives, courses, activities, and consultancy services to guide individuals and companies along their innovation journeys.

Overall, the chosen cases offer a rich and diverse dataset, allowing for cross-comparison and in-depth exploration of the design, functioning, and management aspects of learning spaces for innovation. While existing literature has made some attempts to address this issue, much of it is focused on educational learning environments geared towards facilitating the acquisition of knowledge and skills by students. In contrast, this study seeks to delve into the specific management dynamics of TELS aimed at fostering innovation.

The comparative analysis supports the identification of distinct phases in the management process of TELS for innovation, ultimately leading to the development of a management framework.

Findings

The study investigates various TELS for innovation across different contexts, outlining their management strategies. The study investigates various TELS for innovation across different contexts, outlining their management strategies, activities, and impacts. Here is a summary of the key findings from each case:

Tx	It is a community space supported by public financing that aims to connect actors in the startup and innovation ecosystem. It organises events, courses, and networking opportunities. Challenges include assessing long-term impacts and effectiveness, and plans are in place to develop better assessment metrics.
Hx	Situated within a university, Hx fosters entrepreneurial expertise through tailored methodologies like Innovation Challenges and Sprint Innovation Festival. Communication, community development, and continuous feedback are prioritised, alongside integrating technology into the learning process.
Dx	A leading co-creation space focusing on transformative dynamics, Dx brings together professionals, researchers, and facilitators to address high-risk challenges. Their strategy involves understanding diverse motivations, implementing digital technologies, and lean management practices, emphasising co-creation and partnerships.
Kx	This space facilitates collaboration and networking between industries and universities, offering innovative workplaces and co-working labs. It emphasises concrete outcomes, such as new projects and collaborations, and utilises technology to support communication and project organisation.
Ax	Originating from a regional grant, Ax is a diffused learning space for digital innovation, offering courses, seminars, and co-working spaces. Their management approach involves bottom-up and top-down planning, continuous adaptation, and collaboration with associations and local businesses.
Cx	A multi-functional learning space, Cx focuses on sustainable entrepreneurship and offers events, workshops, and creative labs. They sustain their initiatives through a mix of private funding and public calls, engaging learners through tailored events and technology-driven initiatives.
Dixx	Dedicated to disseminating digital culture and innovation, Dixx operates across small towns, fostering social innovation through activities like hackathons and workshops. Their management approach emphasises joint planning, engagement with young people, and collaboration with local associations.
Dihx	Dihx supports SMEs in digital transformation and offers consultancy, training, and prototyping services. Its management practices involve lean and agile methodologies, community development, and integrating advanced technologies like AI and big data.
Ox	A public-driven space for innovation, Ox focuses on community engagement and developing digital and entrepreneurial skills. It emphasises interaction with the territory, offering diverse activities like training paths, hackathons, and co-creation projects. Ox plans to assess long-term impacts more comprehensively.

Overall, these cases demonstrate diverse approaches to managing TELS for innovation, highlighting the importance of community engagement, strategic planning, continuous feedback, and leveraging technology to drive impactful outcomes.

One pivotal finding of this study emphasises the multifaceted nature of TELS management, which extends far beyond the confines of educational pedagogy. It was revealed that effective TELS management necessitates navigating through a myriad of contextual landscapes, considering legal, institutional, political, economic, and social dimensions, both at local and global scales. This contextual analysis serves as the foundation upon which strategic decision-making is built, empowering TELS leaders to identify and face challenges and barriers while capitalising on emerging opportunities.

Moreover, the study revealed a diverse spectrum of financing models employed by TELS, ranging from profit-driven private initiatives to collaborative ventures with public entities and academic institutions. This diversity accentuates the adaptive nature of TELS management, which is finely attuned to each space's unique needs and aspirations.

COMMUNITY

Community engagement emerged as a pivotal phase in the management of TELS, serving as a conduit for co-creating value propositions intricately aligned with learners' evolving needs and the broader societal landscape. Whether driven by specific demands articulated by learners or broader imperatives identified within the community, TELS leaders engage in co-creation and co-design activities to define strategic intentions and chart a course of action. This bottom-up approach ensures a degree of flexibility and adaptability essential for TELS to evolve in tandem with the dynamic demands of the innovation ecosystem, allowing them to remain relevant and impactful.

