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"ASSESSMENT AND MANAGEMENT OF LEARNING SPACE PERFORMANCES BASED ON 4.0 TECHNOLOGIES"

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Rosaria

Publications related to the monography

The present monographic dissertation is linked to papers published, presented, submitted, or under development as inserted in working pipeline. The following table presents such contributions of the author related to this monography: per each paper, it details the reference (or proposed title, for working papers), the status and the connection to the monography.

Reference/ proposed title	Status	Connection with the monography
LAGRUTTA, R. SANTARSIERO, F., LERRO, A., CARLUCCI, D. (2021). **Leveraging knowledge- based dimensions to implement entrepreneurship education (EE) programs in higher education.** *IFKAD 2020 proceedings*	**Published**	Gathering first insights on how to leverage knowledge based dimensions in educational learning spaces.
LAGRUTTA, R., CARLUCCI, D., SCHIUMA, G., SANTARSIERO, F. (2021). **Assessing virtual learning spaces performances: a conceptual framework.** *IFKAD 2020 proceedings*	**Published**	First draft of conceptual framework for virtual learning spaces.
LAGRUTTA, R., CARLUCCI, D., SCHIUMA, G., SANTARSIERO, F. (2022) "**Management of innovative learning spaces: toward an assessment tool**" *IFKAD 2022 proceedings*	**Published**	First draft of management and assessment model for learning spaces for innovation.
LAGRUTTA, R., CARLUCCI, D., SCHIUMA, G., SANTARSIERO, F., LERRO, A., (2022) **"Undertaking KM initiatives for enterprise 4.0: a tool for assessing their effects"** *IFKAD 2022 proceedings*	**Published**	Learning spaces analysed through the lens of knowledge management initiatives for enterprise 4.0.
LAGRUTTA, R., CARLUCCI, D., SCHIUMA, G., SANTARSIERO, F., LERRO, A., (2023) **"Learning spaces based on Advanced Technologies: Towards a Management and Assessment Tool"** *IFKAD 2023 proceedings*	**Published**	First draft of management and assessment model for technology-enhanced learning spaces.
LAGRUTTA, R., CARLUCCI, D., SCHIUMA, G.,	**Published**	Sheds more light on the connections among Innovation

SANTARSIERO, F., LERRO, A., (2023**) "Exploring Learning Spaces for Innovation Capacity: a Multiple Case Study"** *IFKAD 2023 proceedings*		capacity and learning spaces.
LAGRUTTA, R., CARLUCCI, D., SANTARSIERO, F., SCHIUMA, G., & LERRO, A. (2023). **Distinguishing the Dimensions of Learning Spaces: A Systematic Literature Review.** In European Conference on Knowledge Management (Vol. 24, No. 1, pp. 769-778).	**Published**	Insights from a first systematic literature review in management field, aimed at distinguishing the dimensions characterizing a learning space.
Daniela Carlucci, Dmitry Kudryavtsev, Francesco Santarsiero, Rosaria Lagrutta & Achille Claudio Garavelli (2022) **The ISO 30401 Knowledge Management Systems: a new frame for managing knowledge. Conceptualisation and practice, Knowledge Management Research & Practice**	**Published**	Explores the field of knowledge management systems, with a particular focus on ISO 30401 Standard.
Lerro, A., Santarsiero, F., Carlucci, D., Lagrutta, R., Schiuma, G. (Under review) **Knowledge-based dimensions in Entrepreneurship Education (EE): Modelling and Practices**	**Under review**	The paper first identifies and categorises the potential knowledge-based dimensions grounding EE and then provides a set of case studies to show the theoretical framework's application to actual EE programming.
Distinguishing the dimensions of a technology-enhanced learning space: a systematic literature review	**Working paper**	Systematic literature review of technology-enhanced Learning Spaces in management field. Proposal of a conceptual framework to understand, from a descriptive and a prescriptive viewpoint, to boost continuous innovation dynamics.

ABSTRACT

The research proposes technology-enhanced learning spaces as valuable strategies to support continuous innovation development in organisations centred around knowledge and learning dynamics. Learning spaces enable and catalyse knowledge and learning dynamics, supported by a tangible and intangible infrastructure that fosters open, honest, and receptive interactions among stakeholders that integrate the space into their daily lives (Delgado et al., 2020).

The need for investigating and identifying possible solutions to foster continuous innovation is receiving growing interest, both by scholars and practitioners, because, in the dynamic and interconnected contemporary business landscape, various macro trends exert influence on the organisations, necessitating adaptive thinking and actions. The advent of Industry 4.0 and Industry 5.0, propelled by digital transformation, has resulted in disruptive innovations, reshaping industries and work tasks. Nowadays, in fact, advanced technologies have permeated various sectors, altering workflows, automating processes, and creating new business models.

However, the rapid evolution of digital technologies presents challenges for organisations, requiring them to adapt swiftly to harness opportunities effectively. The competitiveness and attractiveness of organisations and their capacity for survival and growth depend on their ability to face challenges and adapt to the current VUCA (Volatility, Uncertainty, Complexity, Ambiguity) context. Therefore, businesses must create agile and dynamic strategies to adapt quickly and face the challenges. From such a perspective, innovation becomes a crucial driver for survival, competitiveness, long-term growth, and success (Ensslin et al., 2020; Hamidi et al., 2019; Bennett & Lemoine, 2014; O'Connor, 2013; Solomon, 2007).
Although the need to embrace the innovation journey is crucial, it takes a lot of work to manage and exploit.At the basis of the organisations' growth and development, learning and knowledge dynamics act as critical drivers that fuel continuous innovation (Yieldiz et al., 2021; Abukhait & Pillai, 2017). Knowledge creation and practice are in fact the foundations for a company's development, survival and growth (Nonaka & Takeuchi, 2019).

The research problem then focuses on developing effective spaces that, relying on knowledge and learning dynamics and implementing advanced technologies, help companies to fuel and support continuous innovation paths in the Digital Age.

In this vein, the development of innovative spaces based on learning and knowledge dynamics and supporting the use of new advanced technologies may constitute a key concept for all the organisational contexts in which the creation and management of knowledge and learning dynamics are boosting factors that support innovation and growth dynamics. To ensure and evaluate their effectiveness in fostering innovation, the emphasis is placed on management phases and performance dimensions to consider.

Although several studies have discussed the features of learning spaces, especially in educational contexts, there still the need to investigate more regarding a comprehensive and holistic definition of learning spaces, identifying its distinguishing dimensions and characteristics, management phases and performance dimensions. This is particularly true in the management literature (Menninen et al., 2007; Basye, D. et al., 2015; Cheng, 2015; Ryan, 2016; Csizmadia et al., 2022; Kim et al., 2014; Mueller & Strohmeier, 2010).

In this vein, the research begins by establishing a transdisciplinary understanding of the concept of learning spaces, drawing from educational and management fields.

The theoretical section presents a systematic literature review of Learning Space to provide a

comprehensive understanding of the concept and its evolution according to two main dimensions of analysis: design and functioning.

Consequently, five key dimensions have been identified and included in a conceptual framework applicable in multiple contexts. These dimensions also explore how advanced technologies intersect with learning spaces, influencing their evolution and impacting knowledge and learning dynamics. As an output of the literature review, an umbrella definition of "technology-enhanced learning space" has also been provided.

Furthermore, the thesis employs a multiple-case study approach to better enrich the literature's insights and propose a technology-enhanced learning space management model. The model describes key phases and relevant issues for effectively managing technology-enhanced learning spaces for innovation.

Then, the proposed framework has been applied, through an Action Research (AR) project, involving a technology-enhanced LS of an organisation that currently employs advanced technologies for social innovation purposes. The Action Research (AR) project sought to validate the management model by implementing it practically. The primary objective is to ensure the learning space's effectiveness, and then to identify performance dimensions to assess and consider.

To summarise, the research results synthesize data and knowledge gathered from the systematic literature review and the empirical investigations and offer implications and insights both for theory and practice.

Concerning the theoretical implications, the study systematically explores the concept of "learning space" in management literature, focusing on its recent development, the influence of advanced technologies on its design and functioning, its dimensions, and its role in catalysing knowledge and learning dynamics. The integration of advanced technologies within learning spaces is also analysed.

Then, the study addresses a literature gap by developing comprehensive models for managing and assessing learning spaces, contributing to innovation and knowledge management literature.

Some practical implications for managers, leaders, and knowledge providers have been derived. In fact, the findings provide a technology-enhanced learning space management model that suggest specific phases to consider to manage the LS effectively. Therefore, model supports strategic decision-making in creating, developing, managing, and assessing effective learning spaces for innovation. It offers practical insights for organisations aiming to foster innovation in the digital age, guiding the maximization of the potential of advanced technologies implemented within the space. The study also tests the validity of the model, ensuring a real-world implementation, deriving some insights about the effectiveness and usefulness of these kinds of spaces in rural areas.

The research acknowledges certain limitations that could be explored in future research. Additional empirical and quantitative inquiries might expand the sample size, enabling a thorough validation of the Technology-enhanced learning space management model. This future research could also emphasize the development of robust Key Performance Indicators (KPIs).

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ABBREVIATIONS

RQ: Research question
DT: Digital transformation
LS: Learning space
AR: Action research
AI: Artificial intelligence
VUCA: Volatility, Uncertainty, Complexity, Ambiguity
LEEP: Learning Environments Evaluation Programme

I. INTRODUCTION

1.1.Context

The actual business scenario is turbulent and constantly evolving, characterized by complexity, volatility, ambiguity and unpredictability. The surprising aspect, nowadays, is the velocity and scale of the evolutions, primarily because of digital breakthroughs (Lee and Trimi, 2021).

Overall, several drivers and macro trends impact organisations' survival and growth capacity, triggering new ways of thinking and acting. Significant changes are happening in the economy, technology, environment, and culture but cannot be considered distinct. The megatrends impacting the world scenario are, in fact, interconnected and interdependent, and no change happens in isolation (Dufva and Rekola, 2023). Globalization has opened borders, supply chains, and trade patterns, creating impacts in one country or region that affect others. For this, unexpected adverse events, notably the pandemic and the geopolitical instability, profoundly affected the organisations' functioning and solidity at a world scale.

The pandemic has dramatically impacted the business world, leading to a great deal of instability and uncertainty and deepening the geopolitical division. As global wealth inequities grow, the divide between the rich and the poor increases, causing social tensions. The geopolitical instability caused impacts in terms of trade relations, fiscal policy, regional economic health, price of commodities, and supply chain risk. Consequently, it has caused inflation to soar, and firms are facing difficulties in operating their businesses, which has resulted in reduced profits and even bankruptcy for some companies (Lee and Tan, 2023; Karam et al., 2021; Krishnamurthy, 2020; Bennett and Lemoine, 2014).

Moreover, the climate crisis still influences several fields; fostering negative effects on food security, living conditions and biodiversity, among other things. Many of the Earth's carrying capacity limits have already been exceeded. Consequently, consumers have become more empowered and aware, demanding environmentally sustainable products, and organisations have increased their corporate social responsibility efforts and other commitments to society (Dufva and Rekola, 2023; Deloitte, 2017).

Simultaneously, not only adverse events impacted the firms' organisational processes. In fact, digital transformation has caused disruptive innovations in several industries. The emergence of Industry 4.0 and now Industry 5.0 has further accelerated this process, provoking breakthroughs and shifting work tasks (Lee and Tan, 2023). Technology is increasingly embedded in people's daily lives, and data are continuously collected and exploited. In this scenario, manifold advanced technologies have risen and diffused. According to the Gartner Glossary, advanced technologies promise to deliver significant value to the current scenario but still have relatively few users or a low level of maturity and usage.

However, they are defined as highly developed tools, equipment, methodologies, or systems that represent a significant progression in innovation, capability, or efficiency when compared to pre-existing or older technologies (Vrontis et al., 2022).

There are many instances of advanced technologies that can be used and exploited in different comp anies and settings. Additive manufacturing and 3D printing tools, which are production methods computerized and digital processes that create three-dimensional products; the smart robots, able to communicate without human intervention; the augmented and virtual reality tools (AR/ VR), which provides a digitally enhanced view of the real world; the cloud technologies, which allows users to access services immediately via the Internet's network; the Big data, providing high value and competitive advantage to the companies. Moreover, there are Internet of things tools, that include the proliferation of new mobile technologies with sensor and wearable technologies that interact with people, are connected to the Internet and can be accessed remotely; Sharing economy, in which technologies provide access to products through renting or borrowing in an online environment and, last but not least, the Artificial Intelligence tools and systems which allows new technologies to augment the capabilities of human-like Intelligence. Self-driving cars, talking-to devices, customized recommendations and other AI applications are becoming common (Dufva and Rekola, 2023; Lanzolla et al., 2021; Lee and Trimi, 2021: Borgers et al., 2021).
The advancement of technologies as Artificial Intelligence, machine learning, virtual and augmented reality and the Internet of Things have altered the workflow, and businesses can now automate processes, improve efficiency, and enhance customer experiences. This has led to the creation of new business models and the disruption of traditional industries (Dufva and Rekola, 2023). According to Lanzolla et al. (2020), some technologies, such as the Internet of Things, mobile connectivity, cloud services, and artificial Intelligence—are becoming pervasive within institutions, societies, and organisations; for this, they are often linked to concepts such as "transformation," and "paradigm shift".

Moreover, due to their characteristics, digital technologies pose challenges for firms that often need to exploit better the opportunities enabled by these innovative tools.
Advances in digital technologies occur at a remarkably high speed and it is impressive how much these technologies have transformed and are transforming the world. They are not just making businesses more efficient, but they are also helping people and organisations to tackle some of the most significant social issues, having a significant impact on people's lives (Lee and Trimi, 2021). Many digital technologies require fundamentally different capabilities, a better understanding of emergent opportunities, more suitable design criteria, and strategic responses to business model innovation. This represents a significant managerial challenge (Borgers et al., 2021).

1.2. Innovate in the Digital Age – a knowledge-based perspective

Companies that fail to face and adapt to a currently VUCA and rapidly evolving context risk being left behind. Therefore, businesses need to embrace digital transformation and leverage the latest technologies to stay competitive and thrive in the era of Industry 4.0 and 5.0. At the same time, they need to create agile and dynamic strategies, to adapt fastly and face the challenges. From such a perspective, innovation becomes a crucial driver for survival, competitiveness, long-term growth, and success (Ensslin et al., 2020; Hamidi et al., 2019; Bennett and Lemoine, 2014; O'Connor, 2013; Solomon, 2007). Consequently, organisations aiming to survive the competitive and turbulent market in which products' life cycle, technologies, competitors, laws and even whole societies exhibit rapid natural changes must continuously innovate (Kamaruddeen, Yusof and Said, 2010).

Since the start, innovation has been assuming different meanings in different contexts. According to Neely and Hii (1998), change is the main characteristic of innovation. In fact, the word innovation is derived from the Latin word "innovare", which means "to renew, to make new or to alter".

Obviously, the concept and practice of innovation have evolved throughout time, going through different stages. According to Lee and Trimi (2021) the significant phases of innovation evolution are: i) Closed innovation, ii) Collaborative innovation, iii) Open innovation, iv) Co-innovation, and v) Convergence innovation.
Innovate is thus essential but innovating in the digital age becomes even more necessary and assumes different nuances and perspectives. According to Lanzolla et al. (2020), advanced technologies have been associated with new possibilities and opportunities as well as new challenges in the innovation management literature. Consequently, a successful digital technology adoption goes well beyond the technical processes of adopting and involves, for instance, organizing new sociotechnical structures, new organisational and digital skills and new organisational structures (e.g., Almirall and Casadesus-Masanell 2010; Bailey et al., 2012; Troilo et al., 2017; Brunswicker et al., 2019; Viscusi & Tucci, 2018). Innovation in the digital age is all about being agile and adaptable because the pace of change is rapid, and businesses need to be able to pivot quickly to keep up with emerging trends and technologies.
According to several researchers, the creation and management of knowledge and learning dynamics are milestones that stimulate innovation processes, innovation capacity and innovation climate within an organisation (Yieldiz et al., 2021; Nonaka and Takeuchi, 2019; Abukhait and Pillai, 2017).
Consequently, public and private organisations appear increasingly committed to fostering skills necessary to deal with the challenges of the current scenario by enhancing their learning and knowledge management dynamics and processes (Ensslin, 2020, Iqbal, 2018).
Furthermore, there is a necessity to reassess conventional organisational training and learning models due to the growing emphasis on knowledge-based and technology-enhanced work. The primary challenge lies in comprehending how knowledge and learning processes and resources can be effectively supported and managed to stimulate innovation. Identifying the enabling factors, conditions, and dimensions in this context is crucial (Abukhait and Pillai, 2017).

1.3. Motivation of the research

Starting from the above-discussed context, it is possible to argue that the business scenario constantly evolves, influenced by negative and positive externalities, macro-trends and disruptive innovations. The real-life ecosystems, already characterized by complexity and unpredictability, have been further stressed by the Covid-19 outbreak, geopolitical instability and climate emergency. Furthermore, new advanced technologies of the 4.0 and 5.0 industries pervaded every life aspect, challenging firms and generating breakthroughs (Dufva & Rekola, 2023). In such competitive scenario, it becomes essential for companies to grow and face the challenges by innovating continuously. However, supporting those changes and enabling new processes can be challenging and not immediate, especially for SMEs that are often focused on short-term results (Nonaka & Takeuchi, 2019).
At the basis of the organisations' growth and development, learning and knowledge dynamics act as critical drivers that fuel continuous innovation (Yieldiz et al., 2021; Abukhait and Pillai, 2017).

Knowledge creation and practice are in fact the foundations for a company's development, survival and growth (Nonaka and Takeuchi, 2019).

The research problem is then focused on developing effective spaces that, relying on knowledge and learning dynamics and implementing advanced technologies, help companies in fueling and supporting continuous innovation paths in the Digital Age. To ensure and evaluate their efficacy in fostering innovation, the emphasis is placed on mangement phases and performance dimensions to take into consideration.

At the foundation of this study there is the socio-constructivism theory of learning, developed in the educational and pedagogical literature, that suggests the creation of "learning spaces" to enable and catalyze knowledge and learning dynamics, promoting communication, collaboration, knowledge creation, transformation and sharing and fostering learning at individual, group and organisational levels (Yieldiz et al., 2021; Mayer, 2009).

Learning spaces may be considered multidimensional physical or virtual places where people interact cooperatively to generate, manage and exchange knowledge, acquire skills and encourage brainstorming, idea generation and problem-solving opportunities (Nonaka and Tacheuchi, 2019; Iqbal et al, 2018). Specifically, a learning space's goal is to support skills development processes, triggering the development of an innovative capacity by managing knowledge and learning dynamics (see, e.g. Stern et al., 2020; Bossaller et al., 2020; Nonaka and Takeuchi, 2019; Grigol et al., 2014).
It is important to note that the ongoing development of technology, evolving pedagogical methods, and the changing needs of learners constantly challenge and influence the design and use of learning spaces. A noteworthy trend concerns the integration of technology within learning spaces. It started with interactive whiteboards, smart projectors, and other digital tools becoming commonplace in classrooms but it is going to continue with the adoption of advanced technologies as virtual and augmented reality, artificial intelligence, blockchain technologies and others. In this perspective, the choice of how to incorporate technology into a learning space should align with the educational goals and pedagogical approach of the educational institution (Haleem et al., 2022).

Despite the concept of learning space born in educational and pedagogical literature, it may be associated with all those organisational and territorial contexts aimed at developing the organisational basic, distinctive, and dynamic skills and to cope with the challenges of the Digital Age and specifically in all the contexts where learning and knowledge dynamics are essential to enhance innovation and value creation. In this vein, the development of innovative spaces based on active methodologies and supporting the use of new advanced technologies may constitute a key concept for all the organisational contexts in which the creation and management of knowledge and learning dynamics are boosting factors that support innovation and growth dynamics.
Although several studies have discussed the features of learning spaces, especially in educational contexts, there are still gaps regarding a comprehensive and holistic definition and the discernment of the distinguishing dimensions and management phases of technology-enhanced learning spaces. This is particularly true in management literature (Csizmadia et al., 2022; Ryan, 2016; Basye,. et al, 2015; Cheng, 2015; Kim et al., 2014; Mueller & Strohmeier, 2010).

In this vein, and to extend the research stream, ***the intent of this thesis is to study the effectiveness of technology-enhanced learning spaces in fostering and boosting continuous innovation in the Digital Age. In particular, it investigates the design, functioning, and assessment and management model of technology-enhanced learning spaces that support continuous innovation cultivating knowledge and learning processes and dynamics.***

Consequently, the study aims to investigate the concept of "learning space" in management literature by defining and providing insights about their effectiveness and usefulness in respect to innovation purposes, considering their value proposition, design and functioning, and management phases, with a particular focus on the implementation of advanced technologies.

In terms of the theoretical implications, this study attempts to systematise the notion of "learning space" in management literature by analyzing how it has been developing, especially in recent years, how advanced technologies are influencing its design, functioning and management, what are its dimensions, and how they catalyze the dynamics of knowledge and learning.
Simultaneously, the goal is to comprehend how the LS should be designed, managed and assessed to nourish the innovative dynamics and make this spaces effective.
Specifically, the study proposes the understanding of the concept of learning spaces beyond traditional educational contexts. Derived from educational and pedagogical fields, the research provides transdisciplinary insights. This enriches theoretical discussions by incorporating perspectives from diverse disciplines, fostering a holistic understanding of learning spaces and their implications for innovation.
It identifies five key dimensions, contributing to a nuanced conceptual framework applicable in both educational and organisational settings, fostering further exploration. Then, the research enriches theoretical perspectives by analysing the integration of advanced technologies within learning spaces. It extends existing knowledge on technology's role in fostering innovation and broadens theoretical discussions about its impact on learning dynamics. Moreover, it capitalizes on a gap in the literature by developing comprehensive models for managing and assessing learning spaces, thereby contributing to the broader literature on innovation management and knowledge creation.

On the other hand, the study's practical implications offer managers, leaders, and knowledge providers a framework that supports strategic decision-making and insights concerning the creation, development, management, and assessment of successful and effective learning spaces for innovation. In detail, the research offers practical insights for organisations aiming to foster innovation in the digital age. By understanding the dimensions and dynamics of learning spaces, organisations can develop strategies to optimise their use of advanced technologies for innovation.
Then, the study provides organisations with models for managing and assessing these spaces effectively. Insights from the multiple-case study approach and the action research offer practical guidance for real-world implementation, ensuring that learning spaces contribute to continuous innovation. Moreover, the findings may support the integration of advanced technologies in learning spaces. This integration is crucial for adapting to the evolving digital landscape and harnessing the benefits of technology-enhanced learning, with an emphasis not just on the technology's functionality but also on how it interacts with other elements of the learning space.

Given the industrial character of the PhD project, among the practical implications there is the need to work jointly on a common project with the organisation Openet Technology (Matera, Italy), that has developed its own technology-enhanced learning space for social innovation purposes. Specifically, the goal is to support them in developing, managing and assessing their learning space, based on scientific insights and emerging opportunities and threats.

1.4. Research process and design

The research process follows the model proposed by Saunders et al. (2009). The model, representing the research processes and design, is developed as an onion, where the external layers depict the issues underlying the choice of research philosophy, approaches and data collection methods; whilst the inner layers include research strategies, research choices and time horizons. The research philosophy and approaches are based on the view taken of the world. On the other hand, the research design translates the RQs into a research project, describing how the research questions are answered and the contributions are developed (Saunders et al., 2009; Ahlstrom, 2016).

Figure 1 describes the logic behind the model and each layer in detail.

The starting point for this research derives from practical and theoretical insights. Practical issues originate from the need to support and guide organisations through an innovation path in this turbulent digital age. The theoretical issues concern the lack of models and frameworks managing and assessing the performances of technology-enhanced learning spaces for innovation in management literature.,

The research philosophy underpinning the research strategy employed in this study is pragmatic. Saunders et al. (2009, p. 144) declared that "Pragmatism strives to reconcile both objectivism and subjectivism, facts and values, accurate and rigorous knowledge and different contextualized experiences". The reason to choose the pragmatic approach is also provided by the industrial nature of this PhD, that included the development of a research project aimed at practically cooperate and exchange knowledge and insights with an organisation, namely Openet technology (Matera, Italy).

Practically, pragmatism provides external, multiple views chosen to enable answering of the research questions, integrating different perspectives to help interpret the data. In this research, pragmatism is strictly connected with both the philosophies of positivism and interpretivism. Observable, objective phenomena and subjective meanings provide acceptable knowledge dependent upon the research question. Although the pragmatism research philosophy, according to Saunders et al. (2009) provides for various options to collect data, this study follows the Kelemen and Rumens (2008) approach, by which methods are selected based on their ability to gather the most reliable data to produce research advancements.

The approaches layer in the Saunders et al. (2009) model considers the possibility of deduction and induction. Deduction derives hypothesis from theories that are then operationalized and tested, mostly with rigorous scientific methods. Induction, on the other hand, generate new knowledge gaining field data. This study includes a combined approach, with multiple research phases connected to different approaches, making it challenging to define what is prevailing. All research phases consider existing

theories or are informed by insights gathered during previous research activities. However, the first two phases, aimed at developing a theoretical framework, are mostly deductive, whilst the empirical phases are primarily inductive, even though are always informed by theory. The methodological fit, considered as a core notion in management studies (Guo & Ahlstrom, 2016), was respected in each research phase, finding a link between problem, methods and contributions. Specifically, the maturity of knowledge in literature was connected with both the types of contribution and the types of research questions.

Concerning the research methods, in this study, a mixed-method approach was utilized to enhance the validity of the collected data and the accuracy of the findings through triangulation, as recommended by Molina-Azorin (2012). This thesis primarily used qualitative research methods, including systematic literature review, multiple-case study, and Action Research (AR). In the following sections, are provided further details regarding the strategies, time horizon, and techniques and procedures employed.

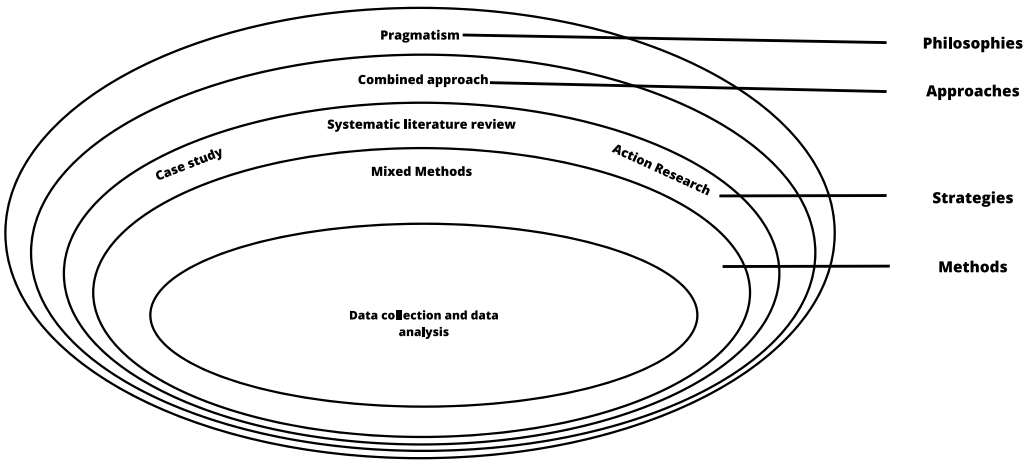

Figure 1. Research Philosophy (modified from Saunders et al., 2009)

1.4.1. Research questions and strategy

In line with the Research Problem, the first phase of this research is then related to deepen the concepts of **knowledge and learning** as drivers of innovation in the digital age.

Specifically, the objective is analysing what frameworks, approaches and solutions have been already employed, to enhance learning and knowledge dynamics, and what is the role of digital and advanced technologies.

First the research is carried on to systematize and understand the approaches and drivers that foster innovation in the Digital Age emphasizing knowledge and learning dynamics. A narrative review of the literature in the fields of innovation management, industry 4.0, and knowledge management has been carried out. The review aimed to detect current trends on these topics, understand how the

organisations face them, and identify the key challenges and barriers generated by the emergence and establishment of advanced 4.0 and 5.0 technologies.

From the the analysis it emerges that knowledge and learning dynamics are milestones that stimulate innovation processes, innovation capacity and innovation climate within an organisation (Yieldiz et al., 2021; Nonaka and Takeuchi, 2019; Abukhait and Pillai, 2017). In fact, several authors stated that today's companies need to improve and foster their learning and knowledge creation, sharing and transfer processes and properly develop and manage spaces that enhance learning and knowledge processes and dynamics. Understanding how knowledge and learning processes and assets may be generated and managed to stimulate innovation, as well as what are the enabling variables, conditions, and dimensions, is therefore the primary concern (Abukhait & Pillai, 2017; Peschl, 2014).
In this scenario, several models and framework emerged from the literature.
Different authors focused on learning organisations and knowledge management systems, i.e., organisational or technological tools to support companies' KM processes (Corso et al., 2003; Lai et al., 2021), whilst others proposed to enhance less conventional practices to foster effective learning processes and develop an organisational learning culture (Lee, 2018).
Other scholars proposed the development of specific places, within or outside the organisation, that embed and support knowledge and learning processes and dynamics.
For instance, Nonaka and Takeuchi (2019) stressed the importance of creating "Ba", i.e. spaces or places where relationships are forged, and knowledge is created through interactions. Peschl (2014) presented the Enabling Spaces, i.e., multi-dimensional spaces that support innovation processes. Whilst Schiuma and Santarsiero (2023) accentuated the significance of innovation labs, i.e. places with adequate and cutting-edge resources that foster innovation and stimulate innovative behaviour and lateral and creative thinking, including interaction, free discussion and knowledge transfer among employees. A similar kind of space is proposed by Heiskanen and Heiskanen, (2011) that introduced the concept of space of innovation that helps understand the structural, social, and mental conditions that facilitate or impede innovation processes.

Despite the emergence of different spaces' configurations sustaining innovation dynamics through learning and knowledge processed, several researchers highlight the need to deepen and widen the understanding of the concept, and to develop management and assessment models that ensure their effectiveness and support the implementation of technologies.
Peschl (2014), for example, highlights the need for a deeper understanding of the concept of enabling spaces in a trans-disciplinary context to allow for a stabler and more robust design process. Furthermore, Schiuma and Santarsiero (2023) stressed the importance of developing a model or management cycle by identifying and describing the phases that characterize the management process of an Innovation Lab. Moreover, regarding the knowledge management systems, several researchers (see e.g. Lai et al., 2022; Pawlowsky and Wagner, 2021; Corso et al., 2003) addressed the importance of developing assessment and evaluation frameworks or insights guidelines to implement and manage them.

To address this gap, this research initiates a quest for a more profound comprehension of the concept of spaces dedicated to learning and knowledge dynamics., in a transdisciplinary context, drawing from educational and pedagogical fields, where learning space and learning environment are actually implemented and used to support innovative learning paradigms. The notions of "learning space" and

"learning environment" draw origin and have their main application in the educational field, within the socio-constructivist learning paradigm, and are described as the result of the interaction between individuals and the tangible and intangible dimensions of their surrounding environment. The terms "learning space" and "learning environment" may be used interchangeably, even though often literature refers to "space" to indicate the physical boundaries and the tangible components and to "environment" to indicate the intangible components within and outside the physical setting (Kuokkanen, and Van der Rest, 2022; Kuuskorpi and Gonzàlez, 2011). For the purpose of this study the label used is "learning space" (LS).

Educational learning spaces are physical environments or virtual platforms designed to facilitate learning and educational activities. These spaces are intentionally created to support and enhance the learning experience for students (Kuuskorpi and Gonzàlez, 2011). Specifically, according to the OECD definition, a learning space is "a physical space which supports multiple learning and innovation through different teaching methods, including emerging digital technologies, functional and stable physical infrastructures and a good cost-effectiveness balance that respects the environment and is in harmony with it, by also encouraging social participation, providing a safe, comfortable and stimulating environment." (Salinas-Navarro, 2019; Morris, 2019; Santoianni, 2017; Kuuskorpi and Gonzàlez, 2011). A learning space is not neutral but may significantly impact learning and knowledge dynamics and their outcomes. Learning spaces enable and facilitate the creation and sharing of knowledge and learning by managing tangible and intangible components and nowadays the focus is on learning spaces supported by advanced technologies. Functional and effective learning spaces must be carefully considered across all management stages, from initiation and planning to execution, monitoring and evaluation (Kuokkanen, and Van der Rest 2022).

In this vein, recognising the learning space as an enabling factor for the creation and management of knowledge and learning makes it possible to extend its scope from the pedagogical sphere and apply it to all those organisational and operational contexts in which the unit of analysis is the understanding of the enabling mechanisms for the generation and application of knowledge. In this perspective, the concept of learning space, may be used as an umbrella concept including several configurations of tangible and intangible spaces, included the ones written down before, and supporting the identification of models for their design, management and assessment.

Specifically, organisational learning spaces refer to the physical and virtual paces within an organisation where learning and knowledge sharing take place. These spaces are designed to facilitate and promote learning, collaboration, and the exchange of information among employees or members of the organisation. Organisational learning spaces can take various forms, and they are essential for fostering a culture of continuous learning and improvement within an organisation (Lee and Tan, 2023). Moving from the considerations highlighted in the previous paragraphs, this thesis aims at shading light on:

How learning spaces based on advanced technologies can foster innovation in the digital age? And how to understand if they are effective?

This broad issue calls for the individuation of more specific elements to describe and understand.

Consequently, following this first step, the first RQ is introduced to better understand how the concept of learning space is conceived in the management field and what is its design and functioning.

RQ1) ***What are the distinctive dimensions of a learning space?*** *What is a learning space? How advanced technologies are impacting on its evolution?*

The specific aims of this RQ are: first, to develop a working definition of learning spaces that may be used as an umbrella concept in different scenarios, then, understand how the concept has evolved through the years and how advanced technologies have impacted on the evolution and finally, to develop a theoretical model that distinguishes its dimensions and explain its functioning.

The knowledge about "learning space" in management is fragmented, and the studies are often referred to public institutions and organisations. Therefore, the RQ1, having descriptive and explanatory nature, aimd to systematize the literature contributions in the management field, deriving a conceptual framework that supports the subsequent research steps and provides a framework, guidelines and insights for the design and functioning of learning spaces for innovation.

This RQ has been answered through a systematic literature review allowing a better understanding of the phenomenon. An analytical review approach has been adopted to systematically analyse the literature's contributions (Ginsberg & Venkatraman, 1985). In particular, for the purpose of this study, a systematic literature review has been carried out because it is the most efficient and high-quality method for identifying and evaluating extensive literature. The approach adopted is the one proposed by Tranfield et al. (2003), which is a scientific and transparent process reported in sufficient detail to permit replication (Tranfield, 2003) and balanced in terms of specificity and sensitivity (The Cochrane Collaboration, 2017). With an SLR approach, insights and evidence from the literature have been found, synthesized and evaluated (Calabrò et al., 2019; Cillo et al., 2019).

The most relevant articles in the field have then been critically analyzed and supported the development of a working definition of learning space.

The findings highlight the rise of creative, technology-enhanced learning spaces. In particular, the reorganisation of dynamic spaces with an emphasis on learners highlighted the spread of LS assisted by cutting-edge technological tools. The pandemic has forced public and private organisations to shift from in-person to virtual teaching and learning. COVID-19 has altered the scenario and forced learning and training environments to quickly evolve to meet new, unexpected challenges and fully exploit digital and advanced digital technologies. Indeed, the digital transformation in education and training and the creation of more advanced learning spaces are not new; the pandemic has just emphasized their usefulness. However, the technological dimension is one of many to consider for designing, managing and assessing a learning space. Other structural dimensions include physical, social and cultural characteristics that sustain learning and knowledge dynamics involving actors having heterogeneous skills; enhance culture and atmosphere that promote cooperation, are free of hierarchical constraints, and are characterized by physical or virtual settings that allow flexibility and dynamicity (Dleikan et al., 2020; Jens and Gregg, 2022). In sum, learning spaces enable and catalyze knowledge and learning dynamics, supported by a tangible and intangible infrastructure and a stable technological component that encourages open, honest, and receptive interactions among the stakeholders involved. Specifically, five distinguishing dimensions derived from the literature analysis are i) Actors; ii) Setting; iii) Technologies & Software; iv) Relationships & Networking; and

v) Organisational atmosphere, culture, methods &practices.

What emerged from the concept's evolution is that nowadays, describing and defining a learning space without considering its virtual or technological components is impossible. Following a fast landscape's evolution, strong technological and digital components have become predominant and influenced and modified the structure and functioning of the Learning Spaces' dimensions. It follows that new configurations of Learning Spaces are also following the latest digital trends, consequently adapting spaces and the tangible and intangible infrastructure. It follows that, to identify cutting-edge learning spaces, it is necessary to define them as technology-enhanced learning spaces, whether they are virtual or hybrid by nature. Technology-enhanced learning spaces may incorporate various technologies to enhance learning and knowledge dynamics; from supporting to advanced technologies, the goal is to create interactive and engaging learning spaces that foster collaboration, creativity, and active participation (Abdalina et al., 2022; Ali et al., 2022; Ghani et al., 2022; Lee and Tan, 2022; Lu, 2022; Reyes-Mercado et al., 2022; Hines and Netland, 2022; Erdoğdu and Çakıroğlu, 2021).
It follows that a technology-enhanced Learning Space 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."***

As a result of the review, it also emerged the importance of managing and assessing the performances of those kind of spaces. However, there is a lack of managerial and assessment models that describe the critical phases for adequately managing and assessing a learning space. Most of the studies on the subject focus indeed on structural components. Concerning the assessment of their performances, there are tools focused merely on technology readiness and implementation may provide fragmented information about the effectiveness of a space because a learning space traverses all physical, virtual and social space, within and outside the confines of the learning institutions. Therefore, other factors should be evaluated, in relation to the educational learning spaces' effectiveness.

Therefore, it becomes essential to understand better how to manage these spaces to make the phenomenon replicable and to promote its diffusion in those organisations that continuously innovate, relying on knowledge and learning dynamics.

A second RQ was, therefore, necessary:

RQ2) ***How to manage a technology-enhanced learning space for innovation?*** *How learning spaces' dimensions catalyse learning and knowledge dynamics, particularly for innovation? How to manage advanced technologies in a learning space for innovation?*

To answer this question, consistently with a combined approach, a multiple-case study approach is carried out. It was developed partially during my research period spent abroad (at the Tampere University - Finland) and partially in Italy (Veneto), observing nine different learning spaces for innovation and interviewing their respective managers. This methodological approach has been chosen because it is considered a valid tool to generate critical managerial knowledge by deeply

exploring key variables and their relationships (Yin, 1994; Eisenhardt, 1989). Conducting this empirical investigation with multiple case studies was appropriate to observe the phenomena in their contexts. Given the main research problem, which is understanding the effectiveness of technology enhanced learning spaces to innovate in the Digital Age, the spaces chosen consider innovation as their primary purpose, organizing learning and knowledge processes and dynamics to foster it. In addition, these learning spaces for innovation are emerging places that use and employ advanced digital technologies such as 3D printers, smart robots, artificial intelligence and virtual and augmented reality.

The use of a multiple-case study approach serves two essential purposes. First, it helps to validate insights gained from literature through empirical verification of patterns identified in a systematic literature review, enriching the findings with the leans of innovation as output. Secondly, it enables the establishment of a management model, that identifies three subsequent critical phases *i) Define, ii) Cultivate, iii) Collect* and two transversal phases distinguishing the management of a technology-enhanced Learning Space for Innovation, i.e. *iv) Analyse, and v) Involve & include.*

This approach has led to the development of a new definition of technology-enanced Learning Space for innovation and to the enrichment of the structural dimensions by identifying new further characteristics of learning spaces, analising the data together with the results of previously reviewed literature.

Specifically, the new definition is: ***a dynamic space - of physical, virtual and hybrid nature - characterised by action and interactions among different actors and their capabilities, which promotes cognitive processes and sustains knowledge and learning dynamics through its tangible and intangible components, especially exploiting the potential of advanced technologies. It aims to promote and encourage innovation dynamics and capacity and to influence and be influenced by the territory in which it is embedded, stimulating the development of a community.***

Once this management model has been elaborated, there is a need to validate it through further empirical investigation. The research continued with a final step aimed at understanding the model's applicability to a real-life context understanding how to successfully implement it in the processes of design and management of the space, to ensure its effectiveness. Moreover, the study discerns the performances to consider to assess the effectiveness of the space in relation to the continuous innovation purposes.

Hence the third RQ is:

RQ3) ***How to ensure the effectiveness of the technology-enhanced learning spaces for innovation?*** *What are the performances to consider to assess their effectiveness? How to implement the management model to ensure their effectiveness?*

An Action Research project has been designed to answer this RQ. An organisation operating in the Basilicata region has been involved in the research. Specifically, the company developed a learning space for innovation dedicated to Space Business, within which to develop "technology transfer and capacity building" actions to facilitate the use of advanced technologies and systems for social innovation purposes.

The Action Research (AR) project seeks to validate the management model derived from the preceding research stages by putting it into practical implementation. The primary objective is to ensure the effectiveness of the learning space, including the identification of performance dimensions to assess and consider. With an alignment of vision and objectives, the AR project evolved into a shared opportunity for both the researcher and the organisation.

The thesis is organized as follows. Section two provides a narrative literature review on innovation management, industry 4.0, and knowledge management, considering knowledge and learning as drivers to detect challenges and opportunities for organisations. In the third section, a systematic literature review of Learning Spaces' dimensions and characteristics has been carried out to understand the phenomenon that results from the previous analysis as one of the emerging trends to face context challenges and opportunities. The fourth section then reports a multiple-case study approach, through which nine technology-enhanced Learning Spaces for innovation have been analysed to enrich the understanding of the concept of technology-enhanced Learning Spaces and to propose a management framework that is then applied, validated and enriched through an AR project. AR project is discussed in the fifth section. Lastly, the thesis concludes with final discussions, conclusions, limitations and future research directions.

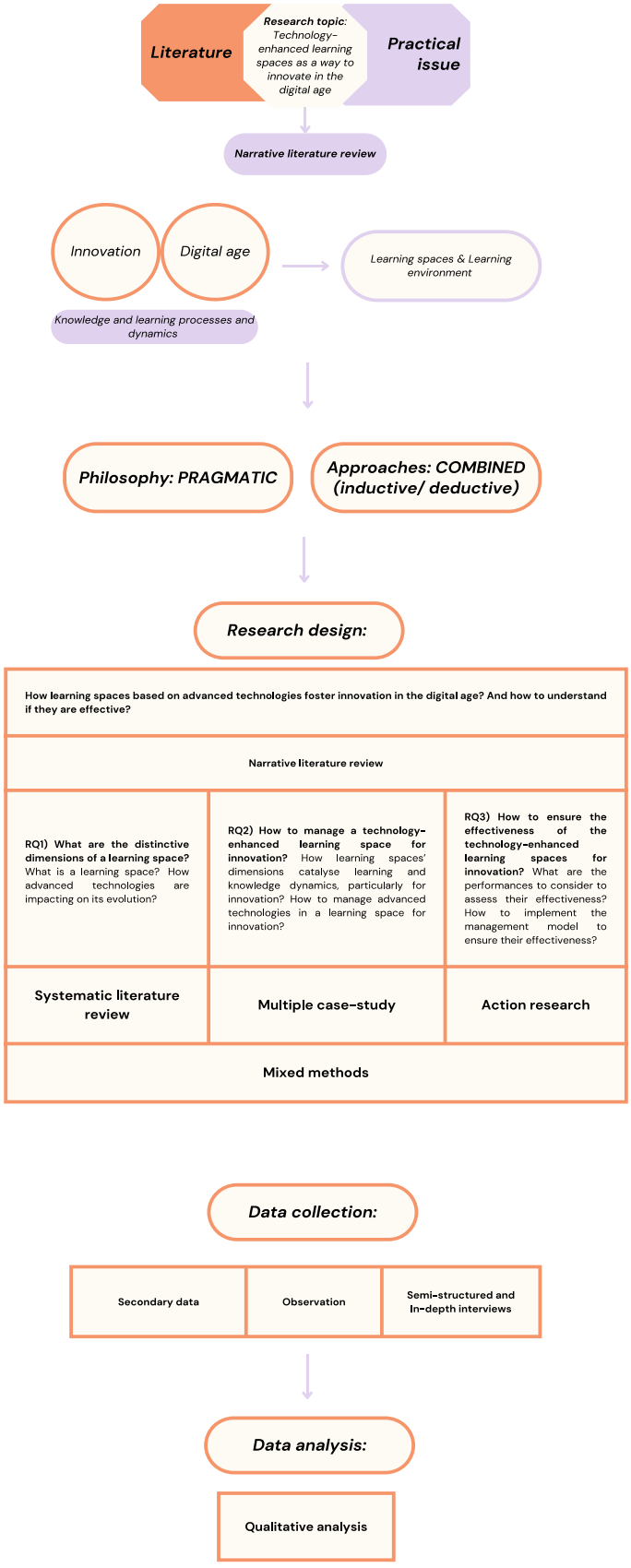

Figure 2. Research process (Modified from Saunders et al., 2009)

II. CATALYSING KNOWLEDGE AND LEARNING DYNAMICS TO INNOVATE IN THE DIGITAL AGE

2.1 Introduction

The advent of the Digital Age represents a pivotal point in human history, giving rise to a multitude of profound transformations across various domains (Dufva & Rekola, 2023).

At the centre of this impact, there are digital technologies and especially advanced technologies (e.g. Big Data, Analytics, Immersive Reality, Artificial Intelligence, etc.) that may provide noteworthy contributions in organisation's productivity, competitiveness, and overall performance, as well as in how they capture, share, and leverage knowledge. It follows that technology results as a driving force of today's competitive landscape as long as they are used and implemented effectively.

In this scenario, innovation becomes essential for organisational success in the Digital Age. It enables them to remain competitive, meet customer expectations, optimize operations, and navigate an ever-changing scenario. Embracing innovation as a core business strategy is crucial for long-term growth and sustainability (Lanzolla et al., 2021; Lee and Trimi, 2021).

A dedicated learning space, that relies on knowledge and learning dynamics, can be an effective strategy to promote continuous innovation within an organisation. It provides a physical, virtual and mental place where actors involved can focus on knowledge creation and sharing and consequently on innovation efforts that foster positive change. The integration of advanced technologies in learning spaces can have various consequences, both positive and challenging. These consequences depend on the specific technologies, how they are implemented, and the organisation's ability to adapt to the changes.

Therefore, continuously innovate, catalyse knowledge and learning dynamics and implement technologies effectively are current almost mandatory topics for organisations' competitive advantage, survival and growth.
In this regard, this chapter is focused on various settings that may enhance continuous innovation, nurturing knowledge and learning dynamics.

In this chapter, desk research in the fields of innovation management, knowledge management and education has been carried out to understand how learning spaces can support organisations in the path of continuous innovation and how to deduce if they are effective.

The chapter is structured as follows. The 2.2 paragraph analyzes the Digital Age concept, paying attention to the state of the art, influences from the 4.0 and 5.0 industry. Then, paragraph 2.3 focuses on Innovation in the Digital Age, proposing frameworks and solutions to continuously innovate relying on knowledge and learning dynamics. Finally, the last part of the chapter focuses on the concept of learning spaces, providing definition and development of those spaces in the educational contexts.

2.2. The Digital Age - state of the art and influences

The contemporary Digital Age represents a dynamic and quickly evolving domain encompassing multifarious technology, communication, and information facets. It is a massive phenomenon that has profoundly transformed how individuals live, work, communicate, and engage with the surrounding environment (Nambisan et al., 2017)

When considering the characteristics of the current Digital Age, it is essential to evaluate the factors that have contributed to its development, from technological advancements to consumer behaviour shifts and the fields where technologies are pervading. A comprehensive understanding of the nuances and influences of this complex landscape is vital for businesses, policymakers, and individuals striving to adapt and prosper in the digital era effectively and to face the challenges of the VUCA context (Zhang et al., 2023; Chen, 2022; Wang and Su, 2021).

Concerning the factors that contributed to the progression of the current digital age, a multifaceted interplay of diverse elements has collectively shaped its trajectory and pace. These factors encompass a broad spectrum of dimensions, including technological, societal, economic, and regulatory perspectives. First, technological advancements and innovation occupy a central position. The latest progresses in hardware, software, connectivity, and emerging advanced technologies, such as artificial intelligence (AI), and quantum computing, are ground-breaking. On the other hand, the availability and quality of digital infrastructure and the endeavours to foster digital inclusion through initiatives like digital literacy programs play a pivotal role in determining the spread of digital services. Other factors not technology-related included economic conditions, market dynamics, government policies and regulatory frameworks, as well as societal norms, cultural mores, and ethics. Specifically, factors such as economic stability, allocations for research and development, and access to financial capital collectively contribute to shaping the digital landscape (Zhang et al., 2023; Chen, 2022; Wang and Su, 2021; Popkova, & Gulzat, 2020; Schallmo et al., 2019).

The emergence and advancement of pillar technologies fostering production efficiency, improved products and higher quality are referred to as the Fourth Industrial Revolution. It represents a paradigm shift characterised by the integration of advanced digital technologies that boost the development of organisations, societal patterns and processes. This evolution significantly affects how organisations operate, innovate, and compete in a rapidly moving world (Xu et al, 2018; Maynard, 2015).

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4.0 industry allows organisations to gain a significant competitive advantage by enhancing operational efficiency, reducing costs, and allowing for quicker responses to market changes; the ability to rapidly collect and analyse data can drive innovation by uncovering new insights and opportunities for product and process improvements; moreover, it supports a more expansive connection and a broader customer base, new job roles in areas such as data analysis, cybersecurity, and AI development and economic growth by boosting productivity and competitiveness (Xu et al, 2018; Loureiro, 2018; Maynard, 2015).

Technology and data are completely embedded in people's daily lives, and data are progressively collected and exploited. Consequently, the examples of advanced technologies that are quickly spreading are often related to data acquisition. The newest technologies and processes, namely

advanced technologies, are i) Additive manufacturing and 3D printing, which are production methods computerised and digital processes that create three-dimensional products; ii) Smart robots, able to communicate without human intervention; iii) Augmented and Virtual reality (AR/ VR), which provides a digitally enhanced view of the real world. AR adds technology layers (e.g., graphics, sound, or feedback) to the physical environment, whilst VR is entirely immersive; iv) Cloud technology, which allows users to access services immediately via the Internet's network; v) Big data used to gain a competitive advantage; vi) the Internet of things, that includes the proliferation of new mobile technologies with sensor and wearable technologies that interact with people, are connected to the Internet and can be accessed remotely; vii) Sharing economy, in which technologies provide access to products through renting or borrowing in an online environment and, most of all, viii) Artificial Intelligence which allows new technologies to augment the capabilities of human-like intelligence. Self-driving cars, talking-to devices, customised recommendations and other AI applications are becoming common (Dufva & Rekola, 2023; Lanzolla et al., 2021; Lee and Trimi, 2021; Borgers et al., 2021).

Industry 4.0 represents a transformative phenomenon that offers opportunities for many businesses that are still working hard, making significant efforts to achieve competitive advantages, face the challenges and transform and evolve in order to meet the demands of this new era.

Understanding the opportunities and challenges of Industry 4.0 is crucial for businesses and economies to prosper in this new landscape. There are still some opposing forces and factors that impede development and transformation, especially concerning human resources' skills, attitude and behaviour and cybersecurity risks (Del Diudice, 2018; Bresciani et al., 2021a; Bresciani et al., 2021b; Del Giudice et al., 2021).

Employers, in fact, should be able to develop digital literacy and competence (Teng et al., 2019) and adapt to new roles, including working alongside robots and AI systems. At the same time, a growing emphasis is placed on creativity, problem-solving, and innovation.

Human resources have been considered, through the years, as a critical driving force in terms of advancement since the first Industrial Revolution, when the production of mechanical power was carried out with primitive resources, and have acquired a more significant and central value nowadays, with the 5.0 industrial revolution.

Specifically, the introduction of Information Technologies (IT) started with the Third Industrial Revolution, and human resources were considered manufacturers who used assembly lines and mass production or integrated automation into the production chain. Advanced technologies, such as the Internet of Things (IoT) and cloud computing in conjunction with Artificial Intelligence (AI), have been used since the fourth phase of the Industrial Revolution. Industry 5.0 is currently happening, and its three interconnected core values are human-centricity, sustainability and resilience **(**Harahap and Rafika, 2020; Karanikola, Z., & Panagiotopoulos, 2018). The substantial difference from 4.0 to 5.0 industry, in fact, is the switch to an approach that puts core human needs and interests at the heart of the production process rather than the technology-driven progress.

The greater significance given to the human approaches assumes a higher complexity; however, it prioritises physical health, mental health and well-being and ultimately safeguards worker's fundamental rights, i.e., autonomy, human dignity and privacy.

Workers are valuable investments with knowledge, opinions, skills and feelings. In this vein, they need to keep upskilling and re-skilling (Dai et al., 2020). The advanced technologies of the 5.0

Industry are human-machine interaction technologies; Bio and smart technologies with sensors and recyclable components; Technologies for energy efficiency, renewables, storage and autonomy; Digital Twins allowing simulation and long-distance security checks; Big data and system interoperability; and Artificial Intelligence (Demir et al., 2022; Qi et al., 2021; Dai et al., 2020).

In sum, the notion of the 5.0 Industry enhances and further extends the distinctive aspects of the 4.0 Industry, and consequently, they are two concepts that require being considered simultaneously. Specifically, the 4.0 Industry is driven by technology, and the 5.0 Industry is driven by human values and skills (Noble et al., 2022; Sarfraz et al., 2021). Therefore, the emergence of 4.0 Industry first and 5.0 Industry now, has further accelerated the implementation and habitual use of advanced technologies in every field and business; technologies that are already considered remarkable catalysts for creativity, collaboration and innovation, providing a bunch of opportunities **(**Lee and Tan, 2023; Misuraca et al., 2012).

2.3.Innovate in the Digital Age

Due to the already discussed digital landscape, companies that do not readily react to these changes risk being left behind in a quickly changing environment.

Diverse technologies do not foster negative or positive effects by themselves, but depending on their intrinsic characteristics and circumstances, they may represent risks or provide opportunities (Christensen, 2002). In this vein, organisations must carefully analyse how to support technological integration and use. A rising number of businesses are testing and using new advanced technologies and tools like smart devices, mobile apps, analytics, and social media to improve efficiency in customer interaction, internal procedures, and growth strategy (Westerman et al., 2014). Consequently, a multifaceted process known as “digital transformation” (DT) involves integrating digital technologies into various organisational functions, strategies, and cultural tenets with the primary goal of fundamentally altering the organisation's operational paradigm and value proposition to its stakeholders or clients. The efficient use of digital innovations goes beyond simple technology adoption and necessitates a meticulous revaluation and restructuring of corporate processes, models, and institutional frameworks (Dai et al., 2021; Ghobakhloo et Chang, 2019).

Organisations are now fully experiencing the transformative effects of Digital Transformation (DT) but also of digitisation and digitalisation due to a process of constant acceleration, which is opening up new channels for business and interactions as well as new data-gathering opportunities. The concepts of digitisation digitalisation and digital transformation cannot be used interchangeably. Digitisation refers to the process of transformation from analogue to digital form (e.g. from paper-based to digital documents), whilst digitalisation refers to the use of digital technologies in specific processes to change a whole business model and provide new opportunities (Gartner, 2020; Bloomberg, 2018). Therefore, digitalisation is not just about introducing new technology but refers to the new processes (e.g. automatisation of the processes) derived from this introduction and the changes in how people work (Muro et al., 2017).

On the other hand, digital transformation is a broader and more complex concept. It is closer to a whole organisational transformation, a human-centred roadmap that calls for a profound and comprehensive connection between technologies and people. A DT process may involve various digitalisation projects, but it is not just the sum of these. It is comparable to a journey encouraging an organisation to become human-driven and agile to handle changes successfully. It has to do with acquiring a mindset that enables the organisation to take the lead in the change and the transition to digital. Its implications are beyond the growth of digital competencies for managing cutting-edge technologies (Berghaus & Back, 2016; Chanias & Hes., 2016; Morakanyane et al., 2017). In sum, digitisation is focused on information, digitalisation on processes and roles and Digital transformation on people, businesses and strategy (Bloomberg, 2018).

In order to survive and grow in the era of Industry 4.0 and 5.0, organisations have to embrace digitisation, digitalisation and digital transformation and employ the most advanced technology. Consequently, to quickly adapt and face the problems, they need to develop flexible, creative and dynamic solutions aimed at fostering innovation to stimulate and incentivise organisational growth, evolution and transformation (Scuotto et al., 2023; Bennett & Lemoine, 2014; O'Connor, 2013; Solomon, 2007).
Literature refers to innovation as a crucial driver for survival, competitiveness, long-term growth, and success (Ensslin et al., 2020; Hamidi et al., 2019; Bennett & Lemoine, 2014; O'Connor, 2013; Solomon, 2007) and organisations aiming to survive the competitive and turbulent market must continuously innovate (Kamaruddeen, Yusof and Said, 2010). Innovation that is carried over and over again ceaselessly and repeatedly supports incremental improvements that allow organisations to remain resilient and survive in the long run (Nonaka & Takeuchi, 2019).

Nevertheless, the concept of innovation has been assuming manifold meanings in different contexts. According to Neely and Hii (1998), change is the main characteristic of innovation. In fact, its definition is derived from the Latin word "innovare", which means "to renew, to make new or to alter" and refers to the introduction of new processes, products, practices or ideas (Goldsmith & Foxall, 2003).
Innovativeness relates to a firm's capacity to engage in innovation and is directly linked to business performance (Hult et al., 2004; Porter, 1990; Schumpeter, 1934).
Industrial managers have considerable control over innovativeness and may address business issues and challenges, using these solutions as the foundation for long-term survival and success (Hult et al., 2004).
On the other hand, "innovation capacity" refers to the continuous improvement of capabilities and resources that an organisation possesses in order to explore and exploit opportunities for developing new products to meet market needs (Yildiz et al., 2021; Forsman, 2011).

Obviously, the concept and practice of innovation have evolved throughout time, going through different stages. According to Lee and Trimi (2021), the significant phases of innovation evolution are:

Stage of evolution	**Definition**
Closed innovation	It is originated from internal R&D lab and protected.

Collaborative innovation	It is derived from agreement, partnerships and collaboration.
Open innovation	It is a set of open sources and collective intelligences exploited to generate new knowledge.
Co-innovation	It regards value co-creation to foster core capabilities to the value chain.
Convergence innovation	It involves fusing seemingly unrelated objects, ideas, or experiences together in innovative ways. This method has been used by organisations and people from different industries and countries who share goals with stakeholders. By bundling together disparate elements, they can create something entirely new and valuable.

Table 1. Development of the concept of innovation

However, innovation in the digital landscape assumes a wider perspective. According to Lanzolla et al. (2020), digital technologies have always been associated with new possibilities and opportunities in the innovation management literature. Numerous new advanced technologies resulting from Industry 4.0 and 5.0 fuel innovation and, at the same time, to be effectively implemented, need to be supported by innovation processes, climate and practices. Therefore, a successful technology adoption goes well beyond the technical processes of adopting and involves, for instance, organising new sociotechnical structures, new organisational skills and structures and embracing digital transformation (e.g., Almirall and Casadesus-Masanell 2010; Bailey et al., 2012; Yoo, 2012; Yoo et al., 2010; Troilo et al., 2017; Brunswicker et al., 2019; Viscusi & Tucci, 2018). Innovation in the digital era is about being agile and adaptable because the pace of change is rapid, and businesses need to pivot quickly to keep up with emerging trends and technologies.

Moreover, as already discussed, the latest trends in the digital landscape concern both technology and people. For this reason, organisations' strategies should focus on people and their skills, knowledge and competencies. Consequently, continuous innovation capacity may be developed by enhancing learning and knowledge dynamics. Knowledge represents the engine for the development of the capabilities for sustainability in the new business age: capacity for value orientation and transformation (Stern et al, 2020; Nonaka & Takeuchi, 2019).

2.3.1. A knowledge-based innovation in the Digital Age

According to Peschl (2014; 2006), innovation always includes the creation of new knowledge and knowledge dynamics represent the engine for the development of the capabilities for sustainability in the new digital era. Therefore, knowledge is recognised as having a pivotal role in the long-term success of an organisation and, more specifically, the creation and management of knowledge and learning dynamics are milestones that stimulate innovativeness, innovation capacity and innovation climate within an organisation (Yieldiz et al., 2021; Nonaka & Takeuchi, 2019; Abukhait & Pillai, 2017). Knowledge is a dynamic asset created by social interactions among individuals and organisations; it is about valid and justified beliefs and commitment and may be deemed considering different facets: i) an object to be stored and manipulated, ii) a process of simultaneously knowing and acting; iii) an individual's state of mind; iv) a condition of having access to information, v) the

capability of interpreting and using information (Nonaka & Takeuchi, 2019; Alavi and Leidner, 2001; McQueen, 1998; Zack, 1998; Carlsson et al., 1996).

From the literature, several research areas discussed knowledge and learning dynamics as crucial drivers of innovation. Nonaka and Takeuchi (2019) stated that knowledge is about action and meanings; thus, one of its uses is nourishing innovation. Knowledge creation generates innovation and, simultaneously, knowledge practice fuels continuous innovation, namely a strategic approach that emphasizes the constant and iterative process of generating and implementing innovation (Nonaka & Takeuchi, 2019; Lau et al., 2018). In this vein, organisations that aim to focus beyond the short-term results, generating incremental improvements, should continuously leverage knowledge and learning dynamics, where learning is the sum of individuals' experiences and new knowledge (Vey et al., 2017).

Moreover, shifting from the 4.0 to the 5.0 industry has opened new debates where human skills and knowledge, such as creativity, entrepreneurial skills, and digital humanism are central. Investing in human resources and generating new ways to work and learn becomes thus critical (Scuotto et al., 2022; Del Giudice, 2021). Consequently, public and private organisations appear increasingly committed to fostering the skills necessary to deal with the challenges of the current scenario by enhancing their learning and knowledge management dynamics and processes (Ensslin, 2020; Iqbal, 2018). There is then the need to review organisations' traditional training and learning models because work is becoming increasingly knowledge-based, and there has been a shift from purely operational to knowledge-based work and from individual to collaborative work, and challenges have been raised about how individuals may be more effectively equipped and re-skilled in a technological landscape (Benson et al., 2002; OECD, 2019).

Additionally, when organisations focus on merging topic-specific expertise with digital competencies, the DT provides greater knowledge search and more efficient knowledge recombination in the creativity phase of innovation. In this vein, all the knowledge activities, namely knowledge application, storage, mapping, sharing, transfer, application and codification, become crucial innovation drivers (Savino et al., 2017).

2.3.2. Catalysing and managing knowledge for innovation

Researching innovation processes actually requires more than just examining cognitive processes; there is also the need to comprehend how these processes are embedded in the physical and social environment and how managing knowledge leads to innovation. In consequence, generating new knowledge with the aim of fueling innovation does not imply that no rules are allowed for structuring and organising knowledge processes and dynamics (Peschl et al., 2014).

According to the Constructivism theory, knowledge is not passively perceived but actively constructed, and that results as a fundamental concept in the context of innovation. Hence, innovation is about functioning and viable knowledge that has come about in the construction process and the creation of new concepts and relationships. (Von Glasersfeld, 1989; Peschl et al., 2014).

Consequently, the major challenge is understanding how knowledge and learning processes and assets can be developed and managed to foster innovation and what are the enabling factors, conditions and dimensions (Abukhait & Pillai, 2017; Peschl, 2014).

In this vein, different perspectives of knowledge impact several perceptions of knowledge management (KM) (Nonaka & Takeuchi, 2019; Alavi & Leidner, 2001). KM may be viewed as a systematic, articulated and intentional process that fosters a new way of thinking about the organisation. It is supported by the creation, transfer, storage and dissemination of knowledge throughout and outside the organisation to achieve organisational excellence and competitive advantage. The KM process consists of systematic efforts to expand personal knowledge and finding, organising, giving access and sharing tacit and explicit knowledge (Junior et al., 2020; Corso et al., 2003; Nonaka & Takeuchi, 1995).

As the world changes, new levels of complexity pervade knowledge management. Knowledge is now free, limitless and personalised and advanced technologies are generating new prospects; for example, Big Data, Cloud Computing and Artificial Intelligence are forming a trove of data and information, whilst the Internet of Things is creating innovative products incorporating knowledge sharing. These developments make knowledge global, complex, open, profound, and connected. In this vein, companies must address the information overload issue and use greater caution while harnessing appropriate knowledge. To do so, it is essential to understand the context where knowledge is created, delivered and shared because, unlike rough information and data, knowledge is shaped by human values, ethics and morality (Nonaka & Takeuchi, 2019; Santoro et al., 2018).

Consequently, contexts, relations and mainly people are essential components that give meaning to knowledge (Nonaka & Takeuchi, 2019). According to Santoro et al. (2018), two main essential dimensions in knowledge management take account of these elements, namely enablers and processes. Enablers assemble the infrastructure that improves knowledge management processes and facilitates knowledge management activities, and knowledge management processes refer to the organised and coordinated procedures of managing knowledge effectively.

Given the significance of knowledge as an asset for innovation, several scholars addressed the issues, providing organisational or management frameworks to effectively address knowledge and learning dynamics to trigger innovation and improve organisational performance, thus enhancing the competitive advantage (Shujahata et al., 2019).

One example is provided by Senge (2001) who articulated the concept of "learning organisation (LO)". LO is an organisational framework that places learning at its core. Central to the system of a learning organisation is the establishment of a shared vision, aligning all stakeholders toward overarching objectives and acting as a catalyst for continuous learning.

According to Örtenblad (2013), there are four elements that compose up the learning organisation (LO): workplace learning (ongoing learning via experience, informal learning grounded in social practise, and knowledge sharing); organisational learning (learning from routines, shared understandings, organisational knowledge, and organisational memory); learning climate (leaders promoting learning, workplace that starts and fosters learning); and learning structures (Borge et al., 2018).

This holistic perspective encourages organisation members to acquire new competencies, refine existing ones, and deepen their knowledge base. Therefore, learning organisations foster an environment where individuals are encouraged to challenge and revise their mental models or

preconceived notions. Knowledge management systems and practices are central to learning organisations, facilitating the capture and dissemination of valuable knowledge and best practices.

Knowledge management systems (KMS) are considered as KM-supporting systems, often including a solid technological component (Santoro et al., 2018). The definition of KMS has been evolving and changing alongside the constant advancement of the business scenario towards more comprehensive perspectives and more advanced technologies.

Bolisani and Scarso (2013) described a sort of KMS supporting valuable knowledge exchange and transfer between firms. The transfer process requires complex tacit and explicit knowledge conversion, and it goes beyond the mere knowledge transmission, including its interpretation and acquisition by the receiver. Consequently, a sophisticated technological infrastructure is insufficient to achieve effective interpretation, assimilation and use of knowledge.

Generally, several authors agree in defining KMS as technological as well as organisational tools and practices supporting and facilitating KM processes to optimise knowledge resources use, activating innovation dynamics and improving companies' performances, efficacy and effectiveness (Corso et al., 2003). In this regard, the two essential components of a KMSs are KM-Practices and KM-Tools. KM-Practices are methods and techniques supporting KM processes (i.e. creation, storage and transfer) whilst KM-Tools are organisational tools and digital technologies assisting KM-Practices (Junior et al, 2020; Centobelli et al., 2019; Cerchione and Esposito, 2017). KM-Practices and KM-Tools, used in combination, create the KMSs (Junior et al, 2020; Santoro et al., 2018; Scuotto et al., 2017; Chhim et al., 2017; Bolisani and Scarso, 2016; Lockett et al. 2009). The efficiency of a KMS depends on the choice of the technological tool that must be implemented effectively and consistently with the organisation's purposes (Del Giudice & Della Peruta, 2016; Alavi & Leidner, 2001). The design of a KMS is challenging because it is strictly linked to understanding the nature and types of organisational knowledge and the technologies' potential. The importance of choosing the tool to implement is reflected in the evolution of the KMS definitions. The latest researches are mainly focused on implementing innovative and advanced technologies because digital transformation drives the development and the introduction of cheaper, more user-friendly and more effective KMSs (Cerchione et al., 2020). To support organisations in KMS implementation, more recently, ISO 30401 has been established to set requirements and provide guidelines for establishing, implementing, maintaining, reviewing and improving an effective management system for KM in organisations (ISO 30401, 2018). The ISO 30401 aims to help organisations standardise their KM actions and systems in order to enable and improve value-creation from knowledge (Carlucci et al., 2022).

Despite the emergence of manifold knowledge-based solutions for fueling innovation, it is essential to acknowledge that implementing such frameworks and management systems presents limitations and challenges. First, they can be time-consuming and resource-intensive. Small and medium enterprises (SMEs) are always committed to enhancing their ability to provide customers with better and innovative products and services but often operate with limited resources, including financial, human, and time-related assets, and may find more challenging to allocate these resources toward the development of a learning organisation or a knowledge management system (Carlucci et al., 2022; Lai et al., 2021; Cerchione et al., 2020; Corso et al., 2003). Then, there is the use of a too complex language, difficult to understand and apply effectively (Carlucci et al., 2022). Moreover, the standard

is focused on a comprehensive definition, but it provides neither guidelines for the standard implementation (e.g. technological tools to implement) nor KPI to monitor and evaluate the KMS, and it does not capture the intangible aspect linked to the human value and interactions. For these reasons, literature on the learning organisation and KMS has been criticised for not sufficiently addressing how and why learning occurs, what are the supporting tools and mechanisms but instead describing learning as more theoretical and prescriptive than practical (Lai et al., 2021; Pawlowski et al., 2020; Senge and Kofman, 1995).

In such a scenario, several authors propose solutions to support organisations in fostering innovation through knowledge management, trying to build specific spaces that may hold knowledge management systems or relying on learning organisations' principles.

One way to practically manage knowledge for innovation is to focus on improving organisational learning, which is typically structured using standard in-house learning models aiming to equip employees with the technical skills they need for operational requirements (Amitabh & Sinha, 2012). Concerns have been raised regarding the difficulties in encouraging knowledge transfer and sharing among employees because actors involved in organisational learning processes often develop defensive routines or predetermined mental reactions that may affect knowledge transfer and sharing, especially tacit knowledge, whether on purpose or unintentionally (Lau et al., 2018; Easterby-Smith & Burgoyne, 1999; Edmondson, 1999).

Consequently, organisational learning needs to be more effective and flexible, and establishing successful learning has to be actualised through a vital process of knowledge sharing and transfer among the actors involved. In this vein, Lee, Lau and Chang (2018) proposed to enhance less conventional practices to foster effective learning processes and develop an organisational learning culture. Some elements emphasised as critical features to cope with the rapid changes in organisations and to maintain sustainability are, for example, a proactive and flexible learning approach, collective learning practices (which may include risk-taking, goal sharing and knowledge matching), and learning by doing and by practices (Lau, 2014; Anderson & Lewis, 2014; Bunderson & Reagans, 2011; Farago & Skyrme, 1995).

Lee and Tan (2022) suggest focusing on the workplaces, considered as informal places for learning implicitly or explicitly. This entails supporting individual cognitive development and the social participation process, considering that knowledge exchange, tacitly or explicitly, mainly occurs while working with others (Nonaka & Tacheuki, 2019; Eraut, 2004). The literature emphasises the features that influence workplace learning, generally considered a function between the individual actor and the workplace (Eraut, 2004; Billett, 2002; Billett, 2001b). The first set of features relates to the individual's attributes in seeking challenges, opportunities, and supporting learning endeavours, especially their approaches to learning resources, activities, reflections and everyday tasks to determine learning. Workplace learning strategies are the methods people use to acquire knowledge and skills they need to improve their proficiency at work and, consequently, innovation. It is possible to articulate the strategies on an individual, social, and organisational level (Lee & Tan, 2022; Crouse et al., 2011). The other set includes tangible and intangible factors characterising the working space. Workplace learning, especially in the context of digital age, has yet to be studied extensively (Lee & Tan, 2022; Vey et al., 2017).

Other scholars proposed the development of specific places, within or outside the organisation, that embed and support knowledge and learning processes and dynamics. For instance, Nonaka and Takeuchi (2019) stressed the importance of creating spaces or places where relationships are forged and knowledge is created through interactions. Specifically, they describe the "Ba" as places or fields where people learn and co-create knowledge. Within an organisation, the Ba can be composed of members with different ideas, experiences, sensitivities and ways of thinking. Consequently, members hold different kinds of knowledge that, combined and exchanged, create a source of innovation. The people participating in a Ba exchange knowledge through interactions and relationships because each individual can consider himself in relation to the others and be engaged in understanding different points of view and values. Ba can be a physical, virtual or cognitive space in a formal or informal context (Nonaka & Takeuchi, 2019; Nonaka & Konno, 1998; Nonaka & Toyama, 2003; Nonaka et al., 2008).

Krogh et al. (2000) further developed the concept of "Ba" in the context of knowledge creation. Moultrie et al. (2007), Lewis and Moultrie (2005), and Kristensen (2004) have produced theoretical as well as practical results in the field of theory and technology for creative spaces. Furthermore, several examples exist in the design of architectural spaces for innovation (e.g., Allen and Henn, 2007; Oblinger, 2006; Peschl, 2006).

In this vein, Peschl (2014; 2006) presented the Enabling Spaces, i.e., multi-dimensional spaces that support innovation processes. Those spaces provide the boundary conditions for the processes of knowledge creation. In their perspective, the boundaries to those spaces are not constraints but support and frame innovation processes, allowing observations through new perspectives and providing fresh insights. The idea of enabling spaces relies on an expansive definition of space, which is seen as a container that provides a set of constraints while also furnishing a basic structure, interventions, and dynamics. It is a setting that offers supportive structures, elements that facilitate and influence innovation processes, and restrictions allowing knowledge processes to flow and develop their own dynamics so that radically new knowledge may emerge.

On the other hand, Schiuma and Santarsiero (2023) accentuated the significance of innovation labs, i.e. places with adequate and cutting-edge resources that foster innovation and stimulate innovative behaviour and lateral and creative thinking, including interaction, free discussion and knowledge transfer among employees. A similar kind of space is proposed by Heiskanen and Heiskanen (2011), who introduced the concept of space of innovation that helps understand the structural, social, and mental conditions that facilitate or impede innovation processes.