Consequently, by adapting to local needs and involving community members in the decision-making process, TELS adopt collaborative and inclusive approach to innovation fosters a dynamic environment where continuous learning and adaptation drive sustained development and success. Central to TELS operations and to their continuous connections and interactions with the surrounding territories, lays the concept of open innovation, which emphasizes the integration of manifold perspectives. In this context, the creation and development of communities is critical and necessary. Initial actions, in fact, aim to engage individuals, considering inputs from various stakeholders to shape the definition of the value proposition, through open innovation principles.

The planning phase of TELS management revolves around the formation of strategic partnerships, judicious allocation of resources, and integration of cutting-edge technologies. Despite the transformative potential of advanced technologies in enriching learning processes, challenges persist in their effective implementation and in assessing their tangible impact. Nevertheless, TELS leaders remain buoyantly optimistic about integrating these technologies into their spaces, particularly in light of the seismic shifts precipitated by the global pandemic, which prompted an accelerated adoption of hybrid learning models.

TELS foster innovation-friendly environments by adopting active methodologies and knowledge-sharing initiatives to nurture a culture of creativity and collaboration. Community development emerges as a transversal activity, facilitating continuous engagement and collaboration among internal stakeholders as well as external partners. Moreover, TELS prioritise the principles of privacy, accessibility, and inclusivity, particularly in the context of leveraging emerging technologies, to ensure a safe, equitable, and empowering learning environment for all participants.

Continuous monitoring and evaluation emerged as the basis of effective TELS management, allowing iterative improvements and data-driven decision-making. response, a proposed management model distilled recurring processes into distinctive phases, offering a comprehensive framework for planning and managing TELS effectively.

Discussion: TELS management framework

Following the comparative analysis of the case studies, a framework to manage TELS for innovation is presented (figure 2). The management framework for TELS for innovation, presented in figure 2, consists of three sequential phases: Define, Cultivate, and Collect, along with two transversal phases: Analyse and Involve, and include.

Define Phase

In this phase, the value proposition and objectives are defined based on a shared vision. Planning includes top-down or bottom-up approaches to goal-setting, defining core activities, strategic resources (primarily technological), and budget planning.

Cultivate Phase

Once optimal conditions and objectives are set, this phase focuses on executing core activities tailored to the goals, target audience, and available resources. Knowledge and learning dynamics are activated through specific methodologies and activities, facilitated by knowledge providers. The space should support innovation dynamics through adaptable settings, stable technology infrastructure, and activities fostering high-quality relationships and innovation.

Collect Phase

This phase involves gathering reflections and assessing outcomes and impacts achieved. Activity results are compared with initial aims to identify insights for learning and developing innovation activities and strategies. This phase initiates continuous improvement cycles, guiding organisations in ongoing innovation processes to remain competitive in an evolving environment.

Additionally, two transversal phases run through the framework:

Analyse Phase

This phase addresses social, legal, and political barriers, seeks economic opportunities, and identifies territorial needs through context analysis and continuous monitoring activities.

Involve & Include Phase

This phase focuses on communication activities and dynamics to facilitate the development of quality relationships and the creation of an innovative community, in line with the principles of open innovation. It emphasises overcoming privacy, accessibility, and inclusivity concerns and building valuable external partnerships with stakeholders.

Overall, this framework provides a structured approach for managing technology-enhanced learning spaces for innovation, guiding organisations through goal-setting, execution, assessment, and continuous improvement processes.