Despite the emergence of different spaces' configurations sustaining innovation dynamics through learning and knowledge management, the management literature needs models to support these spaces' development and management. In particular, Peschl (2014), highlights the need for a deeper understanding of enabling spaces in a trans-disciplinary context to allow for a stabler and more robust design process. Schiuma and Santarsiero (2023) stressed the importance of developing a model or management cycle by identifying and describing the phases that characterise the management process of an Innovation Lab. Moreover, regarding the knowledge management systems, several researchers (see e.g. Pawlowsky and Wagner, 2021; Lai et al., 2021; Corso et al., 2003) addressed the importance of developing an assessment and evaluation model and guidelines to implement and manage them

practically.

As an implication, this study focuses on the need to find a model that can support companies, and especially small and medium-sized enterprises, in a process of continuous innovation in the Digital Age.

2.4. Constructivism theory of learning to foster innovation

As previously stated, according to the management literature, new spaces and platforms to foster innovation boosting learning and knowledge dynamics are increasingly becoming critical objectives for public and private organisations to fuel continuous innovation. Consequently, developing an adequate and functional space for learning is essential to support the development of people's capabilities, organisational transformation and innovation capacity (Morris, 2020; Ellis & Goodyear, 2016).

In this vein, several authors mentioned the need to frame knowledge and learning dynamics in tangible and intangible spaces that may have different configurations to support innovation processes. Despite the importance of the concept, especially in the VUCA and digital scenario, there is yet the need to provide a comprehensive definition of these kinds of spaces that support their development and management, guiding the companies through a path of continuous innovation (Schiuma & Santarsiero, 2023; Pawlowsky & Wagner, 2021; Lai et al., 2021; Peschl, 2014; Heiskanen & Heiskanen, 2011; Corso et al., 2003). This is especially true nowadays, where advanced technologies play a key role in knowledge management, providing mechanisms to facilitate knowledge creation and sharing and new ways to access to knowledge, contents and information (Sousa & Rocha, 2019; Savino et al., 2017).

The definition should be based on the principles behind learning organisation and knoweldge management but provide, at the same time, practical and specific guidance and insights that support organisations in their innovation journey. In this vein, the educational scenario has already recognised a model, namely the “learning space” that provides both the characteristics, and that may be used as an umbrella concept including innovation lab, enabling spaces, innovative workplace and spaces with comparable features. Therefore, to provide a general definition and model to support the management of these spaces, this study borrows the socio-constructivism theory of learning, an increasingly relevant theory with significant impacts on educational research and practice, and analyses the concept of "learning space", born in this context, with a managerial perspective.

The socio-constructivism theory of learning is often considered a framework for understanding how people acquire competencies and develop their experience of the world while emphasising the learner's active role in creating and sharing knowledge. This theory suggests that individuals construct their own understanding of the world and its concepts through a combination of prior knowledge, experiences, and social interactions (Alstete and Beutell, 2018; Raelin and Coghlan, 2006). Learning, in this vein, is considered as i) a creation of meanings, ii) the development of an identity, iii) the sense of belonging to a community and a practice inside the community (Rick et al., 2012). In this scenario, educational literature highlighted the importance to develop learning through active methodologies, fostering knowledge processes and learning dynamics and reinventing the learning experiences in a way that anticipates the challenges of the real ecosystems (Kuuskorpi et al., 2011; Santoianni, 2017).

According to this emerging vision, the traditional teaching model, lecturing, is becoming outdated, favouring the emergence of new perspectives. Classical educational models aim at the presentation, dissemination and repetition of contents, information and knowledge, whilst innovative ways of teaching and learning do not contemplate the reproduction of knowledge but the creation and understanding of new knowledge (Peschl, 2014). Lecturing is a common practice in education; however, it is just a part of the pedagogical repertoire, integrated with more active learning approaches and innovative tools (Alstete & Beutell, 2018).

Different researchers (see e.g. Alstete and Beutell, 2018; Raelin and Coghlan, 2006) claimed the importance of incorporating active learning possibilities in addition to the lecture method (i.e. team exercises, cases presentations, class debates) facilitating interactions and relationships between students and between students and teachers. In particular, Kickul and Fayolle (2007) asserted the importance of a complete shift from passive teaching to an active learning perspective. The latter is less oriented towards narrow and specialised-based approaches, whilst it is more focused on contents and processes organised by the students and aimed at achieving learning outcomes. Active participation in learning helps create and construct knowledge, involving students in the learning process dynamically and experientially. Consequently, students engaged with this methodology are more likely to retain the acquired knowledge and to achieve positive impacts on learning outcomes (Karam et al., 2021).

Other examples of active learning include experiential learning, also named reflection on doing and learning by doing, considered one of the most spontaneous and powerful forms of learning, based on trial and error processes. The progresses happen through virtuous cycles of practice, reflection, understanding and repetition. Lifelong, life-wide and life-deep learning are other active learning methodologies focused on individuals who pursue continuous learning in a voluntary and self-motivated way for personal or professional reasons (Bauman, 2006; Barnett, 2010).

2.4.1. Introducing the concept of "educational learning space"

Following these new trends, traditional classroom spaces and settings are increasingly considered ineffective in supporting and favouring the achievement of learning outputs because they often present aligned work tables and facilitate an unidirectional flow of communication for knowledge broadcasting or "delivery" (Long & Ehrmann, 2005). Classroom design is, in fact, more oriented to the space itself and not to the learner and the learning process, and it is considered a neutral, uninfluential space (Alstete & Beutell, 2018; Ellis & Goodyear, 2016). Zini (2017) highlights the inadequacy of the scholastic heritage, emphasising the slow pace of the transformations, not in line with the speed of the educational innovations spread. He also claimed the need to consider educational institutions as living organisms that constantly change and are enriched following life transformations and experiences. On the contrary, the existing school building stock is primarily anonymous, ugly and poorly kept. In most cases, they are places that cannot emotionally involve students nor motivate them.

Therefore, a relatively new research stream, namely learning space (LS), particularly educational learning space, has acquired significant relevance in the socio-constructivist theory of learning. Recalling Kurt Lewin's equation B=f(p,e) (i.e. B=behavior, p=person, and e=environment), a learning space may be conceptualised as a space of interactions among the individuals and the environment.

In this perspective, the design and planning of learning spaces are driven by these interactions (Morris, 2019; Ellis & Goodyear, 2016). According to the OECD definition, a first official interpretation of educational learning space is: "a physical space which supports multiple learning and innovation through different teaching methods, including emerging digital technologies, functional and stable physical infrastructures and a good cost-effectiveness balance that respects the environment and is in harmony with it, by also encouraging social participation, providing a safe, comfortable and stimulating environment." (Kuuskorpi, K. e Gonzàlez, 2011). Within these spaces, different actors develop a system of interactions inside and outside the frame of reference. These spaces are oriented and designed towards the learner and the learning process. Assuming that knowledge is active, contextual and social, learning is a process of conscious reorganisation of the individuals' experiences in which knowledge is not only shared and applied but also created. An educational learning space may be recognised as a virtual location or physical place, such as a classroom, a laboratory, a lecture room or a workshop, where knowledge is created, shared and applied. The educational learning space concept is thus referred to as any type of physical, virtual or hybrid environment, formal or informal, in which learning and teaching happen synchronously or asynchronously (Morris, 2019; Kuuskorpi and Gonzàlez, 2011).

The debate around the relationship between space and learning and knowledge dynamics is not exclusively limited to pedagogical science, and it is not the exclusive subject of technicians or designers, but it is a meeting ground for different professionals, such as managers or architects, that engage in a continuous dialogue. Generally, according to Long and Ehrmann (2005), the architecture of the LS is no longer a container in which teaching and learning happen and includes several dimensions to support learning. A learning space's structure embraces mutually influencing interactions between different kinds of nested dimensions and learning outputs (Ellis & Goodyear, 2016). A “space” is, in fact, everything that surrounds the learner, not only the physical layout and tools but also the mental, cognitive and intangible components. Those components are not static and neutral: their structure, quality and predisposition are critical features influencing learning and knowledge creation and exchange processes (Loiero, 2008). The most innovative learning spaces are conceived to provide students with all the necessary tools, transmit them values and drive them through the most effective learning paths. They may be the main incentive for students when well organised, friendly, pleasant, functional and flexible in duration and location. Loiero (2008) claimed that developing effective learning spaces means focusing on how to create learning opportunities in a context where students learn and grow.

Consequently, students have the possibility to develop their authentic product and the trainers can use real contexts in order to provide experiences that enable better learning activities and processes. They are autonomous and have a wide range of resources available (contents, technologies etc.), can organise and manage learning activities supported by mentors and can easily develop self-confidence and professionalism (Marconato, 2014).

The first innovative clues about learning spaces were provided by Maria Montessori, who disapproved the rigidity of the traditional spaces, proposing specific wide environments predisposed to stimulate and motivate the students (Santoianni, 2012). Nowadays, according to the pedagogical literature, those kinds of spaces and environments should offer multiple representations of the reality to respect its complexity and be focused on authentic relationship development. The environments

should indeed be inspired by the real world, based on actual cases rather than predetermined teaching sequences (Calvani, 2000). Following this definition, educational learning spaces enclose time, feelings, culture, and traditions.

The relevance of these spaces is also recognised on the national Italian territory, where the INDIRE institute established and proposed solutions, good practices and examples of school environments experienced in Italy and abroad. In their view, designing modern environments means eliminating the clear separation between designers and participants, fostering participation around a shared idea (Biondi, 2017). The national guidelines emphasise the requirements for learning spaces which can host and promote student-centred activities and have to be adapted in welcoming and promoting methodological and organisational innovations. They aim to develop tools that can accompany the school in organising and using flexible environments and innovative spaces, transforming older buildings into newer and more effective spaces for learning (Bori, 2021; Laici et al., 2015).

According to the educational literature, the learning space should always be considered in a multi-dimensional perspective where all dimensions are interrelated and connected and thus have to be analysed holistically. With this kind of educational learning space, rigidity, immobility, discipline and control are substituted with flexibility, functionality, participation and empowerment (Bori, 2021; Carvalho & Yeoman, 2018; Laici et al., 2015; Santoianni, 2012). The dimensions distinguished are the following: i) the physical environment that, designed as a support for the mentor and students, has to be smart, comfortable and warm, with an adjustable and wide layout. More attention is required to the structures' predisposition, safety and quality. The new spaces and layouts should not be anonymous and box-type but broken up into a number of linked learning areas with specific functions (e.g. Individual spaces, collaborative spaces, creative spaces). ii) the relational dimension, where positive relationships are fostered and that allows students to become a learning community. Workgroup activities are privileged to foster participation and interactions and build knowledge in a more straightforward, stimulating and durable way (Mosa, Tosi, 2016); iii) the emotional and mental dimension, i.e. an inclusive atmosphere that encourages a positive, open and friendly attitude, favouring positive interactions and a welcoming environment (Carvalho & Yeoman, 2018; Santoianni, 2012). The mental dimension focuses on motivation, stress management and commitment to learning. The emotive dimension, on the other hand, concerns students' feelings and soft skills. The soft skills include the most profound human characteristics as resilience, emotions, critical thinking, and involvement, and the only way to stimulate them is the creation of an environment that allows free and open discussions and activities; iv) The organisational dimension, i.e. methods and contents for learning experiences. The way of teaching significantly impacts the learning experience, and active and innovative methodologies are preferred in more innovative spaces (Benade, 2019; Loiero, 2008).

2.4.2. Technologies in an educational learning space

Recently, the reorganisation of spaces oriented towards the learners and the learning process emphasises the diffusion of LS supported by digital and advanced tools (Marconato, 2014). The technological innovation process in educational institutions is still in course, and it is challenging and dynamic because the technology cannot be passively adapted to every approach; there is a need for

coherence and commitment (Trentin, 2016; Jung, & Latchem, 2011; Zevenbergen & Lerman, 2008; Fantinato, 2012).
According to the educational literature, a learning space supported with digital technologies combines elements enhancing the learning process with a strong technological component (Karam et al., 2021). Given the inclusion of several technological tools, a LS is not limited to the boundaries of a physical space but can connect remote realities. These kinds of spaces include some specific components and features, such as: i) they are designed information space; ii) they include an explicit representation through several modalities, e.g. texts, graphic interface, immersive scenarios; iii) they may enrich classroom activities and be overlapped with the physical environments; iv) they integrate heterogeneous technologies with multiple pedagogical approaches (Murugaiah and Yen., 2019; Dillenbourg et al., 2002).

These spaces are not conceived just for distance education but are also hybrid spaces where the technological components amplify the dynamicity of the interactions. In the realm of education, technology has emerged as a transformative force, reshaping pedagogical approaches and broadening access to learning resources. In fact, technology in education fosters a lot of opportunities and many instances of technological integration have already begun (Murugaiah and Yen., 2019; Trentin, 2016). However, the pandemic has given a new emphasis on the usefulness of these spaces (Karam et al., 2021; Krishnamurthy, 2020), as it has forced public and private organisations to shift from in-person to virtual teaching and learning. COVID-19 has altered the educational and training landscape and forced learning and training environments to quickly evolve to meet new unexpected challenges and fully exploit digital technology for training purposes (Karam et al., 2021; Krishnamurthy, 2020). The pandemic has further highlighted the importance of rethinking the learning and teaching process, as well as virtual and physical learning spaces (Karam et al., 2021).

In this vein, private and public educational institutions are reorganising spaces and identifying solutions to include innovative digital tools and methods for students to learn effectively. In the process of reorganisation, understanding how technologies are implemented in a learning space is critical to maximise their potential. A technology-enhance learning space, in fact, does not ensure effective learning processes per se; pedagogical scenarios must be integrated with the choice of suitable technological tools. Integrating the technologies in a learning space is a complex process rather than a passive approach. The technology should not be considered in isolation from the learning space because the whole learning experience is defined through all the physical, virtual and social learning elements thath have to be aligned and the space is more than a box containing digital technologies (Murugaiah and Yen., 2019; Trentin, 2016; Dillenbourg et al., 2002).

Human resources managing the learning space have a key role; before implementing an innovative tool in a business learning environment, they need to design innovative learning experiences to foster a skillset that enables learners to respond to challenges and develop a successful career in the future (Tarabasz et al., 2018). Specifically, the technological infrastructure has to become an integral part of the learning space, and students and teachers should constantly interact with digital tools. The technologies that may be included in a learning space are several and present distinctive characteristics, and students can increase their productivity and learning performance by interacting effectively with these tools. Some examples are presented in the following table 2, highlighting the main benefits and barrier to maximize and hinder:

Technology	Key insghts	Benefits	Barriers	References
Online platforms	Learning management systems (LMS), Massive Open Online Courses (MOOCs), video conferencing and webinars platforms offer an array of synchronous and asynchronous courses and educational content transcending geographical constraints.	High quality education at a global scale Flexibility Asynchronous learning and self-paced study Enhanced educational experiences Interactive learning and multimedia integration Personalisation Cost-efficiency Accessibility	Privacy concerns Digital Divide Lack of Digital Literacy: Technical Issues Isolation and Lack of Social Interaction	Altalhi, M. (2021). Toward a model for acceptance of MOOCs in higher education: The modified UTAUT model for Saudi Arabia. *Education and Information Technologies*, *26*, 1589-1605. Al-Khanjari, Z., & Al-Kindi, I. (2021). Proposing A Systematic Framework for SQU-Smart Learning Management System (SQU-SLMS). *International Journal of Computing and Digital Systems*, *10*, 1-13.
Mobile learning	Smartphones, apps, Ebooks and open educational resources empower students fostering wider the accessibility to content and resources.	Flexibility Accessibility Engagement with interactive features and multimedia Personalisation and tailored contents Collaboration and work group	Technical Challenges and connectivity issues Lack of digital literacy Distractions and limited interactivity Security and Privacy Concerns Battery and Reliability of mobile tools Health Issues	Winters, N. (2007). What is mobile learning. *Big issues in mobile learning*, *7*(11). Chao, C. M. (2019). Factors determining the behavioral intention to use mobile learning: An application and extension of the UTAUT model. *Frontiers in psychology*, *10*, 1652.

Gamification	The use of game components and game design ideas in educational settings to improve motivation, engagement, and learning outcomes.	Engaging and enjoyable activities Interactivity and motivation Problem-Solving Skills Competition and Collaboration Feedback and progress tracking Personalisation and tailored activities Simulation activities Contents accessibility	Design Complexity Not Suitable for all subjects Technical Issues Health Concerns Lack of digital literacy High costs Game Addiction Risk	Dicheva, D., Dichev, C., Agre, G., & Angelova, G. (2015). Gamification in education: A systematic mapping study. Journal of educational technology & society, 18(3), 75-88. Ofosu-Ampong, K. (2020). The shift to gamification in education: A review on dominant issues. Journal of Educational Technology Systems, 49(1), 113-137. Nah, F. F. H., Zeng, Q., Telaprolu, V. R., Ayyappa, A. P., & Eschenbrenner, B. (2014). Gamification of education: a review of literature. In HCI in Business: First International Conference, HCIB 2014, Held as Part of HCI International 2014, Heraklion, Crete, Greece, June 22-27, 2014. Proceedings 1 (pp. 401-409). Springer International Publishing.
AI driven algorithms	AI-driven algorithms harness student data to craft customized learning paths; chatbots and virtual assistants play a pivotal role in providing instantaneous feedback and support.	Personalised and tailored learning High level of commitment and engagement Interactivity Data driven insights Accessibility Continuous and immediate feedback	Lack of Digital Literacy Technical issues Routine and resistance to change Privacy Concerns Bias and Fairness High costs activities Ethical Concerns Low level of interactions	Shum, S. J. B., & Luckin, R. (2019). Learning analytics and AI: Politics, pedagogy and practices. *British journal of educational technology*, *50*(6), 2785-2793. Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *Ieee Access*, *8*, 75264-75278.
Virtual	Virtual Reality	Immersive nature	Technical issues	Pimentel et al., (2022) "AN

Reality, Augmented reality and Extended reality	(VR), Augmented Reality (AR) and extended reality (XR) offer immersive educational experiences; gamification and educational games infuse elements of interactivity and fun, encouraging critical thinking and problem-solving skills among students	of the experience Remote education Flexibility Interesting, remarkable, learning experience Simulation	Lack of human interactions Health concerns (dizziness or headaches)	INTRODUCTION TO LEARNING IN THE METAVERSE", Report. Hines, P., & Netland, T. H. (2022). Teaching a Lean masterclass in the metaverse. *International Journal of Lean Six Sigma*.
Metaverse	Metaverse allows the creation of an engaging and life-like online classroom, promote communication, support immersive learning, make learning fun, and enrich students' learning experience.	Engagement and motivation Personalization Attractive visualization Simulation and gamification Immersive experience Social interactions	Cognitive Load Time Constraints Accessibility Privacy and Safety Assessment difficulties	Upadhyay, A. K., & Khandelwal, K. (2022). Metaverse: the future of immersive training. Strategic HR Review, 21(3), 83-86. Xu, M., Ng, W. C., Lim, W. Y. B., Kang, J., Xiong, Z., Niyato, D., ... & Miao, C. (2022). A full dive into realizing the edge-enabled metaverse: Visions, enabling technologies, and challenges. *IEEE Communications Surveys & Tutorials*. Rospigliosi, P. A. (2022). Metaverse or Simulacra? Roblox, Minecraft, Meta and the turn to virtual reality for education, socialisation and work. *Interactive Learning Environments*, *30*(1), 1-3.

Digital Twin	Digital twin refers to a virtual replica or simulation of physical objects, environments, or processes, which can be used to enhance learning experiences.	Simulation and creation of double virtual laboratories Enhanced and Practical Learning Cost Savings Accessibility Interactivity and flexibility Adaptive and personalised Learning	High investments High quality and stable infrastructure and connectivity Lack od digital literacy Content quality and accurancy Need of continuous support to effectively use the technology	Sepasgozar, S. M. (2020). Digital twin and web-based virtual gaming technologies for online education: A case of construction management and engineering. *Applied Sciences*, *10*(13), 4678. Alexopoulos, K., Nikolakis, N., & Chryssolouris, G. (2020). Digital twin-driven supervised machine learning for the development of artificial intelligence applications in manufacturing. *International Journal of Computer Integrated Manufacturing*, *33*(5), 429-439.
Blockchain technologies	Blockchain technologies and facial recognition technologies secure storage and verification of educational credentials.	Educational credential Verification Data Security Transparency Possibility to enhance life-long learning	Technical Complexity, need of resources and expertise Lack of Standardization High costs Resistance and reluctance to change and blockchain integration Data Privacy and Security Concerns Regulatory and Legal Issues Fraud concerns	Alammary, A., Alhazmi, S., Almasri, M., & Gillani, S. (2019). Blockchain-based applications in education: A systematic review. *Applied Sciences*, *9*(12), 2400.

Table 2. Technologies in educational learning spaces

In order to obtain the best results from these kinds of spaces, integrating technological tools with adequate pedagogical paradigms and preparing a strategy to maximize the benefits and face the barriers favors a real innovation of the learning and teaching processes (Trentin, 2016). Digital technologies have already changed the learning experiences; communication and access to

information are the tasks where most transformations have occurred. The discussion nowadays is focused on 4.0 technologies that can provide an immersive experience, fostering a high level of engagement, social connections, personalised learning, student-centric learning and new ways of discovery and achievement (Jung, & Latchem, 2011; Zevenbergen & Lerman, 2008).

In a technology –enhanced learning space, how people interact with the technology becomes essential. Learners, for example, through structured activities, can construct and share objects like web pages, projects, videos, and avatars, improve communication and knowledge sharing, and become knowledge creators and producers.

On the other hand, while it is unlikely that some particular technologies directly bring changes in learning processes, educators can experiment with innovative forms of pedagogy, deciding to implement and use, in an effective way, digital tools inside the classroom to support students' learning (Meriaux, 2019). In this vein, educators are always more willing to share teaching materials, create online activities or assignments, deliver small online courses, and interact with robots, wearable devices, video and podcasts. They can facilitate indirect positive impacts as, for example, effective feedback, motivating and helpful visual representation or immersive experiences. In this regard, advanced digital technologies have the potential to become powerful and potential changing agents and strategic allies for sustainable and inclusive development of innovative, cheaper and more user-friendly learning spaces and effective knowledge creation and exchange.

Despite the increasing importance of technology –enhanced learning spaces, there are some obvious gaps that the educational context discloses, mainly from the digital maturity point of view. The use of advanced technologies, indeed, continues to be fragmented and discontinued or restricted to situations of crises. However, the limitations do not concern only the educational scenario but there is yet the need to stabilise the increase of effective use and implementation of technologies and advanced technologies in all the knowledge management contexts by ensuring support even in a post-emergency period and by rethinking and enhancing the learning and knowledge ecosystem vision, more oriented to the digital era and perspective (Giovannella, 2020).

The non-homogeneous diffusion of the technologies in the knowledge and learning contexts, in a state or in a local territory, strictly contributes to the general degree of use and integration of the digital tools. By considering the DESI index (2022), the AGCOM study (2019 - Educare in digitale) or the Eurydice Report (2022) it is possible to notice that the level of adoption and use of digital technologies is different for each country and one of the most influential factor that determines the gaps is the rate of digital literacy and competence. Different territorial backgrounds show distinct rates of adoption and efficiency; therefore, technology usage cannot be the same everywhere. The prerequisite for an effective implementation is the analysis of the territorial conditions because cultural, social and ethnic backgrounds influence the willingness to use technologies in knowledge and learning contexts. The maturity of the technological offer and of the local context should be at the same level (Tricarico and Bielli, 2019; Hernández-Lara et al., 2018) and the tool chosen should be the easiest to use in respect to the conditions of the territory where it is applied. For example, it is not recommended to implement VR or AI where the digital maturity is still low because its potential cannot be exploited and it enhances complexity and high investments, primarily for small and medium companies (Elmqadden, 2018; Stenger, 2017). Technology readiness is indeed a critical

dimension connected with students' learning. Digital technologies provide anywhere, anytime access to learning content (Kim et al., 2019), but one's willingness and competencies to leverage advanced technologies in performing tasks is a crucial aspect. Advanced technologies, though well established, still face the challenge of being readily accepted and effectively used when introduced to a new application setting.

2.5. Discussion

The current scenario is characterised by complexity, volatility, ambiguity and unpredictability. Overall, several unexpected adverse events, in particular the pandemic and political instability, profoundly affected the organisations' solidity and capacity for survival and growth (Lee and Tan, 2023; Karam et al., 2021; Krishnamurthy, 2020; Bennett and Lemoine, 2014).

On the other hand, also impacted the firms' organisational processes. The emergence of Industry 4.0 and now Industry 5.0 has provoked breakthroughs and shifting work tasks (Lee and Tan, 2023).

Companies that face these changes avoid being left behind in this rapidly evolving landscape. Therefore, businesses need to embrace digital transformation and leverage the latest technologies to stay competitive and thrive in the era of Industry 4.0 and 5.0. From such a perspective, innovation becomes a crucial driver for survival, competitiveness, long-term growth, and success (Ensslin et al., 2020; Hamidi et al., 2019; Bennett & Lemoine, 2014; O'Connor, 2013; Solomon, 2007).

Continuous innovation involves fully engaging the organisation, its stakeholders, and its customers. To effectively participate and create value, each actor in the innovation process needs to be aware of the organisation's vision, goals, and strategy and included in the innovation process (Lianto et al., 2018; Nonaka and Takeuchi, 2019). In the pursuit of continuous innovation, a deliberate and structured approach is then essential to catalyse its generation and involve all the actors in a process of change and transformation. An organisation's, society's, or person's process of innovation may be nurtured by knowledge dynamics. In this perspective, von Glasersfeld (1991a, 1989a, 1989b) and Peschl. (2014) outlined that in the constructivism theory, the self-organisation of knowledge produces what is known as learning. Knowledge can never be acquired passively, but only be managed by assimilation and sharing to an already-existing cognitive framework. Actually, an experience is not considered new and innovative by an actor unless it produces a change in relation to an anticipated outcome. When a novel conceptual structure is developed, a new equilibrium is restored (Glasersfeld 1989a). Therefore, continuous innovation requires the establishment of places that nurture and encourage the iterative refinement of knowledge and the application of unexplored and innovative methodologies (Nonaka & Tacheuki, 2019) and actors involved have to acquire, exchange and retain knowledge and use knowledge effectively (Mahdi et al., 2019).Knowledge is always flexible and capable of providing fresh insights into a particular phenomenon due to its constructive nature. This aspect is crucial for one who wants to develop and design places where innovation is fostered and developed (Peschl, 2014).

However, a further aspect to consider is the fast spread of technologies and advanced technologies that significantly impact knowledge search and recombination, as well as on the whole learning experience (Lanzolla et al., 2021). Technologies have the ability to make learning and knowledge processes and dynamics more accessible and inclusive removing geographical and social barriers, to develop enjoyable, engaging and motivating experiences; to create and distribute contents more cheaply, and to allow personalization (Caprara & Caprara 2021; Lanzolla et al., 2021; Tricarico and Bielli, 2019). It is essential to note that while these technologies offer significant potential benefits, their effective implementation requires careful planning, professional development for educators, and ongoing evaluation to ensure positive educational outcomes. Moreover, the digital divide can limit access to technology, making it important to address equity and inclusivity in educational technology initiatives (Lanzolla et al., 2021; Tricarico and Bielli, 2019).

Following the previous insights, it appears the need of an organisation to develop a versatile strategy that maintains the balance between all of the mentioned factors. To be more precise, they

might create places and spaces where each of these components, namely technologies, actors interactions, knowledge and learning dynamics converge and combine to encourage and nurture continuous innovation (Vey et al., 2017). In this vein, the term "space" encompasses a wide range of meanings, from the state of being positioned in a certain location or area to the attributes of various environments and surroundings. In this regard, not only the architectural or physical characteristics of spaces are considered but also their social, psychological, epistemological, and technological aspects. Even though these dimensions denote levels and borders, it is crucial to consider them as connecting rather than dividing (Peschl, 2008).

Several authors propose both tangible and abstract organisational spaces, frameworks, or systems that foster innovation relying on knowledge dynamics. The examples of environments suggested in the chapter are learning organisations and KMS, creative areas, enabling spaces, innovation labs, and Ba. Despite each setting has advantages of its own; spatial configurations frequently lack the frameworks and models necessary to enable their design, development, management and assessment. Similarly, LO and KMS are theoretical concepts, more challenging to practically implement, particularly for SMEs Schiuma & Santarsiero, 2023;Carlucci et al., 2022; Pawlowsky & Wagner, 2021; Lai et al., 2021; Peschl, 2014; Heiskanen & Heiskanen, 2011; Corso et al., 2003)..

In order to gain a deeper understanding of the concept and the key dimensions of spaces for learning and knowledge management in a transdisciplinary context, the study focuses on educational learning spaces, in order to borrow the concept and provide a comprehensive definition of LS in management literature, including all the configurations presented above.

The pedagogical perspective allows the identification of the aim and the main characteristics that define learning spaces The literature suggests that learning spaces are places where knowledge is created, shared, and applied that may be described as spaces of interaction between individuals, their behaviours, and the external environment. Despite the notion of learning space draws origin and its main application in the educational institution, in the current scenario they may play pivotal role in fostering continuous innovation in organisational and territorial contexts.

To ensure their success and usefulness in achieving their objectives, learning spaces have to be effective. Effective spaces are designed to balance all the affordances, with a clearly defined understanding of the physical, virtual, and social requirements, as well as how these requirements interact to support the learning experiences as a whole (Byers et al., 2018; Temple, 2018).

The regular assessement of the effectiveness of educational learning spaces is crucial to ensure that it aligns with educational goals, fosters engagement, and contributes to positive learning outcomes. The evaluation process should be ongoing, a continuous cycle of assessment, feedback, and improvement. Regularly revisit the effectiveness of the learning space to ensure it remains aligned with educational objectives and adapts to changing needs. An effective learning space thus evolves with the evolving requirements of learners and educators.

In pedagogical literature, several tools and models are proposed to understand if a learning space is effective in achieving its objecitves. Educational and knowledge management contexts have to be technologically prepared in order to inspire a virtuous cycle of innovation and improvement (Tricarico and Bielli, 2019). For this, manifold assessment tool monitor technology readiness or support effective use of technology to transform the educational experience from design through to evaluation. Existing studies, in fact, have been focused on students' adoption of learning technologies and the determinant factors, for instance, personal innovation, perceived usefulness, performance expectancy, effort expectancy, social influence, perceived playfulness, self-management of learning. One example is the technological Readiness Index (TRI), developed and validated by Parasuraman (2000). It is an assessment scale for technological readiness that includes of 28 items grouped into four categories: optimism, inventiveness, discomfort, and insecurity. These four categories accurately capture actors' attitude towards new technologies in the classroom (Liu, Li, & Carlsson, 2010; Wang, Wu, & Wang, 2009).

Then there are the TPACK model (Technological Pedagogical Content Knowledge) (Rodríguez Moreno et al., 2019), an educational framework that supports educators understand and integrate

technology into learning, differentiating the various components of knowledge; the RAT model (Replacement, Amplification, and Transformation) (Talbert& Mor-Avi, 2019) and the SAMR model (Substitution, Augmentation, Modification, Redefinition), that are implemented from educators to design more engaging and effective lessons that leverage the unique features of technology; the TIM model (Technology Integration Matrix) that is a tool supporting the decision-making process about professional development and technology integration initiatives, ultimately leading to more effective and engaging teaching and learning experiences for students, and, amongst the others, there are the Triple E Framework, and the Rigor-Relevance framework (Kimmons, & Hall, 2018; Kim et al., 2010; Liu, Li, & Carlsson, 2010; Wang, Wu, & Wang, 2009).

Focusing merely on technology readiness and implementation may provide fragmented information concerning the effectiveness of a space because a learning space traverses all physical, virtual and social space, within and outside the confines of the learning institutions. Therefore, other factors should be evaluated, in relation to the educational learning spaces' effectiveness.

The LEEP (Learning Environments Evaluation Programme) framework, for instance, analyses the factors leading to successful learning outcomes evaluating the effectiveness of the learning space given the physical setting, the resources and space planning management and the level of comfort, health, accessibility, safety and security (OECD, 2017). It is therefore focused on the architectural and physical dimension of the educational learning spaces.

Literature reveals that the emphasis is frequently on the learners' dimensions, particularly on their acquired competencies, motivation, and satisfaction. Assessing the learning motivation means to understand if the learner is committed in learning activities at a cognitive, affective, and emotional level (Fredricks, Blumenfeld, & Paris, 2004). Self-efficacy and goal-setting are strongly associated with learning motivation (Che-Ha, Mavondo, & Mohd-Said, 2014; Law & Breznik, 2017; Law, Lee, & Yu, 2010; Ngan & Law, 2015). Concerning satisfaction and competencies, several researchers have tried to develop different methods of assessing the effectiveness of learning spaces, taking account of these indicators.

The assessment frameworks, implemented not merely in educational institutions but also in training programs are the Kirkpatrick model, the A.C. Hamblin's Model of Evaluation, and the CIPO Model (Context, Input, Process, Outcome) (Gautam &.Gautam, 2011; Kirkpatrick, 1996). Kirkpatrick's model continues to be the most popular framework because of its easy applicability (Leach & Liu, 2003) and because it emphasizes the importance of going beyond participants' reactions to measure the impact of training on job performance and overall organisational success. It is in fact based on four level of impact that are reaction to training (i.e. level of satisfaction), learning (i.e. competencies), behavior and results on the organisation.

However, as multiple researchers stated, to better assist the delivery and development of effective learning spaces, the emphasis should shift beyond the evaluation phase and instead be on the decision-making process from design to evaluation. In this vein, the management of educational learning spaces should encompass a multifaceted approach involving the orchestration of physical and digital infrastructures, the formulation of policies, and the implementation of practices. This comprehensive management, necessary to cultivate environments conducive to effective teaching and learning practices. Managing a learning space, whether it is a physical classroom, a virtual environment, or a combination of both, is of paramount importance in education and training. Effective management of learning spaces creates an environment that are effective and promotes positive outcomes for both learners and educators (Ellis & G Goodyear, 2016; Krämer et al., 2015).

This research, thus, aims to focus intensely on Learning Spaces. Specifically, on how to manage technology-enhanced learning spaces, in order to foster continuous innovation in the Digital Age and on how to understand whether they are effective in achieving this purpose. This part of the study has been focused on distinctive issues, considered as start points to further develop the research, that are:

Analysis of the dynamics that boost continuous innovation in the Digital Age and should indeed be promoted within an organisational learning space;

Models, framework and systems that already exist to promote continuous innovation in organisations;

Characterization of educational learning spaces and reasons why they may be effective models in a process of continuous innovation in the Digital Age;
Specific focus on educational learning spaces supported by digital technologies;
Models that assess the educational learning spaces' effectiveness.
Given the fact that educational learning spaces are considered in a multi-dimensional perspective, in the next chapter, through a systematic literature review, the phenomenon is analyzed in detail in management literature to understand and populate its key dimensions and features; to analyse the evolution of the concept, focusing on the impacts that advanced technologies are creating and to provide a comprehensive working definition in order to systematize the knowledge in this field and address future research streams.

III. *INVESTIGATING THE PHENOMENON OF LEARNING SPACE IN MANAGEMENT: A SYSTEMATIC LITERATURE REVIEW*

3.1.Managerial perspectives of the "Learning Space" concept

Organisations need to acquire and retain knowledge and use it in an effective way to continuously innovate and navigate the challenges of the actual scenario (Mahadi et al, 2019). Knowledge and learning are not passively acquired but actively produced, therefore organisations need to engage in structured processes of construction to generate functioning/viable knowledge (Peschl, 2008).

In this vein, several authors stated the importance of developing places external or internal an organisation, to boost continuous innovation. Those places should support the development of a versatile strategy that promotes the right competencies, knowledge and attitudes, is based on learning and knowledge dynamics, foster various level of learning (from individual to community learning), and is flexible enough to evolve with the Digital Age and support the advanced technologies use and spread (Santarsiero & Schiuma, 2023; Nonaka & Tacheuki, 2019; Vey et al., 2017; Peschl et al., 2014).

To do so, different spaces' configurations are emerging, sustaining innovation dynamics through learning and knowledge management. However, the management literature lacks a comprehensive definition that may characterize different configurations and settings that have the same aims, providing insights, requirements and models that support these spaces' development and management (Schiuma and Santarsiero,2023; Pawlowsky and Wagner, 2021; Lai et al., 2021; Vey et al. ;2017; Peschl, 2014).

To do so, this study focused on the concept of "Learning space" (LS) that has been introduced in the educational literature to distinguish the creation of spaces designed to optimise and support active learning and methodologies and amplify their positive effects in learners (Temple, 2018). This definition includes a wide range of physical or virtual locations, venues or environments where teaching, learning and knowledge dynamics occur in presence or at distance. Educational learning spaces might also be open-access places where students formally or informally gather to study, collaborate or work individually and in groups, with or without supervision (Salinas-Navarro, 2019). Despite the notion of learning space draws origin and its main application in the educational institution, in the current scenario, it constitutes a key concept for all those organisational and territorial contexts in which the creation and management of knowledge and learning dynamics are enabling factors that support transformation, innovation and development dynamics. Learning spaces are indeed described as places where knowledge is created, shared, and applied and where interactions between individuals, their behaviours, and the external environment are fostered and supported.

This study's primary goal is to determine how well technology-enhanced LS can foster continuous innovation within organisations. In order to achieve this, first it is important to comprehend how the notion of "Learning Space" is considered and examined in management literature, as well as how the Digital Age—particularly the progression of advanced technologies—influences its evolution.

To fully understand how learning spaces can support organisations' in a path of continuous innovation, it is essential to adopt a holistic approach which considers the multi-dimensionality of the space. For this reason, it is proposed a critical analysis of the management literature adopting a systematic literature review to identify the critical interpretative dimensions of Learning Spaces, defining and analyzing their characteristics and functioning.

3.2.Research Methodology – the systematic literature review

The management literature provides a vast amount of data and articles and analyzing them is a challenging task, especially in the phase of systematization and summary of the contributions (Crossan and Apraydin, 2010). One of the responses is to undertake an extensive analysis of the contributions in the literature (Ginsberg and Venkatraman, 1985). In particular, for the purpose of this study, a systematic literature review has been carried out, because it is the most efficient and high- quality method for identifying and evaluating extensive literatures. The approach adopted is the one proposed by Tranfield et al. (2003), which is a scientific and transparent process, reported in sufficient detail to permit the replication. (Tranfield, 2003), and balanced in terms of specificity and sensitivity (The Cochrane Collaboration, 2017). With a SLR approach, insights and evidences from the literature have been found, synthetized and evaluated (Calabrò et al., 2019; Cillo et al., 2019).

Tranfield et al. (2003) proposed three main phases, that are: i) planning the review; ii) conducting an inspection, and iii) reporting and disseminating.

The first step, concerning the planning phase, was conducted through the arrangement of a panel of six experts, including practitioners, selected based on their experience and background concerning the field to investigate and the research methodology. From the discussion between researchers and practitioners were derived a formalized review protocol, that included the research question, inclusion and exclusion criteria, and the database selection. This step supports objectivity through detailed descriptions of the stages and processes implemented. Flexibility was allowed to state explicitly any changes in the search strategy and the rationale for these changes (Trafield et al, 2003).

Keywords and searching terms to carry out the SLR were defined in the second step. The search strings were defined according to the RQ1: "***What are the distinctive dimensions of a learning space?*** What is a learning space? How advanced technologies are impacting on its evolution?"

Initially, the research strings chosen were "learning space" AND "dimensions". However, formulating a query considering only these two keywords resulted being too wide: indeed, given the plurality of terms used interchangeably to refer to learning spaces and their dimensions, a broader selection requirement has been adopted to include all the significant studies, adding to the query other terms with "OR". In consequence, the selected research strings were "learning space" OR "learning environment" AND "dimensions" OR "components" OR "characteristics" OR "features". The search strings chosen are wide enough to allow the understanding of the level of knowledge and contributions in this field and to identify the areas to explore.

The following steps regarded the conduction of the inspection. Generally, there are different paths for searching data using strings and keywords through an appropriate algorithm; i) choosing a single

database (Cillo et al., 2019); ii) choosing multiple databases (Hossain, 2019) or iii) focusing on the existing literature of the article selection and engage experts that suggest significant works to be referred to (Crossan and Apraydin, 2010).
With the scope of building a holistic and comprehensive understanding of the dimensions of learning spaces, the approach that concerned the use of multiple database has been adopted (Hossain et al., 2019). Specifically, the multiple databases considered were Web of Science (WoS) and Scopus, acknowledged as complete databases for academic papers (Falagas, 2008). The final set of works to be considered has been defined, identifying all relevant articles and removing duplicate papers.

After applying the selection criteria, 439 documents resulted; 370 results from Scopus and 69 from Web of Science. The documents were opened into a spreadsheet and the duplicated were removed.
Then, these pieces of information were exported as a CSV file, saved it in a temporary folder and opened it into a spreadsheet to remove irrelevant information (such as DOI number). After analysing the title, keywords, abstracts of identified papers, the documents essential for the research's purpose were selected. The notion of learning space has been approached from several views and under diverse dimensions. Therefore, to best investigate the topic, studies considering different perspectives were included while those not aligned with defined selection criteria were excluded. Thus, the critical articles selected were 209. The selected 209 papers were critically scrutinized (Fig. 3).

In this specific case, to decide what literature to include or exclude, some predetermined criteria have been defined in advance: first, articles published in scientific journal from *1995 to 2023* were taken into consideration, included in the research field of *Business, Management and Accounting*. Conference papers, articles not written in English, book chapters, and special issue editorials were excluded. All duplicate papers from different sources were identified and removed.
The following step was the scan analysis of titles, abstracts and keywords of the remaining articles, in order to include contributions consistent with the research question and the focus of the analysis. The eligibility criteria were then defined, considering the essential article information.
Specifically, contributions in fields disconnected from business, management and economics were dismissed. Also, articles focused on specific technical issues or specific subjects were not included.

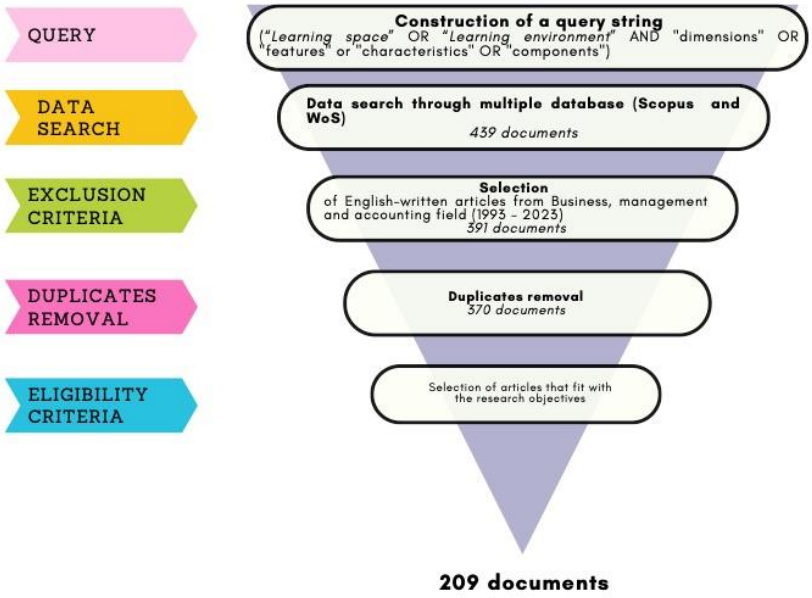


Figure 3. Steps of the research process and number of selected papers

On the other hand, papers disclosing empirical research using case studies, surveys, and similar analysis were included.

This study analyses more fully learning spaces developed in or for private organisations, but papers concerning learning spaces developed in public companies, schools, high education institutions, organisations, territories and so on were included, when focused on one or more components or dimensions characterizing the space.

Figure 3 depicts the steps of the systematic review process and the number of selected studies on each step. Following the interpretative lenses to synthesize the extracted data, the insights derived by the articles were organized according to the different dimensions of a learning space emerged from the literature.

3.3. Analysis of the results

3.3.1. Descriptive statistic

The descriptive statistics suggest that the analysis about the distinctive dimensions and characteristics of “learning spaces” and “learning environments” is a topic acquiring growing interest in management studies. Figure 4 illustrates the number of papers published per year. Although the review period is from 1995 to 2023, it is clear how most of the relevant articles have been issued starting from 2009. In fact, 88% of the papers have been published in the last 15 years and 67% of the papers in the last 10 years. This shows the growing interest and relevance of the topic.

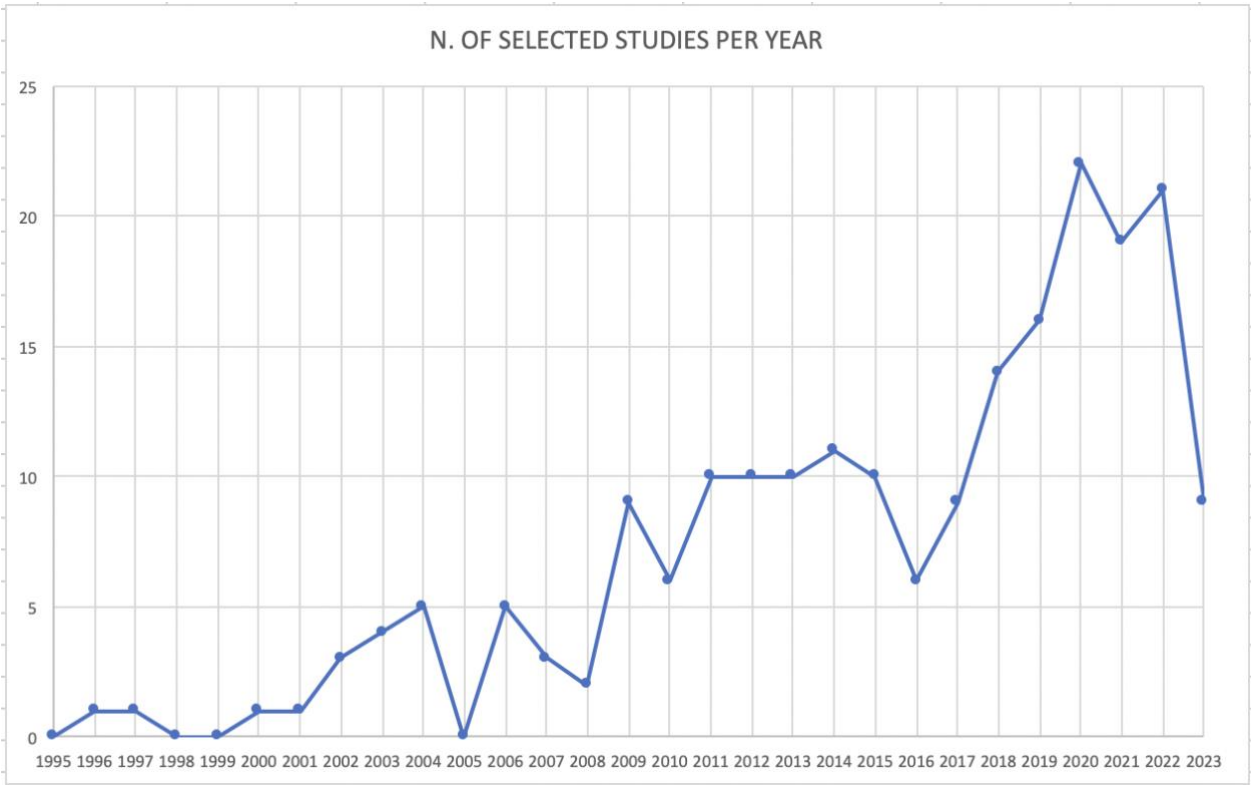


Figure 4. N. of selected studies per year

Concerning the geographical distribution of the articles (Figure 5), the countries with the highest number of articles on the topic have authors from the USA (83 articles) and the UK (32 articles). Moreover, the European Area show a growing interest in the topic. Scholars from Germany, Spain, Denmark, Finland, Netherlands and Italy shaped the bar chart with many published articles. At the same time, and although the number of published papers is not equally high for all the countries listed, the bar chart reveals that the phenomenon of learning spaces is an emerging topic at a global level.

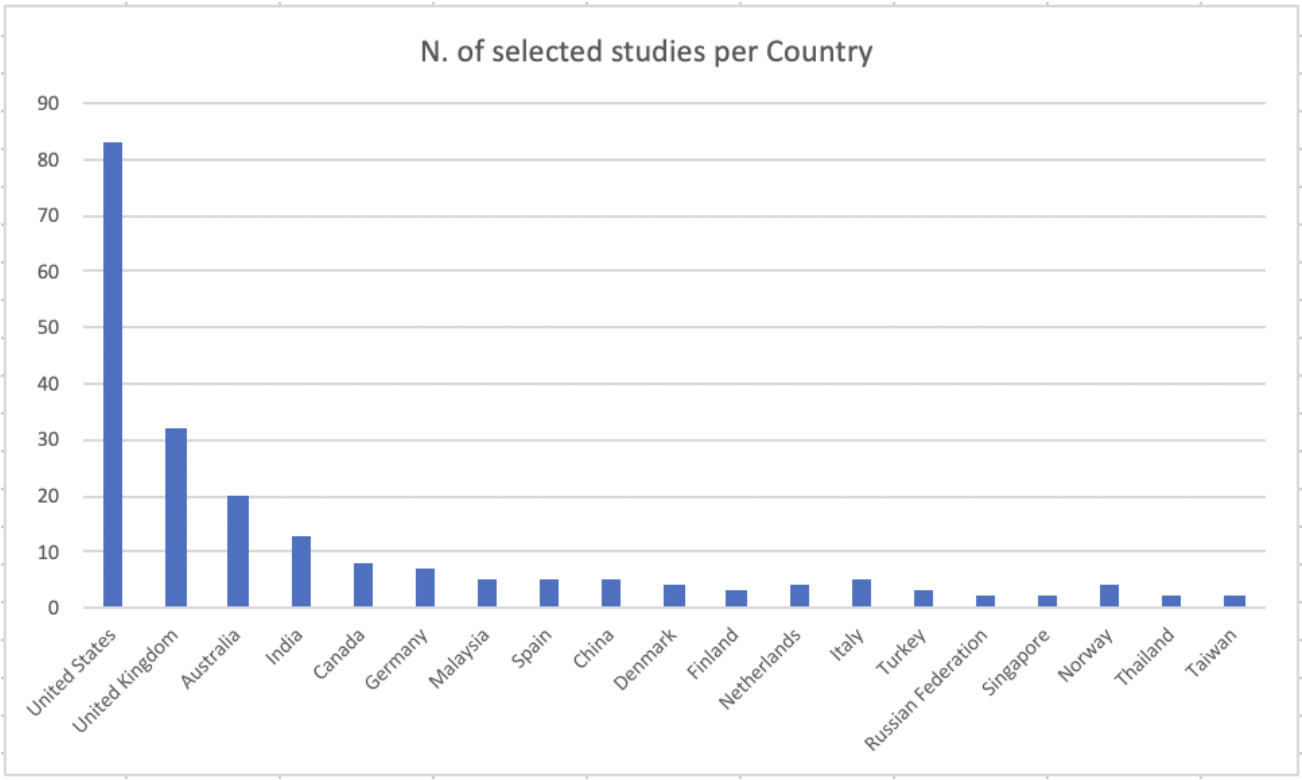


Figure 5. N. of selected studies per country

The learning space concept covers different fields in research areas (Figure 6). The most common research area is "Business, management and accounting", with 46% selected articles. This shows the growing interest of scholars and practitioners in developing and managing learning spaces and their distinctive dimensions and characteristics. "Social science" field (22% of selected articles) find great interest, primarily focusing on the origin of the learning space concept, specifically the educational and pedagogical sciences. "Computer science" and "Information science" fields represent the growing impact of the technologies on the new learning spaces. Moreover, the relevance of the "Psychology" field, reveals the significance of the cognitive dynamics within a learning space. The rest of the research areas like "Arts & Humanities", "Energy", and "Economics, econometric and finance", show the plurality of context of application of learning spaces.

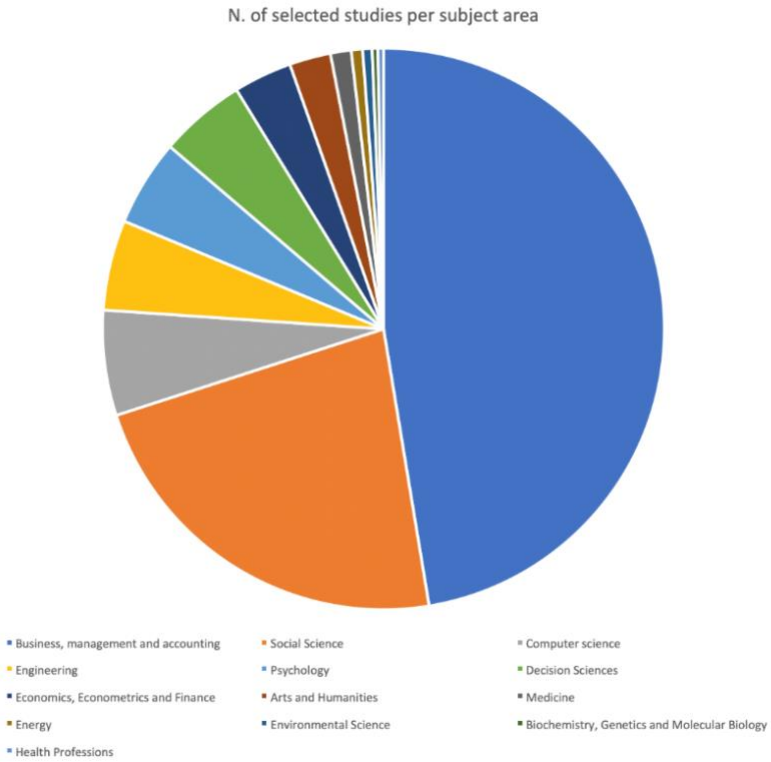


Figure 6. Reserch area of the

selected studies

3.3.2. Learning spaces: evolution of the concept and contexts of application

From a critical analysis of the literature, an evolution of the concepts of "learning space" and "learning environment" with respect to their dimensions and the characteristics has been pointed out.
Initially, as it is possible to see in Tab. 2, the definitions mainly focused on the physical infrastructure and layout of the space. The elements of novelty regarded the active involvement of the learners and the interactions between the actors and the space. Functionality, participation and empowerment were the innovative features, and the main goal was to create an environment that fostered critical thinking, problem-solving, and communication skills while improving learners' engagement and motivation (Alavi et al., 2002; Alessi, 2000).
Moving forward, the researchers gradually added new dimensions and characteristics to the definition of learning space and learning environment, overcoming the boundaries of a physical setting. In fact, different authors used distinct labels referring to learning spaces. Even though it is not possible to give an exhaustive taxonomy of the learning spaces, highlight the distinction is useful to point out that the concept of learning space is wide and used as lens to identify different models of space based on knowledge and learning dynamics. Alessi (2000), for example, labels these kinds of spaces as "Interactive learning environment", emphasizing the active dynamics framed internally. Illeris, (2004) and Lee & Tan (2022) identify the "Workplace learning space" developed within the organisations' workplace. Khandelwal et al. (2022) describe, with the label "Dynamic learning environment", a flexible context that constantly changes and adapts to meet the needs of learners. Then "Space of innovation", according to Heiskanen & Heiskanen (2011) is a physical, social, and mental setting that support innovation processes through learning dynamics. Further details about their contextualization, characteristics, and definition are provided in table 3.

However, over the years, the growing significance of the virtual dimension symbolises the progression of the technologies that become an integral part of learning spaces. In fact, as it is possible to see in Tab. 2 the advancement of digital technologies strongly impacts on the evolution of the concept. The most diffused labels refer to spaces that are enhanced from the technology implementation and are "Virtual learning environment", "online learning environment" "Smart learning environment", "Blended learning environment" or "digital learning environment" (Gilmore and Warren, 2007, Mueller and Strohmeier, 2011; Greasley and Bennet, 2014; Yao, 2019; Hilioui et al., 2020; Erdoğdu and Çakıroğlu,2021; Al – Khanjari, 2021).
Specifically, Scholars as Illeris (2004), Arbaugh et al., (2006), Gilmore and Warren (2007) and Mueller and Strohmeier, (2011) introduced their spaces as physical as well as virtual places, stressing the significance of the remote learning. A virtual learning space enables the learner to interact with the instructors and other learners beyond the boundaries of the space, without being in the same physical location, in a synchronous or in an asynchronous way (Grieves et al., 2006).

The characteristics of a virtual learning space include the use of digital technologies and resources, the ability to access learning materials and resources from anywhere and at any time, the potential for self-directed learning, and the ability to facilitate communication and collaboration between the actors involved. More recently the distinction between virtual and physical space became blurred. Yao (2019) and Lancaster and Milia, (2015), in fact, used the concept of hybrid places where

technologies are used for distance learning or as tools enriching the learning processes and knowledge dynamics within the space. The word hybrid refers to spaces that combine virtual with physical elements, improving flexibility, efficiency, or functionality and enriching the learning experience. Nowadays it is not possible to describe and define a learning space without considering its virtual or technological components. Moreover, as already pointed out in the educational scenario, the implementation of advanced technologies in a learning space is profound and far-reaching, and it is transforming the way knowledge and learning processes are delivered and experienced (Al – Khanjari, 2021).

However, the technology enhanced learning spaces also presents challenges such as the lack of physical and social cues and the need for learners to be self-motivated and self-disciplined (Hliouli et al, 2020; Mueller and Strohmeier, 2011). In consequence, the study will deepen the impact of advanced technologies on the characterization and functioning of the learning spaces' dimensions, with the aim to develop effective technology-enhanced learning spaces.

Concerning the evolution of the concept of learning space, newly added dimensions do not consider only the technological tools but also the intangible components of a space, namely social and a mental space. In this perspective, the culture and the atmosphere diffused, the technical and soft skills of the actors involved, and the relationships shaped assume a critical role, together with dynamicity and flexibility (Khandelwal et al., 2022**)**.

The definitions, contextualization and characterization of these concepts are provided in the table below (Tab.2):

Reference	Dimensions and characteristics	Key insights
Alessi, 2000	• Learners • Setting • Platform • Instructional materials • Activities	An **interactive learning environment** refers to a setting or platform where learners actively engage with instructional materials and participate in activities that promote learning. In this environment, learners have the opportunity to explore, manipulate, and interact with the content, which enhances their understanding and retention of the material.
Alavi, M., Marakas, G. M., & Yoo, Y. 2002	• Physical conditions (classroom/ online setting) • Social conditions (interactions) • Psychological • Learners/ instructors • Atmosphere	A **learning environment** refers to the physical, social, and psychological conditions in which learning takes place. It includes factors such as the classroom or online setting, the resources available, the interactions between learners and instructors, and the overall atmosphere that supports learning.
Illeris, 2004	• Technical-organisational dimension, • Social dimension • Employees' work processes.	A **workplace learning space** refers to the physical or virtual environment where learning happens within a workplace setting. It encompasses the various opportunities and resources available for employees to acquire knowledge, skills, and competencies related to their work.

Grieves et al., 2005	• Physical/ virtual setting • Resources and tools facilitating learning • Social context • Cultural context	A **learning space** is a physical or virtual space where learning takes place. It includes the physical setting, resources, and tools that facilitate learning, as well as the social and cultural context in which learning occurs.
Arbaugh and Benbunan – Fich, 2006	• Physical context • Social context • Psychological context	A **learning space** refers to the physical, social, and psychological context in which learning takes place. It includes factors such as the classroom layout, instructional materials, teaching strategies, student-teacher interactions, and peer interactions
Gilmore and Warren, 2007	• Tools and resources of a digital environment • Individuals	A **virtual learning space** is a digital environment that facilitates online teaching and learning. It can include a range of tools and resources, such as discussion forums, video conferencing, and multimedia content.
Mueller and Strohmeier, 2011	• Physical/virtual space • Resources and tools, • Interactions that support the learning process	A **learning environment** refers to the physical or virtual space where learning occurs. It includes the resources, tools, and interactions that support the learning process. In the context of virtual learning environments (VLEs), a learning environment refers to the online platform or system that facilitates learning activities and provides access to learning materials and resources.
Heiskanen & Heiskanen, 2011	• Physical setting • Social setting • Mental setting • Interactions	A **space of innovation** refers to the physical, social, and mental settings that support or hinder innovation processes and related learning and knowledge activities. It encompasses the boundaries and interactions between these spaces within and outside an organisation.
Greasley and Bennet, 2014	• Platform • Tools and resources that support online teaching and learning	A **Virtual Learning Environment** (VLE) is a computer-based platform that provides a range of tools and resources to support teaching and learning activities. It typically includes elements such as computer-mediated communication, publishing of learning materials, computer-assisted assessment, and course management facilities.
Lancaster and Milia, 2015	• Physical/ virtual environment • Individuals • Technologies	**Learning space** can be defined as any physical or virtual environment that is designed to facilitate learning and support the acquisition of knowledge and skills.
Yao, 2019	• Actors (instructors, learners and decision makers) • Technologies	A **blended learning environment** is characterized by the interactions between the stakeholders involved with their role and competencies, and the technologies with the aim to foster an effective teaching and learning process.
Hilioui et al, 2020	• Web-based platform • Actors • Climate • Social interactions	A **virtual learning environment** (VLE) is a type of online learning environment, typically through a web-based platform.
Al – Khanjari, 2021	• Technical expertise • Pedagogical knowledge	A **smart learning environment** requires a combination of technical expertise, pedagogical knowledge, and effective communication

	• Effective communication and collaboration	and collaboration among stakeholders
Erdoğdu and Çakıroğlu, 2021	• Virtual space • Digital technologies	An **online learning environment** refers to a virtual space where learning activities take place using digital technologies and the internet.
Müller and Wulf, 2022	• Instructional design • Teaching methods • Technology • Classroom climate • Students	A **learning environment** includes factors such as the instructional design, teaching methods, technology, classroom climate, and student characteristics.
Khandelwal, Kolte, Pawar, Martini, 2022	• Flexibility • Collaboration • Dynamicity • Technology • Facilitator	A **dynamic learning environment** is one that is constantly changing and adapting to meet the needs of learners. It is characterized by flexibility, collaboration, and the use of technology to enhance learning experiences. In a dynamic learning environment, learners are encouraged to take an active role in their own learning, and teachers act as facilitators rather than lecturers. This type of environment allows for personalized learning experiences that are tailored to the individual needs and interests of each learner.
Lee and Tan, 2023	• Individual and collective learning strategies • Social strategies • IT strategies • Enterprise oriented strategies	A **workplace learning environment** is the set of supporting features, individual learning strategies the respective enablers and challenges of each category of strategies.
Ching Lee and Yiang Tan, 2023	• Resources • Technologies • Collaboration and interaction	**Learning spaces** are places can enable and enhance digital innovation by providing access to necessary resources and technology, promoting collaboration and interaction among learners, and establishing clear expectations and guidelines for behavior and participation.

Table 3. Evolution of the definition of learning space

Another distinction emerging from the literature analysis concerns the contexts of implementation and development of a learning space. The main discernment regards learning spaces situated and developed in public educational organisations, i.e. schools, universities, and learning spaces linked to private organisations.

An **educational learning space**, already discussed in the previous chapter, is recognized as a virtual location or physical place within an educational institution, such as a classroom, a laboratory, a lecture room or a workshop, where knowledge is created, shared and applied, and learning processes and experiences are organized (Müller and Wulf, 2022; Erdoğdu and Çakıroğlu, 2021; Greasley and Bennet, 2014; Alavi, M., Marakas, G. M., & Yoo, Y. 2002).

On the other hand, **organisational learning spaces** are in-house organisational initiatives or independent spaces that cooperate or distribute services to public and private organisations. Heiskanen and Heiskanen (2011), in their study, analyze “spaces of innovation”, which are spaces that cross the organisation's boundaries, embedding the conditions for knowledge, learning and innovation activities in the company's daily life. Whilst Illeris (2004) and Lee and Tan (2022) identify “learning space” as a workplace learning space and internal strategies implemented in physical,

digital and mental organisational's spaces.

The objective of learning spaces, in an organisational context, is to support the development of competences that are functional in triggering and nurturing the development of continuous innovation through the management of knowledge dynamics, and specifically, of organisational learning dynamics (Lee and Tan, 2023). Thus, the concept of learning space can be associated with all those operational contexts aimed at developing the basic, distinctive and dynamic competences of an organisation, as well as increasing its innovative capacity: a multidimensional space that integrates dimensions linked to physical, social, cognitive, technological, epistemological, cultural, emotional, intellectual/psychological and relational factors.

Consequently, the "learning space" notion is an umbrella concept, including alternative configurations of spaces that have the aim to enhance and foster learning processes and knowledge management initiatives. Following the critical analysis of the papers, all the elements of novelty, characterizing the evolution of the learning space, and already pointed out, are deeply and critically analysed in the following paraghraphs.

3.3.3. Distinctive dimensions of a learning space: and their role in learning and knowledge dynamics

A learning space is not neutral but may significantly impact the learning process, knowledge management dynamics and outcomes (Kuokkanen, and Van der Rest, 2022). From the literature review it appears that the role of the human resources is just as important as the physical infrastructure, which consists of the space itself as well as the organisational and technical instruments. Among the human resources are individual actors, with their psychological and emotional traits as well as the connections between them that support and impact cultural and experiential processes. In consequence, learning spaces enable and catalyze knowledge and learning dynamics, supported by a tangible and intangible infrastructure that fosters open, honest, and receptive interactions among the stakeholders involved that integrate the space in their daily life (Delgado et al, 2020).

Identifying, understanding and managing the different dimensions of a learning space results of vital importance because it involves recognizing the interrelationships between different components and dimensions, simplifying complexity by constructing a model of reality (Grieves et al., 2005).
As already displayed in Tab.2, different researchers identify tangible and intangible components of a learning space that can vary or have different levels of importance according to their configuration, and context of application. For instance, in a virtual learning space, the technological tools have greater significance than the physical layout, whilst in interactive learning spaces, the key features include relationships and interactions.

A critical analysis of the of the papers, done through the SLR suggests that it is possible to identify some critical distinguishing dimensions and components of learning spaces. These dimensions cannot be considered separately because they are all interrelated and complement each other.

The first identified dimension recalls the actors involved in a learning space, their roles, and their individual characteristics. In fact, different researchers state the importance to recognize the impact of actors having different roles (Khandelwal, Kolte, Pawar, Martini, 2022; Müller and Wulf, 2022; Hilioui et al., 2020; Lancaster and Milia, 2015; Alessi, 2000) and the individuals' processes and mental or psychological dimensions (Heiskanen & Heiskanen, 2011; Arbaugh and Benbunan – Fich, 2006; Illeris, 2004) or

Other dimensions included are the tangible ones. Some authors identify the "physical space/ environment" (Lancaster and Milia, 2015). Some others, the "physical setting/layout" (Heiskanen & Heiskanen, 2011; Grieves et al., 2005) or the "physical context" (Arbaugh and Benbunan – Fich, 2006), the "physical conditions" (Alavi et al., 2002), or the "physical resources" (Greasley and Bennet, 2014, Ching Lee and Yiang Tan, 2023).

It is possible to summarise the different labels used by the authors with the epithet "Setting" to include the physical components characterizing also the virtual spaces. Moreover, given the growing relevance of learning spaces embedding technological devices (Alavi et al., 2002; Gilmore & Warren, 2007; Mueller & Strohmeier, 2011), the "Technologies&software" dimension will be considered separately to focus the analysis on the enablers and barriers that sustain or hinder the development of learning spaces based on technologies and advanced technologies.

From the papers analysed, emerged the significance of the spaces' intangible components, namely "relationships and networking", identified by the researchers also as a "social dimension/ context" (Illeris, 2004; Grieves et al., 2005), "social strategies" (Lee & Tan, 2023) "collaboration" or "interactions" (Ching et al., 2023).

Other key intangible elements are culture, climate, norms, values, methodologies and processes that distinguish the learning space. (Lee and Tan, 2023; Csizmadia et al., 2022; Yan et al., 2022; Nashaat et al., 2022; Mojtahedi et al., 2020; Wannapiroon & Petsangsri, 2020; Erdoğdu and Çakıroğlu 2021; Zakaria et al., 2019; Aggarwal, 2017; Dai & Bal, 2009; Jurasaite-Harbison, 2009; MacNeil et al., 2009) For the purpose of this study, they will all be considered in the same dimension, labelled as "Organisational culture, atmosphere, methods &practices."

In sum, the key components and dimensions derived from the literature analysis are: i) actors; ii) setting; iii) technologies&softwares; iv) relationships&networking; v) Organisational atmosphere culture, methods & practices (fig.7).

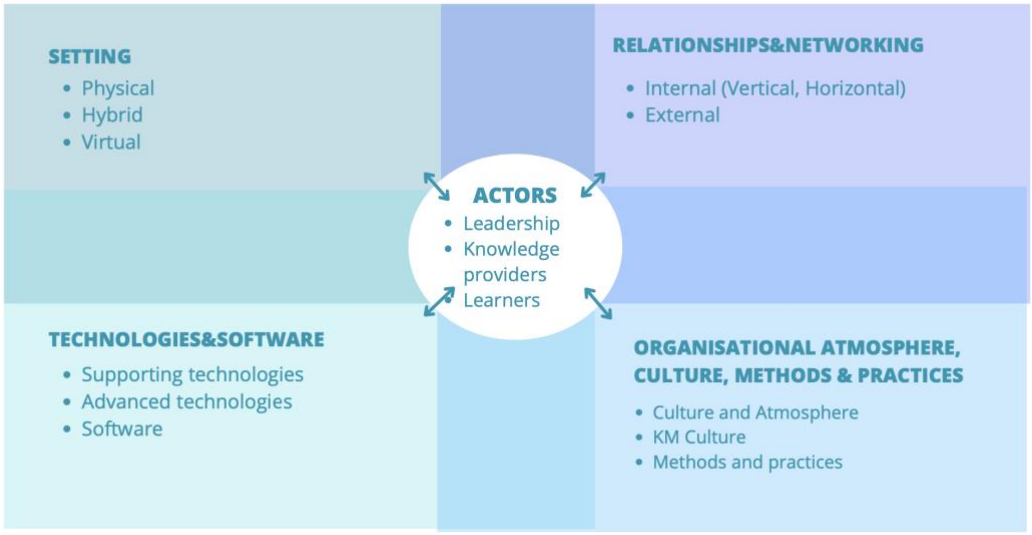


Figure 7. Conceptual framework: distinguish dimensions of a learning space

In the following, according to the analysis of the papers, done with the SLR, each dimension and sub-dimension will be deeply analyzed and discussed.

	Key insights	***Sub - dimensions***	***References***
Actors	This dimension identifies the actors involved in the learning process and their soft characteristics and competences.	• ***Leadership*** *(leaders, decision makers, managers, organizers)* • ***Knowledge providers*** *(e.g. teachers, professors, researchers, mentors, entrepreneurs, facilitators, etc.)* • ***Learners*** *(internal or external: e.g. learners, students, organisations, managers, employees, staff etc.)* • ***Mental dimension*** *(knowledge, competences and strategies of individuals involved, e.g. digital skills, soft skills)*	(Lee and Tan, 2023; van Riesen et al., 2019 Sankari et al, 2018; Lancaster and Milia, 2015; Mihalca et al., 2011; Jurasaite-Harbison, 2009)
Setting	The setting of a learning space refers to the physical spaces and tangible objects in which learning happen(excluding technological resources).	• ***Virtual*** *(eg. individual space characteristics)* • ***Hybrid and physical*** *(furniture, lights, colors, decorations, dynamic space, flexibility and adaptability, layout of the class, spaces and arrangements, study spaces, collaboration spaces.)*	(Christensen et al., 2023; Jens and Gregg, 2022; Berbegal-Mirabent et al, 2021; Sasson et al, 2021; Dleikan et al., 2020; Sankari et al, 2018; Osorio et al, 2017; Lancaster and Milia, 2015; McLaughlin & Faulkner, 2012; Heiskanen & Heiskanen,

			2011)
Technologies & Software	The technological resources in a learning space are a combination of technological tools, software and infrastructures that contribute to the realization of learning processes, supporting and enriching knowledge and learning activities.	• ***Supporting and basic technologies****- (e.g. platforms, tablets, smartphones, webcam, projectors, digital whiteboards, platforms, headphones, digital watches etc.)* • ***Advanced and 4.0 technologies*** *(e.g. artificial intelligence, virtual reality, 3D printers, augmented reality, metaverse, big data, internet of things, additive manufacturing, machine learning, smart factory etc.)* • ***Software***	(Abdalina et al., 2022; Ali et al., 2022; Ghani et al., 2022; Lee and Tan, 2022; Lu, 2022; Reyes-Mercado et al., 2022; Hines and Netland, 2022; Upadhyay and Khandelwal, 2022; Safdar et al., 2022; Snieder and Zhu, 2020; Eisenbardt, 2021; Renz & Vladova, 2021; Akdere et al., 2021; Sasson et al, 2021; Delgado et al, 2020; Hliouli et al, 2020; Latrous & Khadraoui, 2020; Rasheed et al, 2020; Marta, 2019; Borge et al, 2018; Gdanetz et al, 2018; Aouf et al., 2017; Lau, 2015; Mahenge & Mwangoka, 2014; Olsen et al., 2011; Huang et al., 2010; Jurasaite-Harbison, 2009)
Relationship &Networking	This dimension identifies the system of interactions between internal and external actors.	a. ***Internal*** *i.* ***Horizontal*** *(e.g. workgroup, peer relationships)* *ii.* ***Vertical*** *(e.g. scaffolding, supporting relationships, mentoring, leadership, etc.)* b. ***External*** *(e.g. partnerships; coaching)*	(Abuhassna et al., 2022; Ching Lee and Yian Tan, 2022; Müller and Wulf, 2022; Toiviainen et al., 2022; Bianchi & Vignieri, 2021; Delgrado et al, 2020; Elmadani et al., 2015; Esichaikul et al., 2013)
Organisational atmosphere, culture, methods &practices	This dimension identifies the mood, attitudes, practices, norms, sensorial qualities, and intangible resources that support learning processes and knowledge dynamics within a learning space.	a. ***Culture & Atmosphere*** *(e.g. open-minded culture, routine culture, flexible mindset, positive environment with* trust, cooperation, safety, risk-taking support, and equity, *formal or informal atmosphere, motivating and engaging environment, creative atmosphere, friendly atmosphere, academic atmosphere, active learning atmosphere, etc)* b. ***KM culture*** *(the willingness to transfer, create and share knowledge from tacit to tacit, tacit to explicit, and explicit to explicit)* c. **Methods and practices** Systems of methods, practices and procedures that providers use to support and enrich the learning	(Lee and Tan, 2023; Black & Mischel, 2023; Montiel-Ruiz et al., 2023; Gupta & Priyanka, 2023; Lazzari, 2023; Abuhassna et al., 2022; Csizmadia et al., 2022; Yan et al., 2022; Nashaat et al., 2022; Mojtahedi et al., 2020; Wannapiroon & Petsangsri, 2020;; Erdoğdu and Çakıroğlu 2021; Akhmetshin et al., 2019; Burusic, 2019; Maheshwari & Seth, 2019; Zakaria et al., 2019; Xu et al., 2018; Corney, 2018; Song et al., 2018; Filippou et al., 2018; Aggarwal, 2017; Dai & Bal, 2009; Jurasaite-Harbison, 2009; MacNeil et al., 2009)

		processes and knowledge dynamics. *(e.g. project/ problem based- learning, design thinking, storytelling, collaborative communities, web-based videos, narrated stop-motion animation, modeling, gamification, simulation, flipped classrooms, content-driven process etc.)* The topics, themes, concepts and facts, often grouped in subjects, that are expected to be learned (e.g. economics, entrepreneurship, digitalization, STEM subjects etc.)	