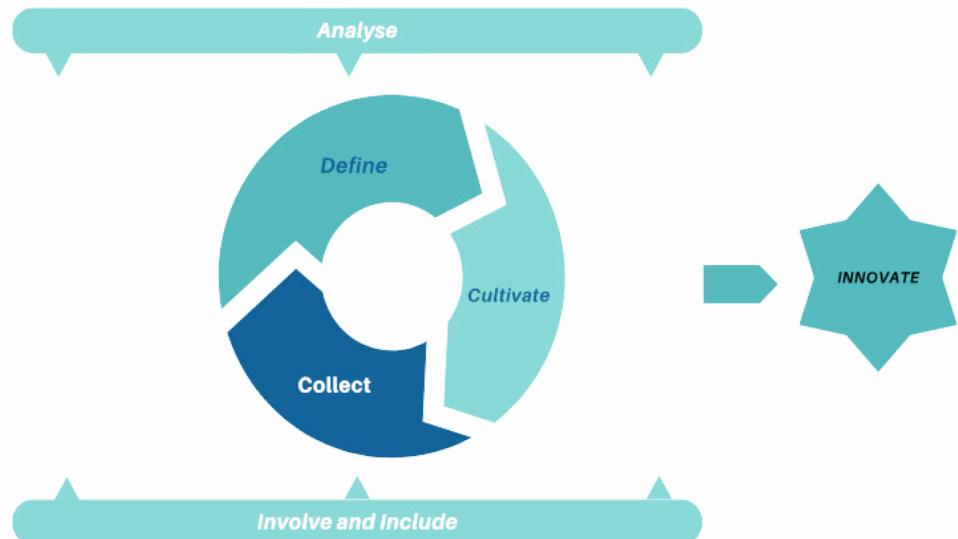


Figure 2. TELS Management Framework

CONCLUSIONS

Conclusion

Today's business landscape is complex and uncertain due to rapid technological advancements and interconnected macro trends and continuous innovation is the key to organizational survival, competitiveness, and sustained growth (Hamidi et al., 2019). The ability to innovate is intricately linked to learning and knowledge processes (Nonaka & Takeuchi, 2019; Hamidi et al., 2019).

Learning and knowledge processes and dynamics form the foundation for cultivating capabilities that are essential for navigating the contemporary business landscape (Yildiz et al., 2021). Therefore, TELS play a crucial role in driving innovation within organisations in the contemporary business landscape.

The evolution of learning spaces has been significantly influenced by various factors, including a shift towards learner-centric approaches and the integration of innovative digital tools. The COVID-19 pandemic has also acted as a catalyst, accelerating the transformation of learning spaces into technology-enhanced learning spaces (TELS) to meet new challenges and leverage digital technologies for learning and knowledge exchange and dissemination.

Following these trends, a working definition of TELS and a conceptual framework summarising critical dimensions for design and functionality has been presented. However, the management and assessment processes require deeper analysis to define and distinguish the management phases. In consequence, the RQ driving this study is: *"How can organisations effectively design and manage TELS to foster innovation?"*

To answer this RQ, a management framework for TELS for innovation has been developed through an empirical approach (i.e. multiple case studies).

Overall, the study highlights the importance of effective TELS design and management to foster innovation and enhance an organisation's learning capacity. The multiple case study approach provides insights into the dimensions and features that differentiate effective TELS in nurturing innovation capacity, which can have practical implications for organisations seeking to drive innovation and remain competitive in the contemporary business landscape.

The research provides both theoretical and practical implications. In terms of theoretical implications, the paper provides findings that enrich the existing knowledge concerning TELS in management literature and allows the development of effective and impactful guidelines for management and decision-making and to support the continuous improvement of the specific spaces. Theoretical implications include also validation and refinement of existing conceptual and theoretical frameworks related to TELS, testing them in real life settings.

On the other hand, in terms of managerial and policy implications, the management framework can be helpful to different actors aimed at developing effective TELS to foster the innovation capacity of public and private organizations. Specifically, the analysis empirically investigates the management aspects of TELS designed to promote innovation. The framework may serve as a valuable resource for academics and practitioners in creating and effectively managing TELSSs.

The study's main limitation is the lack of a deep analysis of the TELS's impacts on short— and long-run outcomes. Specifically, the analysis highlights the lack of effective assessment methodologies, prompting a need to develop more robust evaluation frameworks capable of capturing the long-term impacts of innovation.

The limitations represent opportunities for future research in order to reinforce the conceptual framework, the findings' generalizability as well as to collect more pieces of evidence and further rigorous and valid insights to derive guidelines from assessing effective TELS for innovation capacity.

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