Table 4. Infrastructural dimensions of a learning space

Actors

The success of a learning space strongly depends upon the actors, how they are engaged within the facility, and how they interact with each other (van Riesen et al., 2019 Sankari et al, 2018).

The nature of people or users involved in learning spaces is vast. According to the literature, three types of knowledge actors can be identified in a learning space: leaders, learners and individuals providing knowledge.

Lancaster and Milia (2015) sustained that **leadership** is the most influential factor in creating a supportive and effective learning environment. They are responsible for managing the resources and infrastructure of the learning space and ensuring that the learning space is suitable for learning. The administration and leadership of the learning space create opportunities and stimulate learning, which empowered the knowledge providers to make many decisions about what, when, and how they are going to teach. Administrators and other community members provide support and contribute to the overall atmosphere and culture of the learning space. This role may coincide with transformative leaders, innovation managers, researchers, mentors, and entrepreneurs.

Primary **learners** are the main character and target of a learning space. They engage in various learning activities and can be an internal or external targets; some examples are students, managers, organisations, employees and staff. They are considered central actors, seen as an active developer of their own learning, engaging in authentic learning and knowledge processes (Jurasaite-Harbison, 2009). They are the individuals who are seeking to acquire new knowledge, skills, or attitudes through the learning process and peers who can provide support, feedback, and collaboration opportunities for each other (Lancaster and Milia, 2015).

On the other hand, **knowledge providers** support learners, acting as coordinators who facilitate the interactions, exchange, and development of knowledge. These individuals facilitate learning by designing and delivering learning activities, providing feedback, guidance and supporting learners. They are responsible for creating a positive and engaging environment. In particular, teachers play a significant role in creating a learning culture in a space. They assume great relevance, are the catalyst and act as facilitators of the learning processes. This role may coincide with teachers, professors, facilitators, organizers (Sankari et al., 2018; Mihalca et al., 2011; Jurasaite-Harbison, 2009).

Further studies state the importance of a psychological and mental dimension that include attitudes, beliefs, emotions, prior knowledge and skills of the individuals involved and how they impact their learning processes. Moreover, it includes learning strategies and approaches that individuals adopt to acquire knowledge and skills aligned with a successful performance (Lee and Tan, 2023; van Riesen et al., 2019; Lancaster and Milia, 2015; Mihalca et al., 2011). This category entails strategies that involve self-initiative and self-efforts, self-exploration, problem-solving, reflecting and critical thinking as well as skills that relate to the propensity and the use of digital technologies. (Lee and Tan, 2023) Prior knowledge, which may cover several contents and skills, interacts with other variables to influence learning outcomes and can be further enhanced through a culture oriented to knowledge and the interactions among actors.

Concerning the strategies related to the use of digital technologies, according to the up-to-date literature, the actors are main characters when technologies and advanced technologies are implemented in a learning space. Their interactions with the technologies are crucial for allowing the success and the effectiveness of technology-enhanced learning and knowledge exchange within the space because they may create dynamic and engaging experiences, if developed effectively. However, the strategies and interactions are never one-way because actors should have the right predisposition and be properly skilled to interact with the technologies but, at the same time, the technologies have an influence on actors' attitude, emotions and knowledge, fostering or obstructing their motivation and engagement (Lazzari, 2023; Lee & Tan, 2023). This was also true in the educational context. According to the literature, to be skilled, actors need to participate to training courses and seminars, to increase their digital competence. However, technical skills are not enough, digital competence requires a full change of mindset, that allow people to develop their own technology-enhanced strategy that involves positive attitude, self-initiative and self-effort. To develop this kind of strategy, leadership is fundamental. They have to be supportive and provide guidance and effective instruction, also aimed to overcome the barriers for the use of technologies such as overload of information, and time constraints. The lack of effective guidance may hinder the understanding of the potential and the usefulness of digital and advanced technologies, making difficult their effective implementation (Lee & Tan, 2023).

This dimension is also strictly linked to the "Organisational atmosphere, culture , methods &practices" because organisational atmosphere and culture is defined and enhanced by the single individuals that interact within a learning space (Csizmadia et al., 2022).

Setting

Learning spaces emerge as places where learning and knowledge dynamics are activated and supported. The management literature has highlighted that setting influences dynamics, interactions and processes, as well as individuals' skills development and behaviour definition. Consequently, attention to detail is essential to impact the learning space's effectiveness positively.

According to a critical literature analysis, the "setting" denotes the physical and hybrid or virtual spaces.

The setting of a **physical** learning space refers to the physical space or spaces in which learning

happens and its tangible objects (Berbegal-Mirabent et al, 2021; Sankari et al, 2018).

The setting of a **virtual** learning space refers to the physical space in which learning occurs, such as the learner's home or workplace. While the physical layout may not be as prominent in online learning environments as in traditional face-to-face settings, it can still impact learning outcomes. For example, learners may need a quiet, comfortable space to focus on their studies and access appropriate technology and resources (Erdoğdu and Çakıroğlu, 2021).

In the setting of a learning space, there are **individual** and **common spaces**. Scholars have discussed some key characteristics of such areas, which are furniture, seating arrangements, lighting, temperature, decorations and acoustics (Sasson et al., 2021). Furniture facilitating the interactions between actors, tools and the environment is preferred. At the same time, the quality of the air, luminous colour and light can help develop a favourable and stimulating learning space (Sankari et al, 2018; Osorio et al, 2017). The physical setting may include single or multiple wide spaces with adjustable tables, exhibition stages, and resting and cooking areas (Dleikan et al., 2020; Jens and Gregg, 2022). Generally, an effective learning space design favours engagement, creativity and collaboration and supports various learning activities, such as individual work, group work, and presentations. Comfort and ergonomic design are other key features that can help to reduce physical strain and fatigue, supporting engagement and motivation (Ching Lee and Yian Tan, 2022).

According to Lancaster and Milia (2015), the component of the physical setting can positively impact on safety and accessibility of the learning space, as well as the ability of learners to focus and engage with the materials. For example, a well-lit, ventilated area with comfortable seating and appropriate technology can enhance learning outcomes by promoting a positive and conducive learning environment. On the other hand, learners may be distracted or uncomfortable in an environment that is not conducive to learning (Gilmore and Warren, 2007).

An essential factor to keep in mind about the design of the LS's setting is to ensure accessibility, this entails implementing organisational and technological solutions to guarantee support to all learners (Lee & Tan, 2023).

All the design elements characterizing the space must merge into a synergistic whole (Christensen et al., 2023).

Technologies and mostly advanced technologies have a significant impact on the design and setting of learning spaces, transforming the way knowledge is delivered and experienced. Buncher et al., (2022), in this vein, stated that technologies should be considered as integral part of the design of the space. In fact, when technologies are included in a LS, various factors impact its layout, and concurrently, advanced technologies such as AI, VR and AR may increase the flexibility of the space (Renz & Vladova., 2021).

Furniture, lighting, acoustics, and seating arrangements should be modified to ensure optimal visibility for all learners and to mitigate noise, fostering an environment conducive to learning. This entails the implementation of enablers that support all the phases of technological implementation. Some examples are tools that ensure the connectivity, and the maintenance of a stable and functional technological infrastructure (Lee & Tan, 2022).

In sum, researchers pointed out that creating effective learning spaces means orienting and designing them towards the learner and the learning processes, taking account of some strategies, i.e., i) Providing comfortable and flexible options to help learners feel more relaxed and engaged in learning activities; ii) using pleasant lighting to help create a more pleasant and inviting environment; iii) controlling and maintaining a comfortable temperature; iv) developing a visually appealing environment with colourful decorations and displays can help stimulate learners' interest and engagement; vi) providing easy access to resources, such as books, technology, and other learning materials; vii) develop the physical setting taking account of the technologies implemented (Khandelwal, Kolte, Pawar and Martini, 2022; Heiskanen & Heiskanen, 2011; McLaughlin & Faulkner, 2012).

Technologies and software

The technologies and software dimension contemplates a combination of technological tools, infrastructures and software that enhance the learning and knowledge processes and dynamics. Different technological tools can foster or prevent impacts on the learning processes, enhance digital innovation and provide new learning opportunities. (Jurasaite-Harbison, 2009). Consequently, the design and management of the dimensions of a learning space must be associated with choosing the appropriate tool to exploit their potential and maximize the value added (Sasson et al, 2021; Delgado et al, 2020; Rasheed et al, 2020).

According to the literature, the technological dimension is considered a critical factor in the success of a learning space, as it enables learners to access a wide range of educational content and resources and to engage in active, experiential and collaborative activities. They provide individuals with means for representing knowledge in multiple ways for accessing information, facilitating communication, and enabling learners to practice and receive feedback (Sasson et al., 2021; Borge et al., 2018).

The COVID-19 pandemic, and the consequent security measures, acted as a catalyst and an accelerator for the adoption of digital technologies by most public and private organisations (Ali et al., 2022; Eisenbardt, 2021; Marta, 2019; Reyes-Mercado et al., 2022). According to Eisenbardt (2021), the technological changes undertaken by learning spaces during the COVID-19 pandemic included the implementation of software and hardware solutions (e.g. video conferencing tools, cloud computing, and virtual desktop infrastructure) aimed at enabling remote access to educational resources and facilitating communication and collaboration among students and knowledge providers (Eisenbardt, 2021).

The literature discussed various technological tools, mainly supporting and basic tools, advanced and 4.0 technologies and software. Examples of basic technological assets and software supporting learning and knowledge dynamics are platforms, computers, mobile phones, tablets, projectors, eReader, headphones, digital watches, digital whiteboards, learning management systems, etc. (Abdalina et al., 2022; Aouf et al., 2017; Ghani et al., 2022; Latrous & Khadraoui, 2020; Mahenge & Mwangoka, 2014) Video conferencing tools and software (e.g. Zoom, Microsoft Teams, or Google Meet) support real-time communication and collaboration among knowledge providers and learners, as well as among learners themselves, while learning Management Systems (LMS) are software that provides a platform for managing and delivering online programs (Hliouli et al, 2020). Moreover, to facilitate the usage of tools in the learning space, enablers such as power outlets, data ports, and Wi-

Fi access points must be installed. To guarantee a clean and organized setup, proper cable management and infrastructure architecture are required.

Then there are devices such as smartphones, computers and tablets that can be used to deliver content and activities anytime and anywhere with audio and visual multimodalities that enhance learning processes and knowledge management dynamics (Reyes – Mercado, 2022; Lee and Tan, 2022; Hliouli et al, 2020)

Other examples of **basic and supporting technologies and software** presented in the literature are social media, which may facilitate communication and collaboration among learners and knowledge providers, enabling knowledge-sharing and peer support; educational assessment tools, i.e. Kahoot, Quizlet or Socrative, and information sharing tools such as Google Drive, Dropbox, and OneDrive (Safdar et al., 2022; Lee and Tan, 2022; Hliouli et al, 2020).

Concerning more **advanced technologies**, they can contribute to the enrichment of learning, enhancing the learning strategy and institutionalizing continuous learning and the protocol for sharing and transforming knowledge. Some representative examples pointed out in the literature are the Internet of Things (IoT), augmented and immersive reality, digital platforms, Metaverse, sensors, algorithms, adaptive learning platforms, and other smart technologies that facilitate interaction and collaboration in the learning process (Abdalina et al., 2022; Akdere et al., 2021; Renz & Vladova, 2021; Lau, 2015; Olsen et al., 2011; Huang et al., 2010). The literature also highlights the importance of data analysis and predictive modelling in identifying student dropout cases and developing personalized learning solutions.

Stable, functional and innovative are the key characteristics required for the technological infrastructure and if it enriches the learning and knowledge dynamics (Sasson et al, 2021; Gdanetz et al, 2018). A learning space based on advanced technologies does not ensure effective learning processes per se; learning and knowledge dynamics must be integrated with the choice of suitable technological tools and methodologies. In this regard, new digital technologies have the potential to become powerful and potential changing agents and strategic allies for sustainable and inclusive development of innovative, cheaper and more user-friendly learning spaces and effective knowledge creation and exchange.

Different authors analysed the use of advanced technologies within a learning space through case study analysis. For instance, Lu (2022) conducted a case study analysis about using virtual reality (VR) technology in a learning space. The VR supported the development of an interactive and immersive learning environment that allowed learners to visualize and interact with complex concepts and structures. On the other hand, augmented reality (AR) technology overlays digital and virtual assets into the real world, providing learners with additional information and context to enhance the learning experience with interactive and engaging content. If combined with the choice of appropriate methodologies, they may bring thousands of possibilities for reshaping the conventional learning experiences and facilitating the organisational learning processes (Lau, 2015; Hliouli et al, 2020).

Moreover, Jurasaite-Harbison (2009) and Borge et al. (2018) discussed other advanced technologies, such as robots, blockchain technology and 3D printers, that may be used in a learning space to enhance security, creativity, transparency, and efficiency. 3D printers, for instance, are implemented

to enhance learners' creativity and problem-solving skills and allow learners to design and create physical objects and prototypes (Lau, 2015).

One recent development is Metaverse which was born from the convergence of the previously presented technologies, specifically VR and AR. Within a Metaverse, actors can interact, meet, socialize and work through digital avatars or holograms (Upadhyay and Khandelwal, 2022).

The latest development concerns Artificial intelligence (AI). According to Renz and Vladova (2021), learning spaces are currently at an early stage of incorporating AI into learning and knowledge processes and dynamics. Despite this, AI tools have great potential to personalize learning experiences for learners by analyzing their learning patterns and grade assignments and providing feedbacks. Renz and Valdova (2021) also underline the necessity to develop an AI system that complies with human values without posing risks to humanity. They also sustain that, despite the uncertainty, AI systems used currently enhance already existing technology by providing learners with personalization of their learning patterns, knowledge, and interest in a field.

Learning spaces based on advanced technologies can have different benefits that maximize the potential of the digital tool implemented. Some examples of potential benefits are i) the immersive nature of the experience; ii) the ability to work virtually in remote or unsafe environments; iii) the flexibility of the approach , iv) A remarkable, amazing learning experience that may be exciting, fun and enjoyable; v) personalized learning paths and contents that tailor learning experiences to individual learners (Hines and Netland, 2022; Renz and Valdova, 2021; Al – Khanjari, 2021; Snieder and Zhu, 2020).

However, different researchers also acknowledge the limitations of technology, such as the need for effective data preprocessing and the potential for technology to create a sense of isolation and disconnection among learners. In this vein, the individuals involved in a learning space have to best integrate the technologies into the functioning mechanisms of the space.

Another essential consideration that emerged from the analysis of the literature concerns privacy. Learning spaces should have policies and procedures to protect actors' privacy, such as obtaining consent for data collection and use, ensuring that data is stored securely, and limiting access to sensitive information. Additionally, learning spaces should allow students to control their own data, such as the ability to delete or modify their personal information (Safdar et al., 2022; Al – Khanjari, 2021; Jurasaite-Harbison, 2009). However, ethical issues arise mostly with the usage of technologies (such the AI) that require a large amount of learner data and sensitive information (Renz & Vladova, 2021).

Organisational atmosphere, culture, methods &practices

This dimension includes the tangible and intangible resources that support learning processes and knowledge dynamics within a learning space.

Specifically, it includes methodologies, contents, materials and resources available to support learning. **Learning methodologies** are systems of practices and procedures that providers of knowledge employ to develop a learning process. Some methodologies may include project/problem-based- learning, design thinking, storytelling, collaborative communities, web-based videos, narrated

stop-motion animation, modelling, gamification, simulation, flipped classrooms, content-driven processes, etc. (Gupta & Priyanka, 2023; Montiel-Ruiz et al., 2023; Lazzari, 2023; Wannapiroon & Petsangsri, 2020Mojtahedi et al., 2020; Maheshwari & Seth, 2019; Filippou et al., 2018).

According to the literature, a key aim for developing new learning spaces is to understand what methodologies support and favour the introduction of technologies (Gupta & Priyanka, 2023; Filippou et al., 2018). The strategy implemented should indeed be in line and support specific technological tools and, simultaneously, the choice of the tool should be at the centre of the LS design process (Buncher et al., 2022).

On the other hand, **topics are themes, concepts and facts**, often grouped into subjects, that are expected to be learned (e.g. economics, entrepreneurship, digitalization, STEM subjects etc.) (Aggarwal, 2017; Akhmetshin et al., 2019; Black & Mischel, 2023; Nashaat et al., 2022; Song et al., 2018; Yan et al., 2022; Zakaria et al., 2019).

Culture is an important aspect of a learning environment as it identifies the mood, attitudes, expectations, practices, norms and sensorial qualities distinguishing a learning space. It influences the effectiveness of the space, increasing or preventing motivation, attention, creativity and the level of involvement of people. A learning space includes constructs concerning the experiences lived by the individuals involved, influenced by their behaviour (needs, goals, influences, memories, beliefs, political, social and economic events) as well as the environment (Dai & Bal, 2009; Jurasaite-Harbison, 2009; MacNeil et al., 2009). To develop spaces oriented towards the development of advanced technologies, the key insight, emerged from the literature, is to develop a supporting digital culture, where actors are open and willing to easily interact with the technological tools (Buncher et al., 2022; Lee & Tan, 2022).

The quality of a learning space is strongly influenced by the nature and orientation of the actor's culture (Pawlowski et al., 2020; Corney, 2018). A positive learning environment promotes open-minded culture, flexibility and willingness to engage in innovative activities. It provides opportunities for learners to explore new ideas and concepts and to develop critical thinking and problem-solving skills (Burusic, 2019; Dai & Bal, 2009; MacNeil et al., 2009; Xu et al., 2018).

Therefore, a positive learning culture is characterized by open communication, and a growth mindset. Learners feel comfortable expressing their ideas and opinions, and knowledge providers create a safe and supportive environment for learning. A continuous learning and improvement culture is also emphasized, where learners are encouraged to reflect on their learning and set goals for future growth.

Developing a solid knowledge culture is a crucial determinant of the learning space's effectiveness. In fact, knowledge culture drives, encourages and supports behaviours aimed at researching, sharing, developing, and applying knowledge. Along with the organisational culture, personal attitudes also play a fundamental role in influencing knowledge and learning dynamics, as mentioned above. Consequently, willingness to share knowledge and collaborate contribute to the development of the learning process (Abuhassna et al., 2022; Csizmadia et al., 2022; Karkoulian et al., 2013; Ko et al., 2019; Yusupova et al., 2016). A favourable culture and energy translate into the behaviour of people who appear involved, focused and motivated, dedicating themselves to developing, distributing, exchanging, and transferring knowledge (Stern et al., 2020; Pawlowsky et al., 2020; Corney, 2018).

The **atmosphere** of a learning space refers to the norms and expectations that guide interactions among learners and knowledge providers and the creativity, collaboration, inclusivity fostered within the learning space. A positive learning atmosphere is supportive and friendly, encouraging active participation, critical thinking, and constructive feedback. It also values diversity and promotes a sense of community and belonging among learners. The atmosphere can be formal in traditional learning processes or informal in unstructured settings (Jung et al., 2018).

According to Erdoğdu and Çakıroğlu (2021), the use of humour and storytelling can also help to create a positive and engaging atmosphere in a learning space. In fact, their study found that humour positively affects cognitive engagement, including understanding, problem-solving, cognitive effort, and redirecting to different source materials.

Culture and atmosphere are defined by the individuals involved who create, share and transform knowledge and are the main characters of the learning process. Facilitators have a fundamental role in stimulating relationships and enabling interactions among individuals. They must know how to foster an innovative learning climate which eliminates prejudices and hierarchical levels. The facilitator considers all actors involved at the same level and makes them feel confident in expressing their opinion and confronting with the others (Sasson et al, 2021; Sankari et al, 2018; Fuzi, 2015; Merkel, 2015). From the literature analysis emerged some strategies for creating a positive culture and atmosphere in a learning space, i.e., i) Encouraging open communication among all actors involved; ii) celebrating and promoting diversity and cultural awareness to help learners feel valued and respected; iii) fostering a sense of community to promote engagement and collaboration; iv) Providing opportunities for active learning and hands-on experiences; v) Fostering a sense of community and belonging among learners; vi) Developing a digital culture (Khandelwal et al., 2022; Ching Lee and Yian Tan, 2022)

Relationships and networking

The relationship and networking dimension concerns the system of interactions between internal and external actors that take place in the learning space. According to the literature, the design of the learning space has to promote positive relationships and a sense of belonging.

Learners and providers continuously engage with each other and with the learning space. The interactions can be horizontal, vertical and external. **Horizontal and vertical interactions** can take various forms, such as verbal communication, written communication, scaffolding, collaboration activities, feedback, and reflection. Effective interactions are essential for creating a positive learning environment that fosters engagement, motivation, and learning outcomes. In a physical setting, interactions may occur through face-to-face discussions and group work, whilst in an online learning environment, interactions may occur through discussion forums, video conferencing, and other digital communication tools. Concerning **external interactions**, according to the literature, physical proximity increases communication, face-to-face contact, and knowledge spillovers. In this vein, clusters of organisations with a high level of linkage between them with universities and R&D, centres can foster successful learning environments (Bianchi and Vignieri, 2021; Toiviainen et al., 2022).

Effective interactions require active participation, mutual respect, and a willingness to engage in constructive dialogue and feedback (Abuhassna et al., 2022; Elmadani et al., 2015; Esichaikul et al., 2013).

Generally, the basic assumption is that fruitful relationships enhance knowledge and learning dynamics. In a learning space, the interactions between individuals who are directly involved, between individuals and facilitators and with external actors translate into relationships that contribute to value creation in terms of new skills, new knowledge and a higher level of innovation (Delgrado et al., 2020).

Buncher et al. (2022) and Renz & Vladova (2021) stated that quality communication and relationships are fundamental for effective technology implementation and use. Better communication and work team activities support and foster new opportunities. On the other hand, the absence of a sharing culture may hinder the usefulness of the technological tools because of a more limited mindest. In this vein, Buncher et al. (2022) sustained that helpful and knowledgeable colleagues and supportive leaders are able to balance the need of digital competence and sharing culture, allowing less technological skilled people to fill their gaps. Implementing communication platforms can further support the development of helpful relationships.

According to the literature analysis, it resulted that relationships and networking dimension is considered one of the critical dimensions in a learning space because it can significantly impact learners' engagement and motivation and, consequently, learning outcomes. Networking and relationship development can help learners establish a connection with their providers and peers, which can facilitate and support learning and knowledge processes. In addition, supportive colleagues and effective communication platforms can enable learners to adopt social-leveraged strategies, such as knowledge-sharing and collaboration, which can enhance their learning experience. However, time constraints, disruption, and the absence of a sharing culture can also challenge these strategies (Ching Lee and Yian Tan, 2022; Müller F.A.; Wulf T., 2022).

3.4.Management and assessment of a learning space

The analysis of academic literature reveals the importance given to the management and assessment of learning spaces. In fact, managing and assessing phases and methods are vital to ensure their effectiveness, achieving goals and objectives and triggering a virtuous cycle of improvement (Reyes Mercado, 2022; Greasley and Bennet, 2014; Grieves et al., 2005).

The learning space must be carefully considered across all stages from design, planning, management and evaluation to ensure readiness and effectiveness, supporting engaging learning experiences, and empowering learners and knowledge providers. An essential condition is the development of a plan that starts with defining objectives and results to achieve. In this vein, from the literature analysis, it emerged the importance given to the definition of the strategic intent behind the development of a space and the value that the space aims to create and deliver to its target or to develop it together with the actors involved (Csizmadia et al., 2022; Kuokkanen & der Rest, 2022; Sońta, 2022).
Specifically, the value proposition delineates the learning space's distinctive purpose, which may concern developing specific individual or organisational skills, or innovation. Therefore, the value to generate must be clearly defined, including goals, objectives, and metrics for success. This can ensure

that all actors are aligned, working towards a common goal and developing an effective strategy (Pawlowsky et al., 2020; Corney, 2018). Moreover, a clearly defined value proposition is also needed for assessing the space and the activities developed because it measures learners' progress and makes the required adjustments in case of need. The strategy derived from the value proposition should follow a step-by-step implementation that foresees the lectures' design and contents, matched with the tangible and intangible infrastructure tools better suited to the objectives and the context (Arvind Mallik, 2018).

Managing a learning space means creating an environment that supports learners in their learning and knowledge processes. Specifically, effective management of a learning space involves several management actions, among them:

- providing resources and materials that are relevant to the learners,
- creating a safe and welcoming physical space, and
- establishing clear expectations and guidelines for behaviour.

Effective management also involves building positive relationships with learners and creating opportunities to enhance and improve their learning experiences (Jurasaite-Harbison, 2009).

Some authors proposed tools to manage the specific dimensions of a learning space; for example, Al-Khanjari (2021) proposed a framework for managing the relationship and networking dimension, making the interactions between students and instructors more intelligent, while Schobel & Scholey (2012) stated the importance of defining and managing economic resources and financial strategies. In this vein, the authors argue that learning spaces with well-defined financial strategies are linked to positive outcomes and are well-positioned for success.

Overall, managing a learning space or learning environment requires a holistic approach that considers the actors' needs and goals, considers all the infrastructural dimensions derived from the literature review, and encourages active engagement and participation. Understanding learning spaces' management dynamics and principles is essential to determine the effectiveness of the space but has yet to receive much attention, especially in the management literature (Reyes-Mercado, 2022).

Assessment, on the other hand, is also vital and can have a significant impact on management, learning dynamics and outcomes for various reasons: i) the evaluation of learning space and the activities organised allow the suitability of the environment (Grieves et al., 2005); ii) it is a way to identify strengths and weaknesses, factors that facilitate or hinder learning; iii) it is a way to determine areas for improvement and guide the decision-making. In fact, organisations, through assessing their learning spaces and organised activities, identify gaps and guide decision-making (Lancaster & Milia, 2015).

Assessing a learning environment can be done through various methods, including surveys, observations, and interviews. Observations can provide insights into the physical environment, such as the layout of the space and the availability of resources for learning. Interviews with learners can provide information on their perceptions of the learning space, including the level of support for learning, the availability of learning opportunities, and the effectiveness of leadership in promoting learning (Borge et al., 2018).

Despite the growing importance, the tools proposed in the literature focus on specific dimensions or are developed primarily in public organisations.

For instance, some assessment tools proposed in the literature are developed to evaluate the performance dimensions linked to the individuals' satisfaction, competencies and behaviour, neglecting other performance dimensions that could provoke long-term impacts. Hilioui et al. (2020) focused on developing tools to predict learner disengagement and dropout in learning spaces using machine learning and pattern recognition techniques. Other examples of indicators are i) user satisfaction, which gathers feedback from learners and knowledge providers about their experience using the LS; ii) learning outcome, to understand if the LS effectively support competencies development (Hilioui et al., 2020) and iii) learning analytics, used to track and analyse data about learner behaviour and performance in the learning space. This can include data on engagement, participation, and behaviour (Salinas-Navarro et al., 2023; Lancaster & Milia, 2015).

With the increasing use of technology, there is a growing interest in exploring how the effectiveness of learning spaces incorporating digital and advanced technologies and the factors influencing them can be assessed and how they can be improved to better support learning and knowledge dynamics Ahmad et al., 2023).
In this vein, Reyes-Mercado (2022) developed a framework to assess the technological dimension's performance. In fact, monitoring technical performance can help identify any issues or areas for improvement in the LS's functionality and better assess learners' unique features about learning outcomes mediated by technologies.
However, Salinas - Navarro et al., (2023) stated the need to continue exploring the variables related to the effectiveness of learning spaces including digital technologies to enhance learners' motivation, interest, and engagement. In this vein, different studies emphasise the importance of gathering feedback from learners and knowledge providers to ensure that the learning spaces meet the needs of all actors' needs (Reyes-Mercado, 2022; Müller F.A.; Wulf T., 2022; Erdoğdu and Çakıroğlu, 2021; Greasley and Bennet, 2014; Mueller and Strohmeier, 2011). Specifically, Pye et al. (2022) asserted the necessity of continuing to investigate on assessment feedback in learning spaces including digital technologies to support their design and management through valuable feedbacks. This concept become even more central when the learning spaces include advanced technologies as artificial intelligence (AI), Internet of Things (IoT), augmented and immersive reality, digital platforms, and Metaverse (Abdalina et al., 2022; Akdere et al., 2021; Renz & Vladova, 2021; Lau, 2015; Olsen et al., 2011; Huang et al., 2010). It follows that, considering the potential effects of advanced technologies on the various dimensions of the space as well as the space as a whole, a reconsideration of the design and management paradigm is necessary.

In sum, assessing and managing learning spaces, and specifically spaces including digital and advanced technologies emerged from literature as an essential area of research and practice, still explored fragmentedly (Wu et al., 2019).

3.5.A working definition of technology-enhanced learning spaces

A holistic approach was applied to revise the management literature, which considered the space in a multi-dimensional perspective. Consequently, some critical aspects and interpretative dimensions distinguishing Learning Spaces have emerged and have been described, defining and analysing their characteristics and functioning.

The literature suggests that learning spaces, in management literature, are places where knowledge is created, shared, and applied; they may be described as spaces of interaction between individuals, their behaviours, and the external environment. In such a prospect, based on a systematic review of literature, this study carries out a clear and holistic understanding of infrastructural dimensions characterising a learning space, providing a consistent background for developing a conceptual framework.

From a theoretical viewpoint, the review contributes to further developing the literature about LS in management, analysing it as an umbrella concept that may be used to identify different space models. In this vein, it is necessary to derive a working definition of learning space suitable for all the contexts and configurations.
Specifically, it may be identified as a place where people having heterogeneous skills interact cooperatively to generate, manage and exchange knowledge, acquire skills and encourage opportunities that may trigger innovation dynamics. The atmosphere within these spaces promotes cooperation between the actors and should be free of hierarchical constraints and judgment. Specifically, the dimensions identified from the literature review are: i) Actors; ii) Setting; iii) Technologies&Software; iv) Relationships&Networking; v) Organisational atmosphere, culture, methods &practices. These dimensions are interrelated and mutually influence each other in defining and characterising a learning space.

What emerged from the concept's evolution is that nowadays, describing and defining a learning space without considering its virtual or technological components is impossible. Following a fast landscape's evolution, strong technological and digital components have become predominant and influenced and modified the structure and functioning of the Learning Spaces' dimensions. It follows that new configurations of Learning Spaces are also following the latest digital trends, consequently adapting spaces and the tangible and intangible infrastructure. In this vein, a readjustment of these dimensions has been highlighted in the previous paragraphs, considering the influence of digital and, specifically, advanced technologies on each dimension. It follows that, to identify cutting-edge learning spaces, it is necessary to define them as technology-enhanced learning spaces, whether they are virtual or hybrid by nature. Technology-enhanced learning spaces may incorporate various technologies to enhance learning and knowledge dynamics; from supporting to advanced technologies, the goal is to create interactive and engaging learning spaces that foster collaboration, creativity, and active participation (Abdalina et al., 2022; Ali et al., 2022; Ghani et al., 2022; Lee and Tan, 2022; Lu, 2022; Reyes-Mercado et al., 2022; Hines and Netland, 2022; Erdoğdu and Çakıroğlu, 2021).
It follows that a technology-enhanced Learning Space 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."***

3.6.Discussion

The research, at this stage, providing a systematic analysis of Learning Spaces in management

literature, corroborates studies highlighting the different dimensions characterizing design and functioning of a LS in management literature and the impact of the technological component (Abdalina et al., 2022; Ali et al., 2022; Lee and Tan, 2022; Lu, 2022; Reyes-Mercado et al., 2022). The conducted critical analysis of the literature suggests that for a successful development of Learning Spaces, is important to consider them in a multi-dimensional perspective, considering their tangible and intangible infrastructure and internal functioning. However, the infrastructure is not the only aspect that matters. In fact, as emerged from the review, key aspects to consider are management and assessment dynamics. It also emerges that the term "Learning space" is conceived as an umbrella concept, and the notion denotes different Learning Spaces that can be found in several context. Moreover, considering that describing and defining a learning space without considering its virtual or technological components is not possible nowadays, the working definition provided in this chapter considers “technology-enhanced learning spaces”.

However, the review highlights that the management literature provides tools to manage and assess the spaces focused on few dimensions and performances. Consequently, there is the space for further research on the management and assessment of learning spaces, particularly in terms of defining all the performance dimensions, selecting appropriate advanced technologies, providing training and support for knowledge providers and learners, monitoring usage and engagement, and continuously evaluating and improving the space and the activities organized.

Another aspect emerged from the literature review is the importance of defining a value proposition to guide the strategy definition and the management phases. In this vein, this research is aimed at analyzing technology-enhanced learning spaces conceived to boost continuous innovation through learning and knowledge dynamics. Heiskanen& Heiskanen (2011) suggests that define and effective strategy and managing spaces for innovation, recognizing the strategic value of knowledge, is essential to ensure their success.

Therefore, to understand if technology enhanced learning spaces are effective in boosting continuous innovation dynamics, it emerged the necessity to develop empirical research activities that examine multiple case studies, with managers of technology-enhanced learning spaces, to advance the debate on this research direction and answer questions such as: ***How to manage a technology-enhanced learning space for innovation?*** How learning spaces’ dimensions catalyze learning and knowledge dynamics, particularly for innovation? How to manage advanced technologies in a learning space for innovation?

Further advancements of the research intend to better investigate on assessment and management of technology –enhanced learning spaces that, through knowledge and learning dynamics and processes, foster innovation, a key driver for public and private organisations aiming to reach growth, success and competitiveness in an era characterized by uncertainty, volatility and disruptive changes caused by 4.0 and 5.0 technologies. In this vein, the conceptual framework derived from the literature review support the definition of the management phases.

IV. INSIDE THE TECHNOLOGY –ENHANCED LEARNING SPACES FOR INNOVATION: A MULTIPLE CASE STUDY

4.1. Introduction

The literature review carried out in the previous chapters resulted in a deep analysis of the learning space concept and its evolution, specifically in the management field. Understanding the manifold applications and contextualization of learning spaces leads to the need to discern the tangible and intangible dimensions of the space that impact learning and knowledge dynamics. Consequently, the systematic literature review has provided a working definition of technology-enhanced learning space and a conceptual framework summarising the critical dimensions for design and functioning. Relevant literature contributions help identify and enrich the dimensions that emerged, i.e., actors, setting, technologies and software, relationship and networking, organisational atmosphere, culture, methods & practices. On the other hand, the management and assessment processes need deeper analysis that supports the definition of management phases. In this vein, the emerging contributions rely most on specific management tools and software or logic underpinning distinctive learning spaces rather than management phases that may be generalised (Khanjari 2021; Schobel & Scholey 2012). Anyway, the attention paid to the topic and the related issues is growing. The newest configurations of learning spaces often include advanced technologies, and it is thus necessary to deal with the management and assessment of these sorts of learning spaces. Managing a learning space incorporating a substantial and predominant technological dimension means paying attention to all the structural and dynamical dimensions and understanding how they interact and influence the process of inclusion and use of basic and advanced technologies.
In this regard and considering the emergence of the topic and the lack of systematisation of results, the focusing more on empirical research, support a definition of a clearer picture of the phenomenon in its context (Reyes-Mercado,2022; Pawlowsky et al., 2020; Wu et al., 2019; Corney, 2018).

In line with the objectives of this research, it is essential to profoundly investigate the managerial phases of technology-enhanced learning spaces that: i) are supported by advanced technologies; and ii) aims to promote innovation dynamics. The study, in consequence, seeks to enrich insights emerging from literature and formulate a theory with an empirical approach which can be helpful to academics and managers to create and effectively manage this type of space. Therefore, the analysis first validates theoretical patterns and insights that emerged from the literature and then adopts an inductive approach to develop a managerial model. The empirical approach adopted considers an assortment of practical cases of learning spaces supported by advanced technologies that have the purpose of fostering innovation paths, in line with the research aim.

Accordingly, in this chapter, a multiple case study approach is developed. Its purposes are to:

- Validate and enrich emerged literature findings;
- Develop a managerial model describing the critical phases for effective management of learning spaces for innovation supported by advanced technologies.

This chapter is structured as follows: the first section is dedicated to introducing and describing the methodology adopted for findings, then the cases are analysed individually and then compared to propose a management framework, lastly a final discussion is presented.

4.2. Methodology: Multiple case study analysis

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 theoretical findings.
The multiple case study approach is a methodology in the qualitative research paradigm (Creswell, 1998), aimed at generating and testing theory and provide the management field with groundbreaking insights (Gibbert et al., 2008). Qualitative data analysis procedures allow the development of theory or contribution to theory from data. They include both deductive and inductive approaches and range from the simple categorisation of data to the identification of relationships between categories (Saunders et al., 2009). To be rigorous, qualitative research follows several requirements, i.e. i) a specific design; ii) an explanation of the role that the researcher plays in the study; iii) an ever- expanding list of types of data sources; iv) specific protocols for recording data; v) multiple steps of data analysis; and vi) approaches for documenting the methodological validity and reliability of the data collected (Creswell, 2018).

There are several reasons to employ a case study approach in this step of the research process. First, it is considered an appropriate tool in a new management theory's critical, early phases when key variables and their relationships are being explored (Yin, 1994; Eisenhardt, 1989). Massaro et al. (2019) state that a multiple case study approach could make researchers discover new variables and findings within a social context, respecting the phenomenon's complexity (Gummesson, 2007). Moreover, qualitative management research allows to capture intangible factors that create higher value for the literature. It is thus widely acknowledged that case studies contribute to enriching the empirical base through the answer to "why" and "how" questions, especially when the researchers' interpretation is required in addition to simple context observation (Eisenhardt & Graebner, 2007; Glasser & Strauss, 1967; Pettigrew, 1990; Yin, 2009), when quantitative or statistical data are difficult to extract (Robinson & Shumar, 2014), or when there are broad, complex, and not yet fully defined concepts, like that of learning spaces (Menninen et al, 2007, Basye, D. et al, 2015; Cheng, 2015; Ryan, 2016; Csizmadia et al., 2022; Kim et al., 2014; Mueller & Strohmeier, 2010).

"How" or "why" research questions are relevant when an investigation requires an extensive and "in-depth" description of some social phenomenon. Lastly, according to Yin (2009; 2013), the 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.

Broadening the panel and the variety of cases to consider might provide a clear picture of the phenomena and fill the gaps in the literature indicated above. As a result, this section is structured in

the form of multiple case study analysis, with the goal of testing and validating the insights gathered from the previous systematic literature and focusing further on management phases.
The primary objective of this analysis is to provide a more accurate knowledge of the phenomenon and to propose a management model. The framework, which effectively combines insights from the literature review and data and methods based on multiple case study approaches, will provide guidelines and practical evidence to scholars and practitioners on the development and exploitation of technology-enhanced Learning spaces for innovation, supported by advanced technologies. According to these aims, the research develops the multiple case study analysis following Yin (2014) in defining problems, purposes, and methodological details.

In this regard, given a low level of knowledge maturity concerning the management processes and phases of technology-enhanced learning space for innovation, the multiple case study supports the collection of valuable insights, data and expertise and it is less vulnerable to criticism about the generalizability of the results.
In the specific case, the multiple case study developed focuses on different aims, in line with the research questions (Yin, 2017). First, through a mixed approach it aims to validate, refine and enrich the findings of the literature review. The theoretical framework derived from the systematic literature review is used as the starting point of the analysis to understand if the paths predicted by the literature correspond to real-life situations.
Then the multiple case study approach is employed to build a contribution to the theory. In this case an inductive research, informed by theory, is carried out to identify the key constructs and variables and the linkages between them.
Specifically:

- Deeply analyze the configurations of the technology-enhanced learning spaces in their contexts, understanding value proposition, activities and nature;
- Compare the structural dimensions and characteristics emerged in the literature with the one observed in the case studies. As a result of the comparison, confirm, enrich or refuse, the structural dimensions, updating the conceptual framework proposed;
- Identify and analyze the managerial dimensions of the technology-enhanced learning spaces for innovation;
- Focus on advanced technologies, understanding how they are implemented and exploited in the learning spaces for innovation;
- Propose a technology-enhanced Learning Space's management framework and decision-making model.

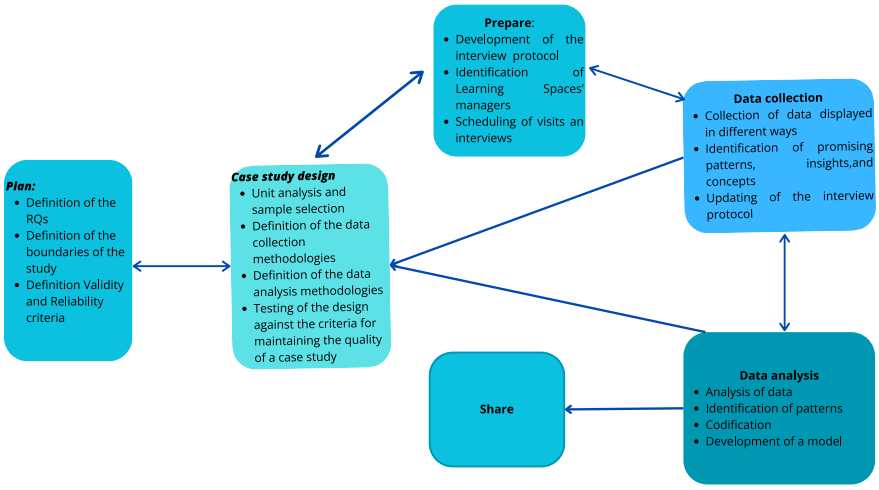
A rigorous development of the analysis, in collaboration with practitioners is done to deal with real management situations and analyse the phenomenon in their contexts in few focused case studies, with the aim to create managerially relevant knowledge.

The RQs linked to the empirical analysis are the second and the third one, i.e. RQ1) ***What are the distinctive dimensions of a learning space?*** What is a learning space? How advanced technologies are impacting on its evolution? And RQ2) ***How to manage a technology-enhanced learning space for innovation?*** *How learning spaces' dimensions catalyse learning and knowledge dynamics,*

particularly for innovation? How to manage advanced technologies in a learning space for innovation?

For the purpose of the study, a participant observation, a comprehensive documentary research and in-depth interviews with the managers of each technology-enhanced Learning space for innovation were conducted.

In terms of methodological details, the next unit of analysis describes sample selection, data collection, and data analysis in detail.



In conclusion, the multiple-case study design guaranteed an exhaustive approach to data collection and analysis.
Figure 8 depicts a process diagram used in the inquiry.

Figure 8. Multiple case study design Adapted from Yin (2014)

4.3. Case study validity and reliability

The case study method and has been under attention regarding methodological rigor in terms of validity and reliability (e.g., Campbell, 1975; Miles, 1979; Daft and Lewin, 1990; March, Sproull, and Tamuz, 1991; Yin, 1981). A lack of rigor is particularly problematic in this phase of the research; first, because case studies are considered appropriate in the critical, early phases of a new management theory and a rigor problem in the early stages of theory development would cause effects throughout later stages. Second, because case studies are typically carried out in close interaction with practitioners that deal with real management situations and need relevant management knowledge. Therefore, ensure validity and reliability of the multiple case studies became of primary importance.
In this perspective, validity and reliability were secured by following the guidelines proposed by Yin (2009) and Gibbert et al. (2008) and are explicated in the following paragraphs. Generally, validity was increased by the choice of using a multiple case study approach, with cases developed in a national and international context. On the other hand, reliability can be demonstrated by the storing of all the data collected and recorded. Reliability enables subsequent researchers to obtain the same findings, if they conduct the study along the same steps again and is guaranteed through transparency and replication.
Transparency is enhanced through careful documentation and clarification of the research procedures, i.e. the interview protocol. Replication is accomplished by developing a case study database including

archivial data, case study notes, transcriptions, and documents collected during the study, organized in such a way as to facilitate retrieval for later researchers (Gibbens et al., 2008).

4.4. Case study design

4.4.1. Unit analysis and sample selection

The rationale for case study selection, i.e. the explanation of why this case study was appropriate in view of the research questions, guarantees the external validity. In this study, a cross-case analysis has been carried out to ensure an analytical generalizability, that is the degree to which the findings can be applied to broader contexts (Yin, 2003; Gibben, 2008). The cross-case analysis of a multiple case study enables the researcher to explore differences within and between cases. The goal is to replicate findings across cases.

The unit of analysis of this empirical investigation consists of a set of nine Learning Spaces, carefully selected.

Despite the different specific aims, the technology-enhanced Learning Spaces selected have as a general mission the enhancement and stimulation of innovation dynamics or innovation capacity of the actors and organisations involved as well as the whole city and region as a source of growth and well-being. This selection leaves outside the scope of the study the Learning Spaces focused primarily on developing specific competencies for training and educational purposes. This lens has been applied because the concept of "Learning Space" is broad and complex, including several configurations of spaces. However, this study is focused on technology-enhanced learning spaces that catalyse learning and knowledge dynamics to support innovation processes in organisations. Consequently, all the learning spaces created and developed solely for educational and training purposes have not been selected.

Furthermore, the Learning Spaces under analysis differ in terms of structure: two are internal to the organisations, and eight of them are external or hybrid.

Concerning the evolution of the concept of Learning Space, nowadays, great emphasis is placed on learning spaces with a strong technological component (Hliouli et al, 2020; Mueller & Strohmeier, 2011). In this vein, the learning spaces selected engage in digitalisation and digital transformation activities and frequently use technologies and implement at least one kind of advanced technology.

Moreover, the selected cases are dynamic and actively involved in the territory and have been held with the cooperation of the academic context and the local, national and international ecosystem.

These aspects are part of the originality of the research. Most of the previous studies consider educational learning space, leaving aside new emerging configurations that require investigation to increase the understanding of the phenomenon.

Practically, the sample selection for the study is drawn from the technology-enhanced Learning Spaces for Innovation operating in two different national landscapes. Notably, four case studies have been selected in the Tampere region, Finland and five other cases in the Veneto region, Italy. This choice is tied to the necessity of widening the findings' generalizability and cross-compare the cases developed in different territorial contexts and circumstances.

The first four cases have been developed during the research period carried out at the Tampere University, during which arose the opportunity to discover and analyse their approaches to innovation and explore their places aimed at promoting innovation dynamics. Therefore, the selection of Learning Space to analyse has considered a heterogeneous sample pool, selecting the cases aligned with the required characteristics and that base their activities on learning and knowledge dynamics.
Similar circumstances have influenced the choice of the Learning Spaces for Innovation in Italy. First, a web search was carried out to understand the level of diffusion of such spaces in Italy. It was then discovered a prize that acknowledged the efforts made in recent years by the Veneto Region to achieve ambitious and inclusive results concerning the spreading of digital and social innovation through spaces based on learning and knowledge dynamics and supported by digital technologies. Even in this case, the selection has first considered a broader sample.
This approach is consistent with the concept of "theoretical sampling", because it selects cases that are not bounded by a priori limits but cases which turn out to be representative of a phenomenon (Strauss and Corbin, 1998).
Access to the sample group was gained through contacts, suggestions and insights provided by colleagues from the University of Basilicata and the Tampere University and personal contacts found on websites and social networks. Direct communication has been established with managers, leaders and mentors of technology-enhanced Learning Spaces for Innovation. Everyone contacted showed interest in the study and willingness to participate and share their thoughts and insights about the topic.
In conclusion, the analysis of the nine technology-enhanced learning spaces offers an articulated and rich picture to apply and validate the findings from the literature review and to provide an original contribution to theory.

Summarising the cases chosen:

- Aim to foster innovation dynamics and innovation capacity of the individuals, the organisations and the territory;
- Are based on learning and knowledge dynamics;
- Are developed within or outside the organisations;
- Are actively involved with the territorial scenario;
- Are engaged with digital transformation and innovation activities;
- Implement digital technologies and advanced digital technologies;
- Are considered as "good practices" in the innovative scenario of the territory where they are developed;
- Are developed on national and international territories.

4.4.2. Data collection

In this study, a case is considered as a single investigation about a technology-enhanced learning space for innovation, supported by advanced technologies. To guarantee the construct validity, i.e. the quality of the conceptualization of the relevant concept, which leads to an accurate observation of reality (Gibben et al., 2008; Yin, 2014), a clear chain of evidence has been established through data triangulation. In particular, to collect the data, different perspectives, collection strategies and sources have been adopted.
Moreover, data collection circumstances are clearly indicated in the following.

A single investigation includes primary and secondary data, developed through: i) a documental analysis, based on multiple websites and database; ii) a participant observation, i.e. an online or in person visit of the space and iii) an in-depth semi-structured interview with the technology-enhanced learning space's manager.
Data were collected over a six-month research period; three months spent in Tampere and other three months in Italy. Interviews were based on a pre-tested protocol, including twelve questions focusing on design and functioning dimensions of the space, derived from the findings identified with the literature review and three open, general questions aimed to identify new patterns concerning the management and assessment of the space.

Secondary data were collected by the technology-enhanced learning spaces for other purposes but resulted useful to enrich the study. Specifically, the dataset chosen included websites, social pages, internal reports, quality surveys, press, and brochures.

Concerning the participant observations, it gives added value to the business and management studies, used in combination with other methods (Saunders et al., 2009). In this case, observation has been conducted before or after the interviews. The data gathered regard mostly the physical structure and the setting components of the technology-enhanced learning spaces for innovation. It was also employed to understand how some activities and courses were carried out within the spaces.

Then, in-depth semi-structured interviews have been developed because they are considered as the most appropriate tool to collect qualitative data, giving great value to personal interactions. They were one-to-one interviews, carried out face to face or with telephone. Credibility is secured providing relevant information and a list of key themes to participants before the interview (Saunders et al., 2009).

Following each visit, notes from the observations and answers from the interviews were transcribed and reported into a structured database. This enabled an effective and accurate track of all the evidence gathered and facilitated the discussion and comparison of the manifold cases analyzed. Maintaining a detailed record of each case was critical in ensuring accuracy and fairness throughout the analysis process. Consequently, each case has been analyzed before conducting the subsequent.

This approach allows both literal and theoretical replications, which can either validate or disprove patterns identified in earlier investigations (Yin, 1994).
In fact, reflecting on previous interviews lead to new insights, perspectives and questions for subsequent analysis. It follows that the interviews developed took account of an adjustable protocol with a list of questions to cover. Some questions have been omitted or removed in particular interviews when they appeared confusing or decontextualized. The order of questions has also been adjusted depending on the conversation flow. On the other hand, emerging relevant questions have been added to the protocol (Saunders et al., 2009).

The analysis of each case focused on design and functioning and managerial and assessment dimensions of a technology-enhanced Learning Space for Innovation. It contributed to validating the Learning Space's distinguishing dimensions and management phases.

After the Finnish cases, a management model was beginning to emerge. Therefore, the Italian cases

have been carried out through new and more detailed questions added to the protocol to determine if the draft models' phases were relevant and should have been accepted or rejected. Moreover, to ensure a solid basis for theoretical replication and develop a reliable model, the latest case studies have been focused on validating both theoretical as well as practical findings.

One of the key benefits of employing the multiple-case study methodology is the ability to adapt and adjust the data collection process as the research progresses. This approach provides greater flexibility and accuracy in our findings (Yin, 2014).

In the following (tab.4) the data collection methods employed are summarized.

Data collection process	Timing	People involved
I) Archival data (websites, social pages, internal reports, quality surveys, press, and depliants)	2 months period	Researcher, key informants
II) Participatory observation derived data (participatory observation by thr researcher)	4 months period	Researcher, COO, CEO, CIO, senior managers, business directors, project managers, coaches, consultants
III) Interview data (original in-depth interviews carried out by the researcher)		

Table 5. Data collection methodologies

4.4.3. Data analysis

After each interview, the analysis of the data collected began. This was a fundamental step in the process because it allowed to identify any emerging patterns or themes and gave a deeper understanding of the interviewee's thoughts, feelings, and opinions. In fact, the utilization of the multiple-case study methodology has proven to be highly effective in facilitating deeper analysis and reflection throughout the data analysis process. Through differentiation of distinct cases, a deep comprehension of the data has been achieved, and more significant insights have been drawn from it (Yin, 2014).

The findings derived from each case study supported the protocol adjustments, adding newly arising questions or deleting confusing, tricky, and out-of-scope questions. The data analysis has been done through a data analysis software (CAQDAS), i.e. NVivo 12.

Data analysis process ensured internal, external and construct validity of the multiple case study. Internal validity refers to the causal relationships between variables and results that have to be compelling enough to defend the research conclusions, construct validity to the clarification of data

analysis procedure and external validity to the generalizability of the results. In this study, different measures have been employed to enhance multiple case studies validity, i.e. i) Empirically observed patterns have been compared with patterns established and predicted by the literature review; ii) Data triangulation has been enhanced by adopting multiple perspectives. Moreover, adopting the multiple case study and cross-comparison, as already mentioned, allowed analytical generalization, which generalizes findings from empirical observations to theory rather than a population (Gibbert et al., 2008).

The multiple case studies translated into a double aim, represented by two distinct levels of analysis. The first level supported the validation of patterns emerging from the literature. The data analysis has been carried out through a deductive approach to pursue this objective. Commencing the investigation from a theoretical perspective has certain advantages because it incorporates the research into the existing body of knowledge and provides an initial analytical framework (Saunders et al., 2009; Yin, 2003).

Main variables, components, themes and issues have already been identified with the literature review (Yin, 2003). The conceptual framework derived was then the starting point to direct the data analysis because it provided the nodes and main themes to consider. Consequently, the evidence that emerged across the various cases analyzed have been compared and triangulated with the data arose from the literature review. The second level aimed to develop a management framework with a grounded approach, particularly a thematic analysis, without a clearly defined theoretical framework. In this case, data have been collected and then explored to see which themes or issues to follow up and concentrate on (Yin, 2003; Saunders et al., 2009).

Combining deductive and inductive approach elements was useful to develop a theoretical position and then test its applicability through subsequent data collection and analysis.

The insights have been collected according to the managerial phases of a technology-enhanced Learning Space for Innovation to propose and test a management model.

This contribution, for the benefit of both academics and practitioners, also results in a more significant and detailed reading of the phenomenon, specifically concerning the implementation of 4.0 technologies and provides an updated framework regarding the structural aspects and characteristics, taking into account the latest trends in the field of innovation management and management of learning and knowledge.

I Level of analysis

At the end of each visit, notes and interviews have been transcribed and then analyzed to identify interesting insights concerning the objectives set in advance. The analysis of each case thus influences subsequent interviews. When any of the findings turn out to be relevant, a reevaluation of the original protocol was done. Specifically, irrelevant or confusing questions gave been eliminated, and new ones that necessitate more research have been included. Reviewing notes after each interview proved highly beneficial in revealing new concepts and insights.

Following this approach, findings related to the design and functioning dimensions demonstrated

confirmation of the dimensions of learning spaces and the characteristics populating the dimensions (considering also how these spaces catalyze learning and knowledge dynamics, particularly for innovation), as well as the emergence of some new enriching insights. Specifically, from the interview analysis, emerged a stronger significance regarding the technological dimension. Interviewers address barriers and benefits preventing and enhancing the implementation and daily use of 4.0 technologies. In this perspective, a matrix supporting the technology implementation has been developed.

In this first level, the data analysis process consisted of a deep analysis of the interview transcripts, the notes derived from the direct observation and the secondary data, then triangulated with data previously emerged from the literature review. Theoretical propositions have been used as means to devise a conceptual framework (Fig.9) supporting organisation and development of the data analysis (Yin, 2003). In fact, the conceptual framework has driven the analysis, predicting what was expected to occur (Yin 2003; Saunders et al., 2009).

The transcripts have been scanned and coded through NVivo 12 software. The coding process, namely the analytic procedure for data exanimation to attribute meaning to notes, has been conducted based on a deductive approach. This involved using codes informed by the literature on the design and functioning dimensions of Learning Spaces. Each dimension was assigned a specific code (nodes in Nvivo 12) to support the analysis.

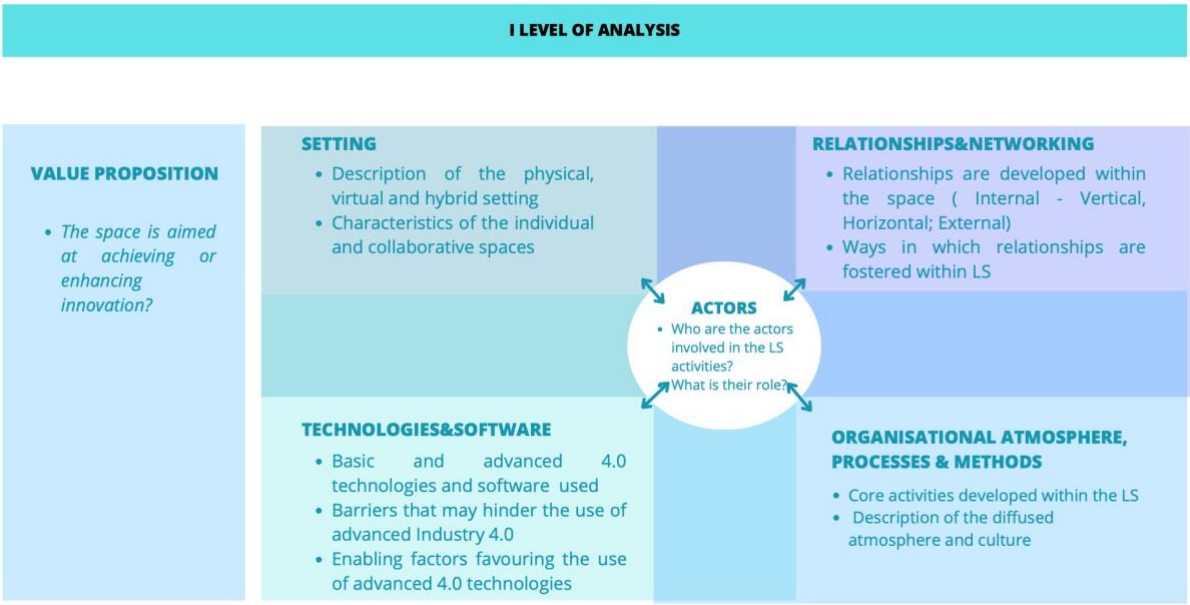


Figure 9. Conceptual framework: I level of analysis

The process was sequential, with each new interview only starting after the revision of the previous one. New notes from each case were compared to those from the previous case. Thanks to the comparison process, evidence has been validated or refused. Moreover, earlier cases were constantly reviewed according to the new emerging perspective.

II Level of analysis: thematic analysis

Then, most effort in optimizing time and participants' attention has been made to investigate the critical theme of the analysis: the managerial dimensions of the technology-enhanced Learning Spaces for Innovation, a relevant literature gap. In particular, management literature does not provide a holistic model, including the management phases of a technology-enhanced learning space for innovation. In this perspective, II level of analysis starts by trying to address the gaps. The analysis process started by adopting an entirely deductive approach, but concerning the managerial phases of a technology-enhanced learning space for innovation, the theoretical insights did not yield a sufficiently convincing answer to RQs and objectives. Therefore, at this point, the data have been analyzed mixing the deductive approach with an inductive one, through a thematic analysis.

Braun and Clarke (2006) defined thematic analysis as a method for identifying, analyzing and reporting patterns, within data that organizes and describes data sets in detail. For this purpose, after the text was entered into the NVivo 12 software, various steps were followed (see fig 10 – thematic analysis).

After the back-and-forth reading of the transcribed and copied data, codes have been assigned with specific labels. The coding process supported the identification of unforeseen areas (Karlsson, 2016; Charmaz et al., 2006).
After that, the derived codes have been revised to identify patterns and develop initial themes within which codes have been clustered. Each theme has been cautiously revised and organized with two perspectives: first, provide an accurate and reliable representation of the data and then, answer the research questions.
In this perspective, relevant managerial aspects emerged after the first conducted interviews, specifically the Finnish interviews. In consequence, Finnish case studies resulted in a relevant starting point to bring out new evidence about the managerial dynamics characterizing these kinds of spaces. Specifically, attitudes, routines and processes to manage these spaces emerged. In response to this, subsequent interviews started from these emerged ideas to search for confirmation or denial and, moving on the last cases, the identified patterns were more predictable. Consequently, visits in Veneto have been focused more on validating the draft of the managerial model that emerged from the first visits.

A framework to manage technology-enhanced learning spaces for innovation has thus been formulated and developed through a literal and theoretical replication based on insights gathered and reinforced during interviews.

The theoretical replication and the recurrence of particular phases resulted an essential aspect for effectively outlining the phases of the managerial model. In this perspective, each new insight contributed to strengthen the evidence and the validity and reliability of the interpretation of the collected data. Consequently, the model has been added to the interviews' protocol (for the interviews conducted in Veneto) to seek confirmations from participants or collect feedback to improve and refine it, making it more reliable.

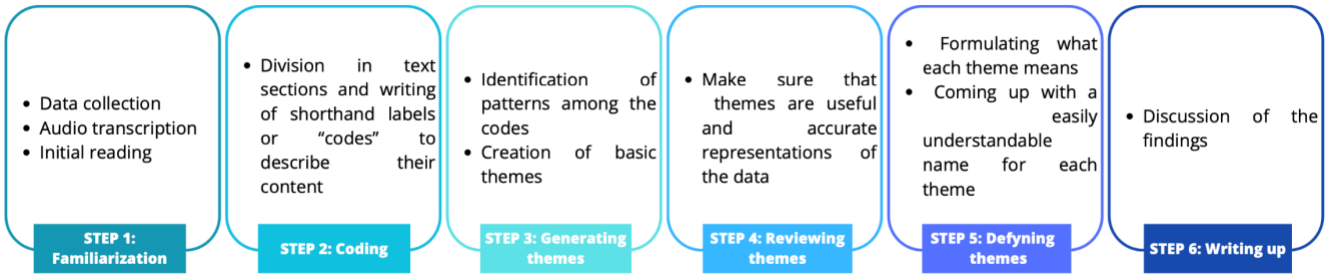


Figure 10. Thematic analysis

Further research was required because discrepancies were discovered during the model's explanatory development. In order to address this issue, relevant data have been re-examined. It was essential to make sure that the concepts were flexible and adaptable to the real-world scenario.

Finally, a triangulated check with each participant was done to confirm the conclusions of the study and reduce the possibility of researcher bias and reactivity.

In summary, the triangulation of data that emerged from the literature review and from the multiple case studies allowed the development of a management framework for a technology-enhanced Learning Space for Innovation, supported by advanced technologies. Findings are presented in the following paragraphs. The results of the initial analysis will be discussed collectively, with a subsequent examination of each individual case during the second level.

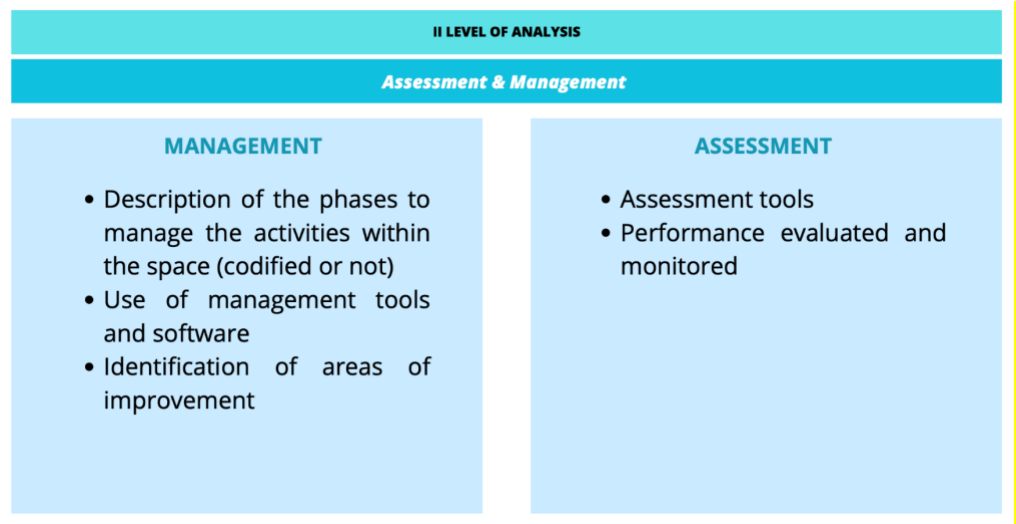


Figure 11. II Level of analysis

4.5. Findings

The RQs leading to this empirical investigation focused on how technology-enhanced learning spaces for innovation function and are designed and managed.

The first part of the analysis demonstrated a theoretical replication and enrichment of design and functioning aspects and dimensions of a learning space for innovation, according to the above-

described approach, and the second level of analysis is focused more on managerial dimensions through a thematic analysis. This allowed the researcher to gather more information and evidence and, therefore, to contribute to knowledge around a topic still fuzzy debated in the management literature.

To better empirically investigate the field of learning spaces, enriching and strengthening the conceptual framework proposed (see Fig.7), the study involved nine learning spaces developed and managed in Tampere (Finland) and Veneto (Italy). They are Tx, Hx, Dx , Kx, Ax, Cx, Dihx, Digx, and Ox. The names have been changed for confidentiality reasons.

The rich body of data collected was fundamental to cross-compare the different realities and to explore in-depth the processes and the dimensions characterizing real Learning Spaces for Innovation.

The results that emerged from the case studies are displayed in different ways, i.e. including tables and graphs, through category matrices, verbatim quotes from interviewees, and narrative paragraphs. A compelling way to convey the richness of data is to combine different ways to display them, choosing the most suitable concerning the nature of data and the complexity of the concept. This brings the reader into the participant's scenario, allowing the understanding of the phenomenon studied (Sanders et al., 2008; Yin, 2014).

As mentioned in the previous paragraph, the data analysis has been carried out following two main levels of analysis. In the following paragraphs, the main results of the joint analysis of the cases carried out will be described for each level of analysis. The next sections will be structured as follows:

- Value proposition & Purpose;
- Design & Functioning;
- Management.

The first two sections are presented through a compared analysis of case studies to validate, refute, and enrich the literature's findings.

Then, each case is analyzed individually, with a specific focus on the management phases highlighted. Subsequently, the results of each case are reviewed and compared to identify common traits and codify the critical phases characterizing a Learning Space for Innovation model that explains its crucial management processes.

4.5.1. Value proposition & Purpose

The literature review analysis highlighted the importance of delineating a clear purpose of the space (Pawlowsky et al., 2020; Corney, 2018). Generally, the overall purpose of a Learning Space is to enhance and improve knowledge and learning processes. However, the general purpose may be translated into specific objectives that differ also depending on the context where they are developed. It is worth noting that the analysis of the case studies essentially confirms the findings discussed in the literature. Specifically, the cases studied involved laboratories designed with similar goals and objectives in mind as those mentioned earlier.

Below there is a table 6 containing the individual cases and their respective purposes and objectives for further information.

Case	Denomination	Value proposition & Purpose	Role spokesperson
1	**Tx**	- Entrepreneurial innovation - Community and network development - Entrepreneurial skills - Provision of access to mentoring services, startup events and a network of other startups, talents, and collaborators.	Chief Operating Officer (COO)
2	**Hx**	- Entrepreneurial innovation - Innovation competences and skills - Community and network development	Coach
3	**Dx**	- Creation of an innovation platform bringing together professionals, organisations, shareholders, researchers and co-creation facilitators - Digital innovation - Develop a shared vision of the future and a roadmap	Chief Executive Officer (CEO)
4	**Kx**	- Brand visibility and social innovation - Digital innovation - Community and network development	Business director
5	**Ax**	- Digital literacy and digital innovation - Community and network development	Project manager
6	**Cx**	- Community and network development - Social innovation - Digital literacy and digital innovation - Entrepreneurial innovation	Senior manager
7	**Digx**	- Digital literacy and innovation - Social Innovation (through open data) - Community and network development - Entrepreneurial competencies	Project manager
8	**Dihx**	- Support to digital transformation path - Digital innovation - Entrepreneurial innovation - Community and network development	Chief Information Officer (CIO)
9	**Ox**	- Digital literacy and innovation - Entrepreneurial innovation	Project manager Consultant

		- Community and network development	

Table 6. Value proposition of the learning spaces under analysis

The choice of this sample is focused on Learning spaces that aim to promote innovation dynamics and capacity, therefore their main value to deliver is linked to innovation. Despite this, it is interesting to notice how several perspectives of innovation are stressed and emerge from the data analysis.
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.

However, the boundaries are not always clearly defined, and, as it is possible to notice in tab. 6, learning spaces' purposes are often related to more than one innovation perspective and deal with several purposes and objectives simultaneously. Furthermore, another aspect that emerged from the case study analysis is that purpose is not always planned structurally and rationally. In fact, it may ideally be placed in a seamless interval at the two extremes: an emergent unplanned relational and infrastructural process and, on the other hand, a structural and planned one. The former results from the quasi-random formation and development of a learning space. Whereas the second responds to a logic of design and a causal definition of Learning Space's purposes.
In this vein, the objective conceived initially adapts and evolves continuously. Ambitious purposes are eventually divided into more achievable sub-objectives. For instance, Case 3 aims to build an innovative vision of the future, share it with all the organisations involved, and work synergistically to achieve it. Reaching this aim starts by creating and enhancing frequent meetings, networking opportunities and fostering communication skills. On the other hand, on the national territory, Case 5 desires to support individuals and firms in using advanced technologies. However, it begins by providing courses and activities related to basic digital technologies to create robust foundations. This aspect is essential because it stresses the need for learning spaces to be flexible and adapt quickly to changing circumstances that lead to the formulation of new value propositions and different strategies to achieve them.
Regardless of the evolutionary dynamics that determined the development of a learning space, it is still always characterized by an identity content, which defines the nature and type of the knowledge system that is nurtured and stratified in the context of reference.

In sum, the Learning Spaces for Innovation taken into consideration in this study mainly play the role of facilitators, helping companies and individuals through the digital, social and entrepreneurial innovation paths by strengthening knowledge and learning dynamics through initiatives, courses, activities, guidance, consultancy services but also through prototyping and testing. Generally, the whole purpose is to enhance innovation, innovative mindsets and contribute to the innovative ecosystems by creating network and communities and by fostering exchange of knowledge between individuals as well as between more and less experienced companies.

4.5.2. Validation and enrichment of the theoretical findings

The design and functioning perspective is the most stressed and addressed in the literature, including the different dimensions that characterize a learning space and how they influence knowledge and

learning dynamics. The concept of Learning Space was first developed in the educational literature within the constructivist paradigm of learning. It is always described in a multi-dimensional perspective, where the dimensions are interrelated, connected and considered in a holistic perspective because the learning space is a set of integrated services offered through a single, multi-dimensional system. In this vein, Learning Spaces enable and facilitate the creation and sharing of knowledge and learning through the management of tangible and intangible components that build the static infrastructure of the space.

Identifying and understanding the functioning of a learning space's different structural dimensions results of vital importance because it involves recognizing the interrelationships between different components and dimensions, simplifying complexity by constructing a model of reality (Grieves et al., 2005).

In this perspective, findings of systematic literature review provide a theoretical framework in which learning spaces are characterized by the following dimensions: i) Actors; ii) Setting; iii) Technologies & Software; iv) Relationships&Networking; v) Organisational atmosphere, culture, methods & practices.

As previously discussed, one of the goal of the empirical investigation is to validate the existing literature by delving deeper into case studies and confirming the evidence through an empirical point of view. In the reviewed literature, in fact, empirical approaches are mainly related to a single case study or the exploration of Learning Spaces developed in educational contexts. This original contribution is consistent with the data presented in the previous chapter, illustrating how modern configurations of Learning Spaces may serve as an advantageous instrument for organisations seeking to drive innovation dynamics. As a result, additional research into structural dimensions was considered to be necessary in order to validate and update the relevant results.

The cases conducted are jointly analyzed below, comparing them with the results of the review. Specifically, each of the dimensions identified with the systematic literature review is enriched with the results derived from analysis of the case studies.

Actors

According to the literature review, the success of a learning space strongly depends upon the actors, how they are engaged within the facility, and how they interact with each other (van Riesen et al., 2019 Sankari et al, 2018).

The nature of people or users involved in learning spaces is vast but there are three types of knowledge actors can be identified: leaders, learners and individuals providing knowledge (Lee and Tan, 2023; van Riesen et al., 2019 Sankari et al, 2018; Lancaster and Milia, 2015; Mihalca et al., 2011; Jurasaite-Harbison, 2009).

Despite adding new insights to the conversation, the respondents essentially validated and reaffirmed the three groups of actors described in the literature.

The respondents discussed the significance of solid and engaged leadership that must contribute to a welcoming and trustworthy environment, as it appeared in the literature. However, they also discussed the importance of flanking support people to the leadership and the knowledge providers

to help them manage and organize the space and the activities and to support them in delivering knowledge.

Specifically, the need for an internal or external network of professionals emerged from the interviews. In fact, in their spaces, they often have operational teams consisting of active people, who work together on a daily basis to maintain and develop their activities and services.

They may have different tasks and competencies, e.g. video makers, graphic designers, accountants, marketing directors, consultants, programmers, and secretaries, and they can collaborate with the leadership or knowledge providers. This newly added dimension of actors will be labelled as staff. Often, especially in learning spaces financed with public funds, the staff include volunteers. In this vein, the project manager of Case 5 stated, "We created all the synergy with the universal civil service projects, in which the municipality participates, to ensure the continuity of the Learning Space for Innovation."

On the other hand, the knowledge providers, as stated in the literature, are mostly coordinators who facilitate learning. However, the empirical analysis proposes two different perspectives of knowledge providers, depending on the level of formality of the activity proposed. The case studies under analysis involved external professionals for specific lessons and courses. In this respect, different respondents claimed that they invited professionals from multinationals, other organisations or universities to provide an innovative glimpse to seminars and lectures. For example, researchers, professors and academic institutions are integrated also with the aim to share knowledge and ideas and understand if they have a shared vision about the future and how to cooperate, optimizing activities and resources.

In this perspective, the business director of "Case 4" declared: "Our space is a bridge - push and pool - between the university and the companies. Universities can sell their ideas, and companies can ask for insights from the universities. It is not formal training; there are meetings, where there is always a team and a topic." Therefore, professionals are not always involved in formal training, but learning spaces are used as platforms to connect people and share knowledge, fueling innovation.

The coach of “Case 2” explains in better words their role: “Part of our coaching is team learning. There are several of us; we are coaches. When we have lessons, they are smaller lectures in a large lecture room. We guide students, questioning them and showing them how something is done when they have doubts. We do not tell them everything but guide them towards a certain direction and answer.” In this vein, it is possible to summarize that knowledge providers can be internal or external actors of a learning space involved in knowledge and learning dynamics in formal or informal manners.

Concerning the learners, learning spaces under analysis involved both single individuals and individuals from organisations. The target group does not have a specific age range but includes young and older people. Specifically, they developed activities with citizens, PA, students, digital nomads, and people from companies at managerial and director levels. Learners came from various kinds of companies, i.e. from global multinational companies to small startups. The aim is indeed to integrate them and make them work together.

Furthermore, respondents confirmed the importance of the mental and psychological dimensions of the actors involved, drawing emphasis on the level of prior knowledge expected concerning the proposed and developed activities. For example, the level of prior digital skills required is determined by the type of technology integrated and employed in the space.

Setting

Learning spaces arise as places that stimulate and facilitate learning and knowledge dynamics. According to management literature, setting influences dynamics, interactions, and processes, as well as individuals' skill development and behaviour defining. As a result, paying attention to detail is critical for favourably impacting the learning space's effectiveness and attitude to innovate. In management literature emerged two distinctive settings, i.e. virtual and physical/ hybrid spaces. (Christensen et al., 2023; Jens and Gregg, 2022; Berbegal-Mirabent et al, 2021; Sasson et al, 2021; Dleikan et al., 2020; Sankari et al, 2018; Osorio et al, 2017; Lancaster and Milia, 2015; McLaughlin & Faulkner, 2012; Heiskanen & Heiskanen, 2011)
Confirmations of what arose from the prior research activity were found in the cases investigated. Evidence and insights concerning this dimension are deducted from the primary observation and the interviews with the managers of the visited LSs.

The LSs involved in the analysis are developed within university campuses or in similar knowledge repositories, such as accelerators, incubators, collaborative platforms and laboratories. Some of them use spaces provided by the university or other institutional actors as the municipality or the region. The different cases present peculiar features but have several common characteristics. The first thing to notice is that LS for innovation are conceived as flexible, open and multifunctional spaces designed in a creative, colourful and friendly way, predisposed to have relaxing areas where to seek socialisation and community building.

Talking with the managers of the various LS, a fascinating aspect emerged; several LSs own more than one spot and are labelled as "diffused learning space". Despite this, LSs conceived in a diffused way often have a central hub and several secondary locations with essential equipment. In this perspective, "Case 5"' project manager stated: "Concerning the setting, the infrastructure includes a network of digital points coordinated by a central laboratory. At the level of the physical infrastructure, these spaces have minimal equipment, while the central laboratory, which is somewhat the cornerstone, is highly innovative." The propensity to create diffused LS, with physical spaces located in different territories, derives from the need to be closer to the community, ensure a widespread presence on the territory, and develop robust networking systems. Moreover, it shows the predisposition for these spaces to open innovation, co-creation, and contamination activities.

Another interesting aspect that emerged from the case study analysis is that virtual space's importance has gradually increased in recent years. Specifically, the managers explained that they often developed an online space to support the physical one. It may be an asynchronous platform equipped with online courses and activities, as in cases 2, 4 and 9 or a synchronous space used as an alternative or in substitution to the physical space, as in cases 5 and 8.
The need to develop an online space, joined to or which replaces the physical space, has been further accelerated during the pandemic. Some of the spaces involved in the study could not continue their activities without a virtual place; they initially decided to build those spaces for survival. However, they noticed that nowadays, the trend is to rely on virtual spaces that may connect remote realities and build a robust and diffused innovation ecosystem.
Consequently, according to the respondents, the LSs are built as open community spaces, innovative workplaces or co-working spaces. Those settings often include formal or informal meeting spots or conference rooms for team meetings. Collaborative and co-working areas are considered an essential

feature of a LS for innovation for all the respondents. In fact, the LS are always characterised by spacious areas with furniture that encourages collaboration and teamwork; then, some of them, as cases 1, 2, 3 and 8, include smaller single rooms dedicated to startups or individuals that work alone. At the same time, the managers interviewed highlight the importance given to the relaxing areas for naps and relaxation or for stimulating creativity and learning. These areas include sofas and easy chairs situated in a coloured setting, with decorations, lighting and moveable chairs and furniture to create an informal and friendly atmosphere. Case 1, 2, 3,6 and 8 have created kitchen and bar areas, and case 1 also had a space dedicated to the gym equipment.
Basic and advanced technologies may often be situated in distinct spaces such as learning centres or fab labs. For instance, cases 4 and 7 rely on learning centres specialised in specific technologies such as Robots and Artificial intelligence. However, the equipment of digital technologies will be further analysed in the following paragraphs.

In sum, from the joint analysis of the case studies, the components derived, characterising individual and common physical settings, are: i) flexible furniture (e.g. moveable chairs, desks and tables); ii) gym equipment; iii) kitchen space (e.g. coffee machines, microwave, dining table); iv) relax space (e.g. sofa, easy chairs, television); v) common networking spaces (e.g. desks for teamwork, post-its, memo board, blackboard); vii) stage; and iix) learning centre (with advanced technologies).

Technologies&Software

The technologies and software dimension considers a combination of technological instruments, infrastructures, and software that improve the processes and dynamics of learning and knowledge. Different technology tools can influence or prevent learning processes, boost digital innovation, and create new learning opportunities (Jurasaite-Harbison, 2009). In the digital age, specifically, innovation is inextricably linked to the usage of cutting-edge technologies. As a result, the design and management of the dimensions of a learning space must be linked to the selection of the suitable tool to maximise their potential and value added (Sasson and colleagues, 2021; Delgado and colleagues, 2020; Rasheed and colleagues, 2020).
Considering the spaces under analysis, they are all are equipped with basic and advanced technology and validates the results of the conceptual framework.
Despite this, the case study analysis results in insights and findings enriching the theoretical framework, giving a broader perspective on implementing the technologies in a LS for innovation. The first important thing to add is that even if new and advanced technologies dominate the current scenario, LSs face several barriers that may hinder the implementation or the daily use of the technologies. Moreover, they are only sometimes equipped with their own advanced technologies. Often, they rely on external specialized labs or learning centres, such as centres that bring together several types of digital technologies and make them available for other structures. Some spaces included in the analysis have their own learning centre or places dedicated to advanced technologies. For example, Case 3, 6 and 8 have places, within their spaces, equipped with visors, 3D printers, lasers, prototyping software, professional video equipment, and coding software. On the other hand, case 4 and 5 cooperate with *external places*, providing them with advanced tools for a once-in-a-while use, such as Robots, AI or IoT.
The leaders of cases 4 and 5 stated that advanced technologies enrich their learning processes in some specific lectures or courses. Specifically, in this case, the technologies are implemented as *learning objects*, and the spaces organize activities, seminars and courses dedicated to their use. CEO of the

case 3 deeply explained how to implement advanced technologies as learning objects: "For smaller companies the key point is to develop new technologies, and for bigger ones is to understand how they might help. More prominent companies do not have to develop technologies but buy them from smaller companies. Middle-size companies can visualize and show what is the benefit of taking new technologies into action. They might be old fashioned, there might be some barriers that stop putting technologies into use, and our job is to explain them, through showcases and lectures, how they can boost productivity with the technologies. We share the case studies regarding results, telling them - this is how they did with that technology; that was the outcome, and you could do the same. -"
Specifically, according to his vision, a method to train people within a LS and make them willing to use and employ digital technologies is to make their potential clear, diffusing information about good practices and effective outcome examples achieved thanks to the technology implementation.

However, this is not the only usage done with technologies in a LS. In fact, respondents mentioned using the technologies, especially advanced technologies to support *organisational processes* within the space (e.g. professional cameras, and communication tools to facilitate relationship building) or to enhance and improve the *learning process* by supporting the learning activities (e.g. Augmented reality tools to make the learning experience more immersive). Further examples were provided by the managers interviewed: i) screens and digital whiteboards for in-events and lecturers; ii) virtual platforms for distance meetings and lectures; iii) digital boxes to enhance collaboration and creativity; iv) app and software used to support relationships building; v) AI and virtual reality, to make pilots, mockups, proof of concepts and demos in a fast and simple way; vi) Big data, machine learning and autonomous technologies to identifying new opportunities and benefits from existing data achieved; vii) computing solutions to improve cyber security or reduce CO2 emissions. Moreover, all the interviewed leaders plan to make substantial investments in the near future, to make the role of the technologies even more central for the space. The CEO of Case 1 and the project manager of the Case 7, for example, stated that, in their LS, they are trying to build their own platform or their own app, suiting the needs of heterogeneous participants, whilst some of the other leaders are planning to implement more advanced technologies, especially AI and Big data.

Generally, according to the results of the analysis, the technology help achieving the LSs' objectives by enhancing the immersive experiences, making the whole projects and activities more interesting, engaging and motivating, and by employing innovative methodologies like storytelling or serious games.
Despite this, nowadays, their potential has not been fully exploited yet, even though the pandemic fostered their use. In fact, before Covid-19, actors of a LS did not use technologies as much as they do now, but they still need time to overcome routine habits and barriers to the implementation.
These efforts need energy and resources but, most of all, they need a change of habits. In Finland, mostly than in Veneto, they can effortlessly access effective and innovative devices and technologies that are easy to use. However, they need substantial training and culture, which emerged as the most influencing factors, according to the analysis of the interviews.

In this vein, the respondents highlighted several barriers to overcome to use technologies more efficiently in a learning space. Each of the barrier can be linked to one or more structural dimensions of a LS. Specifically:

i) Conservatism and routinary habits; ii) Lack of financial resources and investment power; iii) Lack of specialized human resources; iv) Technical limitations; v) Lack of social interactions; vi) Negative effects on health (e.g. headaches); vii) Time limits; viii) Accessibility; iix) Difficulties in finding suitable learning methodologies; ix) Privacy and security; x) Difficulties in assessing learning and knowledge experiences.

In this vein, the analysis of the interview supports a further characterization of the technologies that are included in a learning space for innovation. The synthesis of the findings is presented in the following table 7.

<table>
<tr><td colspan="4">TECHNOLOGIES IN A LEARNING SPACE FOR INNOVATION</td></tr>
<tr><td rowspan="2">NATURE OF THE TECHNOLOGIES - WHAT</td><td colspan="2">Basic technologies</td><td>Advanced technologies</td></tr>
<tr><td colspan="2">Variety of different technologies, that may be fundamental and provide the building blocks for more advanced or specialized technologies. In the context of learning spaces basic technologies are communication technologies and computer technologies.</td><td>Technology that still is no considered standard or mainstream. It may hold great potential for the future. In the context of learning spaces, advanced technologies are the ones of the 4.0 and 5.0 industries such as IoT, VR and AR, AI, big data, cloud, robots, laser, 3D printers.</td></tr>
<tr><td>BARRIERS</td><td colspan="3">i) Conservatism and routinary habits; ii) Lack of financial resources and investment power; iii) Lack of specialized human resources; iv) Technical limitations; v) Lack of social interactions; vi) Negative effects on health (e.g. headaches); vii) Time limits; viii) Accessibility; iix) Difficulties in finding suitable learning methodologies; ix) Privacy and security; x) Difficulties in assessing learning and knowledge experiences.</td></tr>
<tr><td rowspan="2">WHY ARE USED</td><td>Support to organisational processes</td><td>Support to learning processes</td><td>As learning objects</td></tr>
<tr><td>The technologies are implemented into organisational processes, e.g. to support and facilitate communication, to enable the data storage, to develop a virtual space.</td><td>The technologies are implemented into learning processes, e.g. software for business and serious games, VR and AR for enhancing an immersive experience, 3D printer to build mockups and proof of concepts, etc.</td><td>The technologies are used as learning objects, i.e. the lesson topics focus on that specific technology. (e.g. seminars dedicated to the use of Artificial Intelligence)</td></tr>
</table>

***HOW* ARE EMBEDDED**	**Internally**	**Through external specialized labs**
	The learning space has its own technologies or a lab dedicated to specific advanced technologies.	The learning space cooperates with external specialized labs that provide the needed technologies.
***WHEN* ARE USED**	**Daily**	**Rarely**
	The technologies are implemented for in daily activities and projects.	The technologies are used for certain activities.

Table 7. Technology Matrix

Relationships&networking

The relationship and networking dimension concerns the system of interactions between internal and external actors in the LS. According to the literature, the design of the LS has to promote positive relationships and a sense of belonging (Abuhassna et al., 2022; Ching et al., 2022; Müller & Wulf, 2022; Toiviainen et al., 2022; Bianchi & Vignieri, 2021; Delgrado et al., 2020; Elmadani et al., 2015; Esichaikul et al., 2013).

The main idea from the interview analysis is that leaders try to integrate all the actors involved and work together to reach common aims. Moreover, the relationships and networking dimension emerged as one of the most important. In fact, the missions of the LS under analysis are always linked to creating valuable networks and communities and developing bridges between organisations, educational institutions and institutional actors. This was particularly true in Finnish LSs because of a cultural aspect; they always try to create and promote networking and meeting opportunities. Specifically, cases 1 and 2 serve the entire Tampere startup ecosystem by connecting startups, driving individuals and organisations to take action and building a thriving startup community.

In this perspective, the respondents consider high-quality horizontal relationships as crucial characteristics of LSs for Innovation. However, cases 3, 7, 8 and 9 drew attention to the relevance of valuable external relationships and partnerships with institutions or organisations. Their strategy was to create and enhance external relationships to become part of a network and a community.

Communication, as well as knowledge transformation and sharing, are favoured and encouraged in all the cases under analysis, with internal and external trustful relationships that the participants cultivate to collect social capital. Internal continuous and open interaction relationships are facilitated and encouraged by coaches and mentors and by developing trust and reflection in workgroup projects.

On-site and virtual events and team working activities are organized to strengthen internal interactions, human contacts, and knowledge exchange. In this perspective, relationships, team building and skills are developed through collegiality and a relaxed and friendly atmosphere.

On the other hand, external interactions are favoured by authentic experiences with companies, the use of team agreement and seminars about group learning (e.g. principles of dialogue, tasks of a learning team, three-layered learning, significance of trust in teamwork, etc.). Different institutional actors cooperate and impact the LSs under analysis. Concerning the Finnish cases, Tampere organisations or the city of Tampere are highly influential, while in Italian cases, the Veneto Region is a key actor. They all want to strengthen these external relationships, also from an international perspective, to build a more open and vital innovation ecosystem.

Organisational atmosphere, culture, methods & practices

This dimension includes the intangible resources that support learning processes and knowledge dynamics within a LS (Lee & Tan, 2023; Black & Mischel, 2023; Montiel-Ruiz et al., 2023; Gupta

& Priyanka, 2023; Lazzari, 2023; Abuhassna et al., 2022; Csizmadia et al., 2022; Yan et al., 2022; Nashaat et al., 2022; Mojtahedi et al., 2020; Wannapiroon & Petsangsri, 2020; Erdoğdu & Çakıroğlu, 2021; Akhmetshin et al., 2019; Burusic, 2019; Maheshwari & Seth, 2019; Zakaria et al., 2019; Xu et al., 2018; Corney, 2018; Song et al., 2018; Filippou et al., 2018; Aggarwal, 2017; Dai & Bal, 2009; Jurasaite-Harbison, 2009; MacNeil et al., 2009).

This dimension, even from the analysed cases, is considered essential to ensure the effectiveness of the LS for Innovation. This dimension is strictly linked with the others described above. Several peculiarities emerged from the interviews concerning this dimension. In this perspective, atmosphere and culture are spontaneous creations, whilst methods and practices are determined by the leaders and knowledge providers of the LSs, in line with the purposes and the resources used.
Atmosphere and culture are extremely relevant factors that shape and influence almost every decision about the spaces and the activities organised, such as what value to achieve, which tool to use, what kind of program to implement, and how to develop social values and innovation.
A friendly, informal, inclusive and flexible atmosphere is always preferred and favoured by the setting. In this vein, the CEO of Case 3 stated that "the informal atmosphere and configuration should be mainstream because we want to attract as many people as possible to be committed to the future. If we try to do it formally and more oriented towards forced development, it does not work (...) It should be voluntary, willingness-based."

Generally, the respondents describe their spaces as environments where people feel included in a community, safe and free to share knowledge and express their opinions and feelings; therefore, accessibility, respect for privacy and willingness to share knowledge emerge as fundamental pillars.
Moreover, the need to foster a solid digital and innovative culture in contemporary LSs becomes relevant and is often linked with the value proposition.

On the other hand, leaders of Cases 3, 6, 7, and 8 state the importance of finding time for more formal lectures, management boards and meetings with the aim of being perceived as reliable, professional, and trustworthy, especially when money and resource allocation are involved.

Concerning the topics proposed, they are always different, depending on the value proposition, but the more valued by respondents are:

- Digitalisation and digital technologies;
- Entrepreneurship;
- Innovation.

A system of methods, practices and procedures is implemented to deliver these concepts and topics. From the joint analysis of the case studies, it emerges that the leaders, to reach their aims and foster motivation and involvement, proposed several methodologies and ways to support the development of competencies and innovation capacity through learning and knowledge dynamics. Specifically, they proposed different kinds of programs, arranged remotely or physically: i) Seminars and support sessions for people involved within the space; ii) Group coaching programs; iii) Matchmaking events; iv) Networking events; v) Innovation Challenges; vi) Brainstorming, seminars and workshops; vii) Innovation Festivals; viii) Intensive courses, with video, links and lessons; iix) learning by doing and

learning by developing; ix) discussion forums; xi) Gamification that is becoming more and more typical because young people entering the working life are comfortable with digital games.

Generally, from the interviews, it emerged a willingness to use agile and active methods that guide learners toward a certain aim, questioning them and showing them how it works. In this vein, the CEO of the Case 3 explains: "I believe in the power of showing tangible things, tangible case studies and examples. This is what we did, this is the outcome, and this is what you can copy. (...) It is a really motivational factor. (...) It is about competition, to some extent. If we talk on too academic and conceptual level, it does not reflect the world."

It has also been highlighted by the leaders of the Cases 1, 5, 7 and 9, the need to adopt mixed learning methods, facilitating and supporting a multitude of learning experiences. To meet learners' needs, they propose a combination of methods and practices chosen for individual learners and teams on a case-by-case analysis made by coaches and mentors.

4.5.3. Management & assessment process

The other goal of this project is to conduct empirical research on the management aspects of a technology-enhanced Learning Space for Innovation. Fuzzy attempts to address the issue have been discovered in the literature. However, these frameworks appear to be more oriented towards educational Learning Spaces in terms of physical space organisation and exploitation and/or operational logic that drive students to achieve new knowledge and competencies. On the contrary, this study aims to analyse the management dynamics of technology-enhanced learning spaces that foster innovation. Therefore, their impacts have to be considered from a long-run perspective and the management dynamics have to be summarised in a helpful framework for scholars and practitioners to replicate and implement these spaces aimed at encouraging innovation in an organisation. Below, according to this perspective, the case studies will be analysed individually, and then, their comparison will lead to coding the distinctive phases of a technology-enhanced Learning space for the innovation management process, and a management framework will be proposed.

Case 1 - Tx

Tx is a community space, a unique place, developed in Finland. It is a public initiative, supported by public financing methods. They consider themselves as an open community for people who want to sell their ideas and find interesting partners. The space aims to unite actors dedicated to serving the Tampere startup and innovation ecosystem, such as individuals, industries, entrepreneurs and companies. In particular, they organise on-site and external events and lecturers, specific courses about entrepreneurial competencies, business games, meetings and networking events, seminars and webinars.

Specifically, activities are managed as follows.

They participate in public tender notices or projects that municipal and regional institutions propose; in this way, they obtain the financing to carry out the activities within the space. To obtain and maintain the financing, they must meet some goals and targets that the institutions set. Communication activities are made through apps and technological devices. Startups and young people are frequently more motivated and willing to participate in all the activities organised, trying also to develop relationships with larger firms and professionals.

Leaders and knowledge providers support the participants, providing assistance, notions and valuable feedback. They develop projects and learning experiences with different durations and purposes.

They also have a platform where they collect data on the most active community members and basic measurements and metrics to understand their level of satisfaction and participation. The COO claimed to be unsatisfied with the metrics they use to assess the projects because they do not provide all the information needed to understand whether the space is healthy, effective and fuels innovation dynamics in a long run perspective. However, they are also building their own assessment platform, by testing different metrics that do not measure just the end results but the processes, with benchmarking activities and control groups.
In this respect, the respondent states, "Impact is tough to reach and measure, especially in the long run. You can never measure the impact by itself. In ecosystems with different actors, everyone has to participate in the End result. But in this scenario, is always difficult to measure and identify what is your part of the impact, what was your contribution. It is difficult to measure and to manage and it is costly."

Case 2 - Hx
Hx is a learning space situated within the University of Tampere. It offers the opportunity to expand entrepreneurial expertise and find solutions to the real-life challenges of an organisation by creating teams of learners with different backgrounds. Their approach encourages experimentation and stimulates an open mindset and mostly innovation skills. Hx is a unit of entrepreneurship; they offer studies on entrepreneurship and sustainable entrepreneurship.
To meet learners' needs, Hx proposes different methodologies chosen for individuals and teams on a case-by-case basis by coaches and mentors. There are three main paths: i) Innovation Challenge: facilitated and tailored idea competition to achieve solutions; ii) C-LAB: brainstorming, seminars and workshops to prepare for product launch; iii) Sprint Innovation Festival: five-day sprint celebration camp and idea competition.
To do so, they define a strategic management approach. Specifically, the organisation works as a pyramid: online courses are at the basis, then courses that need interactions and workgroups, and at the top pre-incubator courses. Hx provides intensive courses with videos, links and lessons. Everyone can do the courses independently and obtain a peer review to check the assignments. A coach is always available to integrate feedback and interactions. They have a well-structured communication approach to involve participants, create a community, and enhance networking activities. In fact, community development is their priority, and all the activities are strategically organised to develop high-quality relationships and valuable partnerships. During the development of activities and projects, continuous meetings and brainstorming occur frequently to gather feedback and improve the learning experiences. Technologies are integrated into the learning process even though their application result sometimes challenging.

Case 3 - Dx
Case 3 is a leading co-creation learning space that aims to boost transformative and innovative dynamics in Finland and in an international scenario. It is an innovation platform bringing together professionals, organisations, shareholders, researchers and co-creation facilitators. Dx's role is to help companies resolve challenges related to high-risk research activities, disruptive business transformation, and capability development needs by offering focused co-creation services. Their essential purpose is the vision of the future. They aim to make people agree on a shared vision of how the future will be or should be. And then, they develop a roadmap, highlighting how everybody will benefit from the results achieved.
They employ several methodologies and different setups to carry out planned activities and projects. In this vein, they arrange meeting events, seminars and webinars, intensive courses, learning by doing and by development activities, coding projects, physical or digital discussion forums, and gamification.
Their management strategy can be summarised as follows. Before starting the activities, they involve and motivate people. The CEO stated that they aim to attract different targets motivated by different

factors, which represents a challenge. Some people are motivated by the networking opportunities, while others are motivated by the contents and the topics provided. Their strategy is indeed to understand what people desire and sell them exactly what they want by organising community events or showing them the programs, solving the headline of the discussion and the topics of the discussion. They implement digital technologies and particularly advanced technologies within the organisational and learning processes to facilitate the organisations and enhance knowledge and learning dynamics. In their opinion, conservativism and the lack of digital competence represent the main barriers to implementing advanced technologies.
The management plans employed are as lean as possible, using CRM system and gant scheduling for different projects. Each project follows its own strategic schedule. Moreover, daily and weekly meetings are organised to foster high communication among the actors and continuous improvements. Their strategy involves gathering constant feedback and identifying valuable assets that may lead to new opportunities.

In conclusion, they implement performance measurement systems, even if the manager claims the lack of measurement systems for long term impacts.
Precisely, they implement two measurement systems: first, they measure customers' success. They compare the success of their learners to other individuals who are their potential targets but are not their customers. Consequently, they try to analyse the differences between the two groups and understand if their customers perform better.
Another measurement is the customers' satisfaction index. They ask their target about their performance and how they feel within the learning space, to understand their services' quality and relevance.

Case 4 - Kx

Kx is a learning space that offers its members selected services to support collaboration and networking, with the aim to foster and spread innovation. It has several facilities around three campuses and provides access to an international scientific community and talent pool. For companies, membership provides an opportunity to build brand visibility and develop valuable university collaboration in a strong innovation ecosystem. The aim is to create and deepen long-term cooperation between companies and the university through the club's activities, flexible facilities and cooperation models. The focus is on making concrete things happen, creating new projects, networking and finding experts. The spaces' programmes, adaptable facilities, and cooperation models intend to foster and enhance long-term collaboration between industries and the university. The emphasis is on making real things happen, such as starting new projects, networking, and locating expertise.
The spaces offered are innovative workplaces and co-working labs. They are not just physical spaces but also environments where to find a community and a cosy, friendly and motivational atmosphere. The aim is to involve and engage users and encourage them to work in a community. They use management systems and software to organise activities and projects, maintaining a lean approach that is flexible and adaptable. They rely on continuous feedback to realise improvements while learning and knowledge activities are developed. Their plan is to work as connectors and facilitators by helping people find the resources, the technologies and the space where to work and develop their ideas, always supported by knowledge providers and professionals. In this vein, the leader claims their effort in facilitating and improving communication and relationship development by implementing digital technologies.
Lastly, talking with the manager, it emerged that the space lacks assessment tools; they just monitor the achievement of competencies.

Case 5 – Ax

Ax originated from a Veneto Region grant in 2019, which financed the opening of digital literacy centres. It is then a public-driven space.
Ax is a diffused learning space for innovation, with the head centre at the FaberBox office. The general purpose is digital innovation, supporting citizens and organisations in developing and fostering basic and advanced technological skills.
They organise courses, seminars, events, group activities, and one-to-one meetings. Within the space, they also reserve a co-working place for freelancers and professionals.
To do so, they define a strategic management approach to reach their goals. The first step is understanding the opportunities to carry out their activities. In this vein, the objectives are defined taking account of both the public call's requests and the needs of the target. Specifically, they employ a bottom-up approach concerning joint programming with citizens and organisations and a top-down approach for the already defined purposes, which are open innovation, good practice sharing, contamination and co-planning and co-design.
They finance their activities with public funds; therefore, they must reach the goals set by the public call. The value proposition is then in continuous evolution; they set some specific purposes in line with the requests but continuously adapt them to their target. In this vein, the project is divided into a few focus areas to deal with different targets, i.e. citizens, public administration, educational institutions, and organisations. Communication has become of central importance in this scenario and Ax relies on a network of associations supporting and publicising its activities.
In this perspective, the project manager asserted: *"The communication activities involved a referent from the municipality and a number of trade associations. The activities were planned, and all the information materials were sent to the trade associations. The maximum inclusion was requested. The partnerships were functional, they worked quite well. (...) When there was a strong involvement of the municipal administration, there was also a very good response in terms of participation."*
Concerning the technologies, they are used to improve communication (e.g., websites, communication channels), support organisational processes (e.g., online activities), and as learning objects. Ax cooperates with external places to implement advanced technologies, providing them with androids, robots, IoT, and Big Data services.
The project started in the middle of COVID-19, so they initially organised a series of online activities and webinars that are now arranged in a hybrid approach or in presence. They have an iterative process that relies on a monthly reprogramming of activities and budget reconversion in line with the feedback received during frequent meetings.

Case 5 also carries a final shared face-to-face evaluation session, to assess the End Results. In fact, they use some quantitative indicators proposed by the public call, which are the number of webinars, conferences, hackathons, and apps developed. Some other indicators were focused on the individual, for example, the number of people involved and satisfaction. Despite this, talking with the project manager, a lack of long-term indicators emerged. She also evidenced the need to develop some qualitative indicators related to the quality of the time spent by the individuals within the space, their competencies and their behaviour.

Case 6 - Cx

Cx is a multi-purpose multi-functional learning space for innovation. It has different purposes:
the co-working activities to create a community of professionals;
the entrepreneurial courses, events and activities dedicated to startups;
the seminars, conferences, courses, and cultural events to enhance and diffuse innovation and digital competence;
the creative lab that includes activities with advanced 4.0 technologies.
Management practices behind this lab may be synthesised as follows.
They are a learning space for innovation that is both public and private-driven. They consider themselves a sustainable entrepreneurial initiative because the rents collected through the co-working

space allow them to cover human resource costs, extraordinary management costs, and ordinary expenses. On the other hand, they also participate in public calls to collect funds to develop further activities. They evaluate the opportunities and choose the ones that align with their space's mission, i.e., social, digital and entrepreneurial innovation. They involve learners mainly through word of mouth and engage them showing the advantages of joining the space. For instance, to increase the participants' knowledge and competencies and give them stimuli, the program offers them different events, workshops, bootcamps and other activities. Various packages of resources and tools are provided for different needs, together with an innovative and technological place to work. Engage learners, facilitate relationship development, and create an innovative community are relevant activities, according to the senior manager of Case 6. Moreover, they continually strengthen valuable local, national and international partnerships.
Concerning the implementation of advanced technological tools, they have their own space with VR visors, 3D printers, and lasers to attract creative people and companies and provide them with prototyping services. On the other hand, they have professional cameras and educational platforms, serious games, and clouds within the co-working space. The visors are also used as learning objects to make people understand the potential and the barriers of this technological resource, as a support for learning processes, to stimulate team building and as a support for companies that can visualise the products in three dimensions.
When a project or activity ends, they also collect participant feedback and plan to implement an impact analysis to understand their long-term Impact on innovation dynamics.

Case 7 - Digx
Digx pursues the objective of disseminating the culture of digitalisation, assistance in digital services, and the use of Open Data in a Social Innovation perspective aimed at fostering a participatory approach to the modernisation/dissemination of public services in the territory. Digx is a diffused learning space for innovation, a public initiatives with different places in several small towns to spread social innovation even in more rural areas.
To reach their objectives, the activities are managed as follows. First, there is a joint planning and design with the learners involved, aligning the audience's needs with those related to the public call. Their main aim is to involve and engage young people; therefore, they cooperate with the "Young People Project" and other public associations and institutions.
They provide citizens, students and organisations with places to find advanced technologies to carry out a project, verify and test their idea and allow them to participate in hackathons, bootcamps, workshops and lessons to gain entrepreneurial, digitalisation and social innovation competencies. Specifically, they realised a series of actions dedicated to particular topics such as Digital Forensics, Coding, Information Security, and Digital Transformation and realised two hackathons with schools and organisations. Another significant activity developed concerns the organisation of meeting events, where organisations, individuals, and students can meet, confront and exchange information and knowledge.
On the other hand, in cooperation with some local businesses and thanks to access to the Open Data, they also developed some apps and software to support social innovation, such as one app to address privacy concerns and another to redistribute resources among low-income families. They also project to develop a loan service for requalified and advanced technologies. To support different phases, they organise frequent meetings to interact with all the actors involved and understand how to make continuous improvements.

Case 8 –Dihx
Dihx is a public and private initiative, which was created to support SMEs in their digital transformation path by providing consultancy, training, opportunities for experimentation, and tools for realising disruptive and innovative solutions.

Furthermore, DIHx intends to accelerate digital innovation developing initiatives and projects to strengthen enterprises' competitiveness through Industry 4.0 technologies.

They develop their activities by making a distinction between the projects that they carry out.
Concerning the definition of the value to deliver, they adopt a top-down approach when participating in public calls and a bottom-up approach when co-creating the activities with the territory.
Dihx also relies on private funding; for this, another objective is the economic performance to sustain some of the space's activities.
Great relevance is given to community development. Specifically, they continuously engage internal and external actors and consider the community created as a distinctive element of the space. The contamination among the actors promote and generate a high value-added and an advantage for competitiveness.
After business planning and actors' involvement, they organise the activities with lean and agile methodologies by programming everyday stands up and weekly meetings and communicating, within and outside the space, with post-its and support technologies. Concerning the activities developed, Dihx was primarily set up to accompany small and medium-sized enterprises through the digital transformation process. They involve various companies, such as artisan, metal mechanical and companies in the automotive and i-tech sectors; thus, they have a diversified and heterogeneous range of organisations that participate in the activities and may contaminate.
Dihx mainly plays the role of facilitator and helps companies through accompanying activities, guidance, and consultancy, as well as courses, workshops and lecturers. Then, they have a section of their space dedicated to testing and prototyping activities to support organisations and individuals in the path of idea generation and startups before obtaining an investment.
The knowledge providers are mainly researchers who develop research and then spread it through courses, workshops and other educational activities, also cooperating with professionals.
Talking with the CEO, the importance they give to the advanced technologies emerged. Specifically, big data analytics and artificial intelligence are implemented as learning objects because they may support companies in carrying out their activities. They organised a summer school for learners dedicated to machine learning, deep learning and artificial intelligence. Then, with the same lecturers and researchers, an internal training course is organised; in this way, the actors in the learning space can get to know these technologies. Dihx also develops demos, including physical ones, to demonstrate to companies the potential of artificial intelligence and other advanced technologies applied in specific contexts. Hence, they have developed, for example, a demo showing how to use artificial vision to recognise defects or to monitor energy for environmental sustainability in an Industry 5.0 logic.
Other activities are conceived to reach individuals, not only companies and improve their digital skills and knowledge through specific educational paths.
They assess the impacts at the end of each specific project and activity. Continuous monitoring is implemented during daily and weekly meetings. Tasks accomplished and to be accomplished are assigned a weight in order to monitor the most relevant ones more frequently and consider them as priorities. Other evaluation dimensions are turnover and the number of users accessing the services offered. In addition, they often distribute questionnaires to understand the level of involvement and satisfaction of those involved, but also to measure return in terms of visibility that certain activities give at a media level. They need a staff figure in charge of communication and marketing. However, they all feel responsible for spreading information about the activities developed on social, newspaper, institutional and digital channels. They use messaging apps, slack, and OneDrive software to communicate internally.

Case 9 - Ox

Ox is a public-driven learning space for innovation that aims to create a territorial meeting place to encourage contamination and innovation between different actors. In the learning space, opportunities

for discussion and communication favour the development of digital or entrepreneurial skills, curiosity, and networking.
Specifically, there are various objectives, such as the development of apps and infographics, the release of a series of open data, and finally, the creation of courses and training opportunities for digital literacy and education.
Some of the objectives are defined in a top-down approach, from the public call of the Veneto region, but the project manager stated that their general purpose is to innovate and create a community; therefore, they implement further actions and define sub-objectives to achieve this aim.
In this vein, from a managerial point of view, they first carry on a need analysis, gathering insights and ideas from the territory. Then, these insights are merged with the objectives that are already provided. In this way, they continuously update the objectives and align them to the actual scenario. After analysing the territory's needs, the courses and activities are constructed in response to those needs after an extended listening and co-designing phase while considering the macro objectives set out in the call for proposals. Co-projecting is also applied to design the physical setting of the space, following a shared urban regeneration process and not a mere redevelopment of some abandoned spaces.
In this vein, great relevance is assigned to the interactions with the territory, and the project manager claimed that "We do not have just one physical location, we have a central location and ten satellites (...) The central setting is a place of aggregation, but we also have a network to support more rooted in the territory; the satellites are the first real gateway to meet the learners." Communication and identity development become central in this discussion, and Ox's staff is committed to constantly updating the website, social media pages, and broadcast channels.
Even before establishing and differentiating the core activities, Ox won the trust of individuals and organisations in the area, positioning itself as a reference point for the territory and enhancing its social value.

Once the target is involved, they organise different activities and projects, in particular:

- Training paths;
- Seminars;
- Higher education paths, in cooperation with the universities;
- Contamination Lab, a project organised for various targets that serve to build a sustainable business model in the future;
- Hackathons;
- Informal events, realised in partnership with partner associations, e.g. a program called Designer for two days, with some days dedicated to problem-solving and design thinking to get learners to develop an innovative mindset;
- Co-creation of apps and infographics for social innovation.

Some of the topics covered are:

- Entrepreneurship;
- Digitalisation and digital competencies;
- The human-centric revolution and Industry 5.0;
- The value of machine learning in manufacturing activities, especially in storage management activities;
- The potential of IoT and the metaverse in tourism about the proposition of tourism products.

They want to bring an innovative way of thinking and of solving problems even in small and medium-sized companies in the area, which, despite the experience they may have, are more tied to some more traditional processes.

The knowledge providers are often professionals, such as managers at Google and Diesel, and students, to allow them to express their digital training potential.

They rely on the public administration concerning budget planning and funds allocation. It is a public initiative with all the advantages; consequently, the institutional scenario has a significant influence. Talking to the manager, it emerged that increasing relevance is given to the assessment of the impacts. About Ox, they are still at an early stage in developing and implementing assessment tools and indicators. They rely on the next-generation EU targets, especially satisfaction and competencies.

On the other hand, from a qualitative point of view, they would like to analyse the impacts that may cause with their space, particularly on digital innovation and culture and social innovation.

4.6. Compared analysis of the case studies

The management dynamics of the visited technology-enhanced Learning Spaces were examined in detail in the section before. The acquired evidence is now subjected to a comparative analysis that will be discussed below.

Findings demonstrate that the general aim of all the spaces is to foster innovation dynamics, and before choosing one or more specific strategic intentions, the leaders of the technology-enhanced learning spaces carry out an analysis of the context and the territory.
The analysis of the context has manifold aims. First, the external environment, at a local, national and international level, can provide opportunities or hinder the development of technology-enhanced learning spaces' activities. In this vein, leaders detect legal, institutional, political, economic and social barriers or obstacles that need to be faced or turned into opportunities. On the other hand, examining the economic scenario is fundamental to catch funding or business opportunities. Consequently, they are all engaged in tight and challenging budget planning and reporting activities, even though they rely on miscellaneous business models.
Specifically, some technology-enhanced learning spaces for innovation are private initiatives that base their business model on economic results; accordingly, they seek to engage in profitable activities and valuable business opportunities. Then, there are technology-enhanced learning spaces for innovation that base their activities on public calls for financing projects (from municipalities, national and international entities). The involvement of the institutions in this initial step influences all the management phases. Some other labs are managed by universities, schools, or research centres and work as a bridge between the business and the academic scenario. Usually, they are not profit-oriented and operate in cooperation with educational institutions. Non-profit-oriented spaces, primarily aimed at achieving social aims, can also develop some of their activities thanks to voluntary and civic services. Finally, some spaces seek private financing opportunities from investors or institutions, such as banking foundations. In this last case, the image and the credibility shown from

the spaces have a significant role. Leaders and staff are engaged in communication activities to demonstrate their value and identity to raise funds for long-term sustainability.
However, most spaces adopt a mixed approach, taking advantage of various financing methods sustaining distinct activities and projects. Two Finnish LSs, for instance, were initially formed in an Academic setting, but their projects and activities overcame the university's boundaries, involving private organisations and individuals. On the other hand, various learning spaces under analysis participate in public calls and engage in specific projects, maintaining, at the same time, profitable activities to have funds to draw from or rely on volunteers to develop basic tasks.
A further purpose of the context analysis is to focus on the needs and the requests of the target, the potential target and the other actors involved. Regardless of their nature, the LSs of innovation are constantly engaged in continuous connections and interactions with the territory.
In this perspective, community creation and development is a significant and necessary measure to envisage as an initial phase for all the spaces under analysis. Consequently, the initial actions, synergistically with the context analysis, are taken to engage individuals and involve them in defining the value proposition. There are often two primary forms of defining the value proposition and the strategic intention, mainly depending on the nature of the spaces.
It may depend on learners (individuals and/or companies) who approach the technology-enhanced Learning Spaces for innovation to acquire new knowledge or specific skills and, therefore, have specific requests. In this case, the space's leaders engage in co-creation and co-design activities to define the main purposes. Then, it may be defined in line with general needs detected in a specific territory, for instance, the need to develop digital competencies. Even in this case, a bottom-up approach is implemented. An additional scenario arose when the learning spaces draw from public funds. In that case, the public call defines, with a top-down approach, the objectives and specific targets and measures to evaluate the level of achievement. Despite the boundaries depicted by the public calls, the value to deliver is not imposed, but is flexible and adaptable and thus continuously aligned with the evolutions of the territory's needs.

After the value proposition has been defined, it is standard practice across all spaces to start the planning phase. In particular, they create partnerships and work teams, specify training curricula, list necessary tools, equipment, and resources, and schedule events and activities, and their timing. Depending on the goals and objectives of each laboratory, these activities are tailored accordingly. A common trait that emerged from the interviews is the habit of focusing on manifold activities and projects carried out independently and with different timing.
To this point, the setting and the technologies and software dimensions are created or adjusted in relation to the planned activities and events.
Moreover, managing a space supported by advanced technologies presents further barriers. Notably, introducing and using advanced technology requires effort and specific skills, and it acts as something other than a substitute for human resources. Nevertheless, it has the potential to enrich learning and knowledge processes and foster innovation dynamics if used effectively. This phase seemed to be hard to manage from the discussions with managers. In fact, difficulties emerged considering the implementation of advanced technologies as well as the measurement of their impacts on the learning and knowledge processes. Despite this, all the leaders are optimistic and willing to integrate more robustly the advanced technologies in their learning spaces for innovation, aware of their great potential and growing relevance in the current scenario. Moreover, after the pandemic, switching

from face-to-face to virtual activities has become a custom for all the learning spaces for innovation. In fact, most of them are engaged in delivering the activities in a hybrid way and this allow them to broader the potential target.
Once the innovative goals and the resources required to reach them have been established, there is a propensity to begin the operational stages for developing learning and knowledge processes.
This step constitutes the technology-enhanced Learning Space's core phases and is carried out differently depending on the type of space being analysed. Therefore, depending on their scope, the spaces engage in different activities to cultivate knowledge and learning. The common trait is the creation of a climate prone to innovation. Specifically, all the leaders evidence the necessity to enhance a friendly, informal and creative atmosphere, adopting active and motivational methodologies, such as gamification, work-groups projects, brainstorming, matchmaking events, innovation challenges, hackhatons and so on.
In this phase, the knowledge providers that are figures familiar to all spaces, come into play. They act as facilitators and promote the co-creation processes that involve all the participants and help to integrate objectives and strategies. Formal and traditional lectures are occasionally organised to strengthen a trustworthy and reliable image of the learning space.
Concerning the specific activities and events developed, the spaces that foster the creation of digital competencies will work to define adequate courses, seminars, summer schools, and training programs.
Those focused more on entrepreneurship will operate to identify the best experts, tools, and phases to sustain the idea-generation process. On the other hand, the ones aimed at enhancing social innovation will engage more in organising matchmaking and community events.

However, the significance and centrality given to community development concerns more than just this last category of spaces, as already evidenced.
It can be indeed considered as a transversal activity for all the LSs. A recurrent trend regarding most of the spaces analysed is that they are designed with a diffused layout that foresees widespread distribution with smaller places rooted in the territory or on different university campuses. They aim to facilitate continuous community development, contamination, cross-fertilisation and co-creation activities. Consequently, LSs are located in specific contexts and territories and are always open to and influenced by the external ecosystem. Several consequences derive from this assumption. First, they have to quantify and manage public institutions' influence on their activities. This is especially true for spaces based on public initiatives and spaces engaged in activities with citizens and not only private organisations. Second, they have to put effort into communication activities. Effective communication supports the development of valuable partnerships and collaborations in terms of resources and expertise, as well as enables a precise and clear interaction with the target.
Learning Spaces for Innovation are thus considered as platforms, relational places, and intermediates that facilitate the creation and strengthening of a community engaged into innovation activities. This phase also offers ways to involve and include internal and external actors continuously. In order to support the stimulation of innovation through learning and knowledge processes, external players are chosen to fill internal gaps, providing additional expertise and addressing issues from other viewpoints to the typical views of the internal actors.
Others concerns to address regard privacy, accessibility and inclusivity. Privacy concerns are assuming a growing relevance, especially in learning spaces that use virtual platforms, AI or Big Data

technologies. Exploiting data can provoke data breaches and unauthorised access to personal information, and the leaders and staff of the learning space must not allow this to happen. On the other hand, to ensure accessibility, anything that can restrict activities for people with disabilities must be taken down. Concerning inclusion, all people must be considered valuable members of the learning space and should feel free to express themselves, their opinions and their feelings.

An interesting aspect that emerged from the analysis of the case studies concerns the implementation of lean and frequent monitoring of the activities and results. Specifically, all the managers interviewed stated that they constantly track the feedback of the participants and the changing conditions of the scenario and the external environment. In this vein, meetings, brainstorming and events are organised to activate continuous learning mechanism and to understand, from the participants' perspective, what are the weaknesses to address and the strengths to focus on to continuously improve the quality and effectiveness of the learning spaces' activities. At the same time, they are also used to analyse any deviations between expected and achieved results and to reprogram and readapt new paths.
This phase can be considered transversal because it informs and provides insights for every previous phase. However, once a project or a conducted activity is concluded, it is common practice to spend moments of reflection and discussion about the activities' quality and outcomes.
The outcomes are often measured in terms of new competencies developed and satisfaction. The leaders of the LS distribute surveys that provide a broad view of the objectives' achievement level. However, assessment is a frequent subject of conversation and managers appear to be working on it and for which they would be willing to get support. Learning spaces linked to public initiatives frequently report on their work and assess their activities, taking account of quantitative indicators provided by call. Often, these indicators concern the number of participants and the level of achievement of the set objectives (e.g. number of events organised, number of app developed etc.).
On the other hand, spaces based on private initiatives are more concerned with measures pertaining to financial returns.
The respondents consider these indicators fragmented because they do not provide a complete picture of the health and effectiveness of the technology-enhanced Learning Space for Innovation, especially regarding long-term impacts. According to their opinion, the lack depends on the difficulty of tracking valid metrics. Consequently, it emerges a need for more rigorous and structured methods for evaluating performance and measuring the generated impact. This is true especially in terms of long-term impacts on innovation and digital innovation.

After the comparative analysis, certain processes showed clear recurrence, repetition, and replicability patterns. These steps can be envisioned as distinctive phases of a learning space for innovation management model, which will be presented in the next paragraph.
The crucial steps that drive the proper management of a technology-enhanced learning space for innovation are summed up in this model. It serves as a helpful tool that generalises the aforementioned elements, ensuring reproducibility and presenting a clear understanding of a phenomenon.

However, it should draw attention to the fact that not all of the examined technology-enhanced Learning Spaces for Innovation satisfy all of the steps listed above. Some of them are only interested in one or two processes, and as a result, they are encouraged to engage in collaborative dynamics with other spaces operating in the same ecosystem. As a result, the proposed model covers all the

stages that an organisation should take into account while planning to create knowledge and learning processes that promote innovation dynamics.

4.7. Technology-enhanced learning spaces for Innovation - Management Framework

The multiple-case study has provided useful insights to understand the functioning and standard management practices of a technology-enhanced Learning Space. The triangulation of these insights with those emerged from the systematic literature review, lead to the identification of three subsequent critical phases *i) Define, ii) Cultivate, iii) Collect* and two transversal phases distinguishing the management of a technology-enhanced Learning Space for Innovation, i.e. *iv) Analyse, and v) Involve & include.*

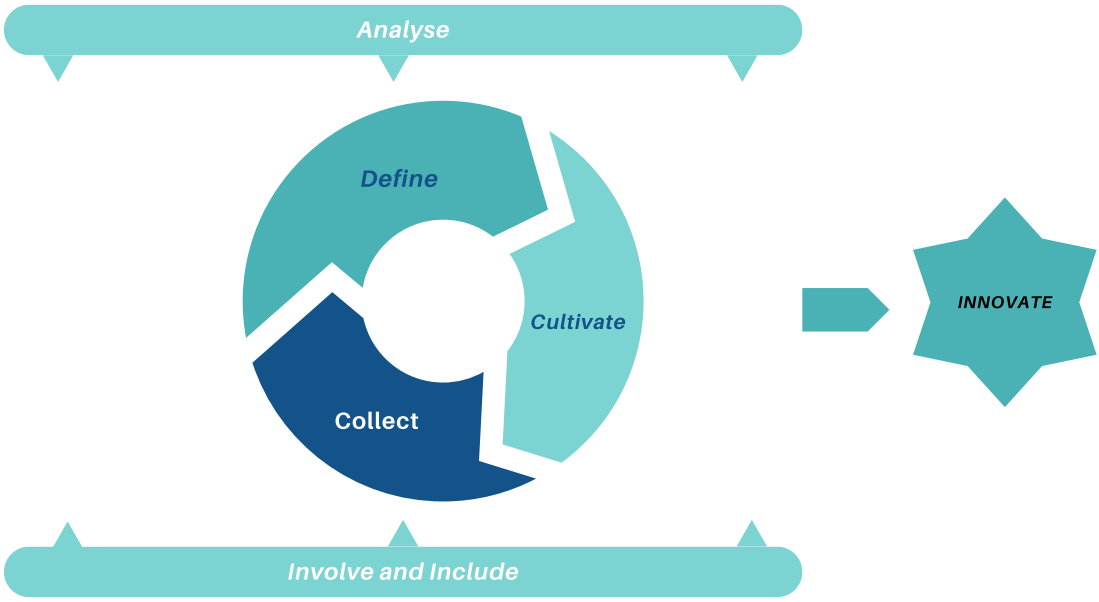


Figure 12. Management model of Learning Space for Innovation

The "Analyse" phase is a transversal phase aimed at creating and maintaining the optimal conditions to develop effectively the activities within a technology-enhanced Learning Space for Innovation. Specifically, it foresees a context analysis to address social, legal and political barriers, seek economic opportunities, and detect the territory's needs. Then, it also envisions continuous monitoring activities, carried out through frequent meetings and brainstorming, to provide updated information and insights for managing the learning spaces' activities and adjusting the paths to the evolving context.

The second transversal phase, namely "Involve and Include", is devoted to the activation of communication activities and dynamics aimed at facilitating and encouraging the development of quality relationships and, consequently, the creation and continuous reinforcement of an innovative community. Moreover, the technology-enhanced Learning Space for Innovation may act as a critical intermediary and innovation catalyst in this community and build valuable external partnerships with various stakeholders (Bianchi & Vignieri, 2021; Delgrado et al, 2020; Elmadani et al., 2015;

Esichaikul et al., 2013). The organisational atmosphere and culture support this phase, reducing hierarchy, allowing learners to express themselves, and stimulating creativity and knowledge creation and exchange. In this perspective, it becomes essential to overcome all the issues concerning privacy concerns as well as accessibility and inclusivity concerns. (Lee and Tan, 2023; Black & Mischel, 2023; Montiel-Ruiz et al., 2023; Gupta & Priyanka, 2023; Lazzari, 2023; Abuhassna et al., 2022; Csizmadia et al., 2022)

The further phases are presented through a cyclical shape. The first one is called "Define" and aims to define the value proposition and the objectives derived through a shared vision and develop a strategy and a project plan to achieve the goals.
Specifically, the value proposition and correlated objectives may be defined with a top-down or bottom-up approach, and the planning is tailored to the goals to reach. The planning foresees the definition of the core activities, the strategic resources with a detailed focus on technological resources, and the budget plan. The matrix developed in the previous paragraph (tab.6) supports the implementation of advanced technologies, defining their nature and the boundaries of their use, understanding why, how and when using a specific technology.

The "Cultivate" phase starts once the optimal conditions and objectives have been addressed and it is strictly linked to the structural dimensions of the space. During this phase, the core activities of a technology-enhanced Learning Space for Innovation are carried out. Specifically, the knowledge and learning dynamics are activated through specific methodologies and activities, determined and developed case-by-case according to the goals, the target and the resources.
At this point, the technology-enhanced Learning Space for Innovation should provide all the needed features and dimensions to support the development of activities aimed at triggering innovation dynamics through learning and knowledge processes. Specifically, the knowledge providers should facilitate the dissemination of concepts and topics, providing, at the same time, services like mentoring, coaching, or facilitating sessions. Moreover, the setting should be adaptable and flexible, the technological infrastructure should be stable and functional, the activities should favour high-quality relationships, and the atmosphere should promote innovation. Added services and supporting activities should be provided as well.

After the core activities have been developed, the 'Collect' phase aims to gather thoughts to stimulate reflections and assessment of the outcomes and the impact achieved. Final results from activities are compared with initial aims to identify insights from which to learn and develop innovation activities and strategies. The cyclical shape of the last three phases deserves a broader discussion. The insights derived from the last phase trigger the activation of continuous and incremental improvement cycles and guide organisations in continuous innovation processes that are increasingly necessary to compete in the current continually evolving competitive scenario.

4.8. Discussion

A multiple-case study analysis was required to fill the gaps revealed by the prior systematic literature review. First, it was essential to confirm the patterns related to the design and functioning dimensions that define this kind of Learning Spaces, implementing a sample of actively engaged technology-

enhanced Learning Spaces for Innovation. Furthermore, it helped to analyse deeply other relevant issues about the management of these facilities. In this line, a Learning Space's management framework was suggested as a result of a comparative examination of the cases' findings. The framework stresses the essential phases to manage a Learning Space for Innovation effectively.
Other critical aspects of Learning Spaces for Innovation have emerged from the revised literature and empirical investigations. Given an excellent adaptability capacity, the learning spaces are evolving faster in line with the landscape's evolution.

As mentioned, the new scenario appears distinguished by highly influential technology and digital components that affect organisational attitudes and behaviours. As a result, processes for learning, gaining and retaining knowledge alter concurrently. Thus, learning spaces for innovation increasingly pervasively include advanced technologies to enrich learning or organisational processes or as learning objects to disseminate an increasingly advanced digital culture and skills. In doing so, it obviously encounters some barriers but simultaneously becomes more dynamic, adaptive and inclusive.

In addition to the technological aspect, another component that comes increasingly into play is developing a community around the learning space. Discussing internal and external relations thus becomes reductive, as the learning space for innovation is evolving, changing its setting as well, intending to be ever closer and more widespread in the territory where it is located. In this vein, a new configuration emerges from the analysis of the case study, that is the diffused learning space, where a central and more equipped place acts as a coordinator of smaller sites that are located diffusely. Consequently, these spaces are rooted in the territory and continuously influenced by open innovation, cross-fertilisation and co-creation dynamics.

In this regard, a new and more up-to-date working definition of Learning Space is required, with a specific focus on innovation, which considers the latest emerging trends and leads to reconsidering an emerging configuration of these structures in a more open perspective and fully incorporated into the ecosystem.

It follows that a technology-enhanced Learning Space for Innovation is: *a dynamic space - of physical, virtual and hybrid nature - characterised by action and interactions among different actors and their capabilities, which promotes cognitive processes and sustains knowledge and learning dynamics through its tangible and intangible components, especially exploiting the potential of advanced technologies. It aims to promote and encourage innovation dynamics and capacity and to influence and be influenced by the territory in which it is embedded, stimulating the development of a community.*

The triangulation between the data emerging from the literature and the analysis of the case studies led to confirm the relevance of these spaces as powerful means for organisations to stimulate innovation effectively, relying on dynamics of knowledge and learning.
At the same time, the research highlighted some gaps that need further investigation, especially at the operational level. Given the level of pervasiveness of advanced technologies in the current scenario, envisioning a space for learning and innovation not equipped with these technologies becomes

unimaginable. Despite this, and despite the efforts made by those who develop and manage these spaces, several barriers often do not allow the maximisation of the potential of these technologies in knowledge and learning processes. At the same time, the need to assess and have tools to evaluate the long-term impacts caused by these spaces has also emerged. Consequently, the next section of the research will focus on an industrial practical question to support the management of technology-enhanced learning spaces for innovation that implement advanced technologies, considering solutions that address the critical issues that emerged and assessing their performances. The research will also prove to be useful for further validating the proposed management framework through practical experiments in direct collaboration with a company.

V. VALIDATING THE TECHNOLOGY-ENHANCED LS MANAGEMENT MODEL AND ASSESSING THE LS EFFECTIVENESS IN STIMULATING CONTINUOUS INNOVATION: AN ACTION RESEARCH PROJECT

5.1. Introduction

The proposed *Technology-enhanced learning spaces management framework* is aimed at supporting organisations in developing LSs as powerful means to stimulate continuous innovation effectively, relying on dynamics of knowledge and learning. It requires further empirical investigation to test and increase validity, reliability, and effectiveness.

Furthermore, considered that the Learning Space under analysis aims to generate social innovation, cooperates with SMEs and is developed in a rural area, an empirical investigation is required to assess its efficacy to support organisations in embracing continuous innovation paths, even in rural areas.

In this regard, action research (AR) has been selected as a research methodology in the pursuit of fulfilling the aforementioned objectives. Since AR "aims to solve pertinent problems in a given context through democratic inquiry in which professional researchers collaborate with local stakeholders to seek and enact solutions to problems of major importance to the stakeholders," it comes out as a suitable methodology (Greenwood and Levin, 2008, p. 72).

Moreover, in this method requires a breadth of pre-understanding of the knowledge that the researcher brings to the research project (Coughlan & Coghlan, 2016), specifically, in this case, the knowledge derived from the literature review and the multiple case study approach.

Therefore, this section entails an AR project carried considering and following a project that has been developed from "Openet spa", an organisation operating in Matera, in the field of satellite telecommunications, by designing, building and managing advanced networks of information / communication for public and private operators.

This chapter is structured as follows. Section 5.2 theoretically describes the methodology and explains the reasons to adopt AR methodology in this research. Section 5.3 describes the carried out project in details, and section 5.4 discusses findings in terms of Learning Space's effectiveness in supporting continuous innovation paths, management model validation; advanced technology implementation and performances to assess. Further insights are also provided concerning the potential of technology enhanced learning spaces for innovating in rural areas.

5.2.The reasons to adopt the AR in this research project

Shani and Pasmore (1985, p. 439) define action research as "*an emergent inquiry process in which applied behavioural science knowledge is integrated with existing organisational knowledge and applied to solve real organisational problems*". It follows that it is needed to cause changes in organisations and develop advancements in scientific knowledge, providing, at the same time, opportunities for cooperation and co-inquiry between organisation and research (Coughlan & Coghlan, 2016). These opportunities also arise because the researcher becomes an insider, and its interventions trigger new and additional practices in areas related to research as well as to practitioner interest (Ollila & Yström, 2020). In fact, Coughlan & Coghlan (2016) stated that the aim of an action research is double, specifically, to solve a practical problem and to contribute to knowledge. In this specific case, AR might contribute with valuable insights to theory develoment in Innovation and Knowledge Management (Ollila and Yström, 2020).

There are then many reasons why the AR approach was chosen for the current inquiry. The first explanation is the chance to assist Openet, the company taking part in the research project, in boosting its capacity to continuously innovate, through its technology-enhanced learning space. Then, to advance knowledge in the field of innovation management and knowledge management. Managing innovation is becoming increasingly challenging. In order to facilitate the interaction of multiple actors that develop new products, services, knowledge, business models, and applications, new collaborative organisational constructs are required. In this vein, AR is a suitable research approach for enabling a continued exploration of current trends, issues and practices in innovation management (Ollila & Yström, 2020). AR in innovation management is particularly well-suited for investigating situations or problems that are typical of emerging scenarios in order to transform practises through interventions. In this vein, the literature outlines three key advantages of conducting AR in innovation management. Specifically, AR has the potential of "(1) providing closeness to living emergent systems, (2) generating rich insights, and (3) generating knowledge for both rigorous theory development and change in practice" (Ollila & Yström, 2020, p. 398).

Consequently, AR is about interactive research, and the challenge for researchers is to take action and contribute to practice, reflecting on it while contributing theory to the body of knowledge. The interconnection between theoretical and practical evidence is essential in Innovation Management (Ritala et al., 2018), and AR makes it possible to generate valuable and rigorous knowledge (Hodgkinson & Rousseau, 2009). Moreover, AR is the most appropriate strategy to analyse complex phenomena, to obtain an holistic understanding, and to have a broad view of how the system works (Coughlan & Coghlan, 2016).

However, given that AR is a methodology that requires continuous exchanges and trade-offs regarding researchers' thinking and acting, it also presents some critical challenges. Three unique features related to the adoption of AR are: the procedure involves a dual aspect of reflexivity and progression, the researcher assumes the roles of both an outsider and an insider, and the result encompasses both general and specific aspects. Therefore, the researcher has to be able to consider the emerging paths and intervene to induce improvements.

The challenges lie in the researcher's dual role as both an external observer and an active participant. Striking the right balance between maintaining an outsider perspective and becoming integrated into

the organisation is crucial. However, it is essential to refrain from becoming overly involved, especially when organisational strategic decisions are involved.

In such instances, maintaining objectivity and acting as an external consultant is crucial to uphold the rigor and quality of the research.

The objective is to produce results that inform both practical applications and academic research. Achieving this involves utilising AR and actively participating in the research process alongside practitioners. This collaborative engagement allows for the gathering of insights from practice, facilitating the development of theoretical models. Simultaneously, these models can be applied to instigate practical advancements, evolutions, and innovations. The execution, communication, and engagement of involved actors in projects are integral processes to comprehend the undertaken initiatives, emphasising the interconnected relationship between theory and practice.

In conclusion, no research approach is exempt from limitations. Noteworthy constraints of this approach include the necessity for access to organisations willing to engage in practitioner-researcher collaboration (Israel et al., 1992), its time-intensive nature, and the potential for overwhelming volumes of research data. Practical limitations also arise when investigating AR on digital platforms, particularly when the researcher is deeply immersed in platform actions.

When the research focus extends to exploring tacit aspects of practices and processes within an emergent or dynamic context, AR emerges as a potent methodology. Its effectiveness lies in its ability to uncover the underlying meaning constructions of individual actions (Coghlan, 2011) within formal and informal organisational processes and settings. It is arguable that deploying AR is neither justified nor appropriate when the research does not delve into organisational aspects or seek to instigate change and improve practices through interventions, as the benefits of the approach may manifest as impediments.

5.3. The development of the action research project

The section reports an AR project carried out in collaboration with Openet, a company that created its own technology-enhanced learning space, subsequently named *Sparkme*, to engage private and public companies and citizens in a process of social innovation.
During the AR project, I had the opportunity to interact with the company over a fragmented period of 16 months. Researcher and organisation defined the project's aim as boosting social innovation through a technology-enhanced learning space and gathering valuable insights about the validity of the management model, exploring deeper the assessment phase.
The **participant organisation** was particularly interested in understanding what performances to consider for assessing the learning space's effectiveness in promoting innovation dynamics. Their interest also lay in managing those kinds of spaces effectively, with particular attention to implementing advanced technologies. Consequently, they sought to explore management approaches conducive to fostering innovation and, in their case, social innovation, while mitigating obstacles and barriers that may have hindered the potential of their technology-enhanced learning space.
From the other side, the **researcher** was encouraged to carry out the AR project for the following reasons:

- Validate the proposed management framework;

- Implement the management framework, analyzing the necessary resources and dimensions to include in each phase and understanding its potential and weaknesses;
- Understand if managing the technology-enhanced learning spaces for innovation can ensure its efficacy in contributing to innovation;
- Understand what performances must be taken into consideration to assess the effectiveness of the space;
- Understand if a technology-enhanced learning space can promote innovation in rural areas.

Researcher	Company
How to ensure the effectiveness of the technology-enhanced learning spaces for innovation?	How to manage a technology-enhanced LS to boost social innovation dynamics?
What are the performances to consider to assess its effectiveness?	How to manage the advanced technology implementation in a LS?
How could the technology-enhanced LS management model help in achieving effectiveness and, consequently, innovation?	What performances to consider for assessing the learning space's effectiveness in promoting innovation dynamics?

Table 8. Action Research RQs

Moreover, the research design was formulated based on Burns' (2007) design principles for systemic Action Research (AR). Burns characterises this design as "*an emergent research design, an exploratory inquiry phase, multiple inquiry streams operating at different levels, a structure for connecting organic inquiry to formal decision-making, a process for identifying cross-cutting links across inquiry streams, a commitment to open boundary inquiry, and the active development of distributed leadership*" (ibid., p. 85). The systemic AR designs outlined by Burns (2007) inherently facilitate reflection on context-related aspects. Hence, it was also considered that Openet activities and projects were mainly developed in rural areas, including cooperations with SMEs. In this perspective, to align the analysis with the context where it is carried out, another perspective was introduced to understand if technology-enhanced learning spaces can support companies and SMEs in innovation paths also in rural areas.

During this collaboration, the processes of context analysis, project analysis, implementation of the management model and collection of the results was carried out through a circular AR process where the parties involved created new insights and defined activities for further collaboration.
Furthermore, the broader aim of knowledge developed from AR is to "provide a better understanding in order to support and promote better managerial and organisational practices" (Palshaugen 2009, p. 231).
It can be inferred that fostering interactions among stakeholders, members of the organisation, and researchers is essential. All involved participants contribute their knowledge bases to collaboratively address and navigate an issue (Eikeland, 2007).
According to Flood (2001), "systemic thinking is not an approach to action research, but a grounding for action research that may broaden action and deepen research" (ibid., p. 143). In line with this perspective, the findings from the previous chapters, especially the management framework, provide the lens for interpreting the work within the action research project.

Furthermore, given the significance of collaboration between researchers and practitioners, the project's nature was iterative, involving continuous adjustments in information, insights, and the phenomenon under study. Consequently, this study does not view collaboration as a linear process to achieve a predetermined goal. Instead, it acknowledges that realignments of objectives were essential throughout the research, where each Action Research (AR) cycle was influenced by the preceding one.
In practice, the collaboration with the company started in May 2022 with an initial discussion on expectations and objectives and definition of the RQs. In this vein, the collaboration between the researcher and the organisation's team started with an observation phase to understand the nature of the project that they were developing, namely *Sparkme*. Engaging in this activity proved beneficial for comprehending the organisation's landscape, considering its vision, strengths, and potential barriers and conflicts.

To resume, the AR project consisted of one cycle in which the company's development of the *Sparkme* project has been examinated.
A second cycle, that is currently in development, fed by the results and reflections arising from the first, which focuses attention on the performance assessment with a more direct and calibrated involvement.
In accordance with the conceptual framework proposed, it is asserted that interventions initiated and carried out by external entities are incapable of altering the existing facets of corporate culture. The company, viewed as a self-referential system, will exclusively embrace changes that originate internally, generated by its own members. (Baitsch and Heideloff 1997).
Therefore, the study is designed as a gradual approach to the research field, which had a clear long-time focus on enhancing the organisation's social innovation capacity. In a nutshell, the intensity of interventions has been increasing gradually. It is crucial to note that the project commenced its development within the operational process by the end of March 2023. A second action research cycle is currently underway, focusing on a more in-depth investigation into performance assessment.

The qualitative methods implemented in this study are:

- *Narrative Interviews* (Kaudela-Baum and Endrissat, 2009), with Openet CEO and its staff. A narrative interview constitutes a qualitative research approach wherein information is gathered through extensive, open-ended conversations with individuals. Unlike structured interviews, which adhere to a predetermined set of questions, narrative interviews offer greater flexibility, permitting participants to articulate their experiences, viewpoints, and narratives in a storytelling format. The objective is to extract detailed and vivid accounts from respondents, enabling researchers to grasp the intricacies and context of the interviewee's life experiences. During a narrative interview, the interviewer typically encourages participants to narrate events, express emotions, and offer personal interpretations, thereby fostering a comprehensive understanding of the individual's narrative.
- *Observation* of Openet routines and attitudes during everyday work, regarding specifically the development of the Sparkme project, but also analysing the other projects. In the meantime, observations allowed to understand the organisational and the business scenario where the organisation operates.

- *Participant observation* is a qualitative research method in which the researcher immerses themselves in the environment or social setting being studied. Unlike traditional observational methods where the researcher remains a passive observer, in participant observation, the researcher actively becomes a part of the group or community under investigation. This involvement allows the researcher to gain a deeper understanding of the context, behaviors, and interactions within the studied group. In this case the participant observation was developed during the activities organised within the technology-enhanced learning space *Sparkme.*
- *Documentary analysis* was then conducted to gain a deeper understanding of the project, analysing internal organisational documents such as meeting minutes, reports, or memoranda, media content, namely newspaper articles, magazines, or online news reports can help understand media representations, framing of issues, and public narratives, social media contents to obtain real-time insights into public opinions, trends, or discussions on specific topics, and advertisements and communication materials (Prior, 2003).
- *Focus groups and meetings* were conducted during reflective phases with Openet staff. These sessions aimed to deliberate on results, extracting insights crucial for the appropriate development and implementation of social innovation processes.

In the following, these AR cycles conducted with *Openet in the* AR project are described in detail. Table provides an overview of conducted AR cycles, highlighting the main goals for each phase both for the researcher and the company.

Action research	Researcher	Openet
Diagnosis I	Definition of the research aims in lines with the organisation, analysis of the scenario of reference	Context analysis/ SWOT analysis
Plan I	Focusing on the structural dimensions of the space,	Transforming challenges and needs into opportunities
Action I	Implementation of the management model and generation of innovation dynamics	Developing the activities to boost social innovation
Reflection I	Feedback for the analysis, focus on performance dimension	Feedback collection

Table 9. Action Research phases

The next session will describe the company and the context where it operates, as well as the methodological and theoretical assumptions, which led to enhance continuous innovation dynamics.

5.3.1. Action research at Openet

The project has been carried out in collaboration with the company “Openet”.

Established in April 2000 in Matera, OPENET Technologies S.p.A originated as a spin-off from a group of researchers. Its rise to significance in Europe is attributed to an unwavering commitment to research endeavors and continual investments in technology and especially advanced technologies.

Initially conceived with a mission to address the telecommunications challenges in remote and geographically isolated regions, Openet experienced substantial transformations over the years.

Combining cutting-edge research, technological know-how, and smart partnerships places OPENET as a leader among Italian businesses, making a substantial contribution to developments in satellite communications and more general projects and activities developed with technologies and advanced technologies to boost social innovation.

Nowadays, OPENET operates from strategically located offices in Rome, Palermo, and Brussels, positioning itself as a dynamic entity capable of delivering sophisticated and innovative services aimed at addressing the digital divide. Specializing in satellite telecommunications, OPENET engages in the design, construction, and management of advanced information/communication networks for both public and private entities.

OPENET's approach conceptualizes technology as a significant and transformative tool, that they engage to boost social innovation and knowledge diffusion about STEM subjects.

Openet's organisational structure has developed into a corporate conglomerate that manages a number of projects and activities, each of which retains a unique degree of managerial and strategic autonomy while also making use of common resources and competences. The organisational culture is highlighted by a decentralised operational model, which places a strong emphasis on cooperative dynamics, knowledge sharing, information distribution, and adaptability. The maximisation of employee cooperation and information symmetry is a fundamental principle of this structure.
Facilitating open lines of communication with external entities, including consumers, suppliers, competitors, and institutional collaborators engaged in diverse projects, underscores Openet's commitment to fostering robust external partnerships. The strategic collaboration with the European Space Agency (ESA) has facilitated the organisation's international footprint, exemplified by the establishment of production units in Africa and Kenya.

The organisational resilience and flexibility of Openet is evident in its evolution from a focus on satellite connectivity to a more comprehensive role as a system integrator. This evolution encompasses planning activities, help desks, and content services, thereby extending its operational activities across the entire value chain. Core principles, including continuous training, openness, and equity, underscore an organisational culture wherein collaborators are afforded opportunities for individual development and potential realization.

Project engagement constitutes a significant facet of Openet's operational landscape, featuring initiatives such as SOLAR CLOUD for energy management, SMART BASILICATA for citizen

participation, and SWAY4EDU, a collaborative effort with international entities supporting educational endeavors in the rural terrains of Africa and Congo. Collaborative involvements with renowned organisations, including the Food and Agriculture Organisation (FAO), ESA, the Italian Ministry of Education, Universities, and Research (MIUR), and the Italian Space Agency (ASI), underscore the organisation's commitment to international cooperative ventures.

An inherent recognition of the pivotal role of research and development (R&D) emerges as an underpinning theme in Openet's operational discourse. The organisation acknowledges the imperative of possessing extensive and in-depth knowledge across multifarious domains to effectively navigate and sustain its diverse and intricate projects.

The project considers *Sparkme* as a technology-enhanced learning space for innovation, developed within an organisation but involging external targets.
SPARKme, situated in Matera, was born as a Technological Accelerator dedicated to fostering "technology transfer and capacity building," specifically aiming to facilitate the integration of space technologies, advanced technologies and satellite systems into innovative commercial applications. To achieve this objective, SPARKme employs a collaborative approach involving the exchange of experiences, knowledge dissemination, mutual enrichment, and discourse among entrepreneurs. The accelerator harnesses the extensive expertise of its partners and network, which includes the Italian and European Space Agencies (ASI and ESA), the National Research Council (CNR), the E4Impact Foundation, and OPENET. This collaborative synergy facilitates cross-disciplinary fertilization, extending its impact across various sectors.

SPARKme also functions as an innovative co-working space, providing professionals, entrepreneurs, and freelancers with a creative, dynamic, and engaging environment. Equipped with cutting-edge technology and infrastructure, the co-working space offers high-speed wifi, satellite connection, and other amenities. Workstations are available for rent on a flexible basis. The open space fosters collaboration, networking, and skill development. Engaging in a shared office environment offers manifold advantages, including networking opportunities, community involvement, events, and the potential for business and skill development. The inclusive rental fee covers all utilities, ensuring a seamless work environment. Additionally, residents can access complimentary consultations and participate in support programs for funding applications.

5.4.The first Action Research Cycle

The first cycle aims to demonstrate the validity of the Technology-enhanced LS management model for developing and managing a learning space to support the organisation in continuous innovation paths.
In this perspective, the implementation of the conceptual model first and the management model then may ensure the effectiveness of technology-enhanced learning spaces in supporting innovation dynamics. In fact, by implementing the management model, organisations can create learning spaces that are effective, dynamic, and supportive of continuous innovation, improvement and growth (Nonaka and Takeuchi, 2019; Lianto et al., 2018; Peschl, 2014). Consequently, ensuring the effectiveness of those kinds of learning spaces involves careful planning, continuous assessment, and

a commitment to fostering a culture of learning within the organisation. In the first chapter, an analysis of the tools and models used to understand if a learning space is effective in achieving its objectives was done. However, assuming the pedagogical nature of the learning spaces considered, the assessment models were fragmented or limited to specific factors, i.e. technology readiness or motivation, and need to be updated and adapted to the context of technology-enhanced learning spaces for innovation.
Furthermore, considering that *Sparkme* acts at a macro level, transversally to several actors involved, it is also possible to evaluate the impact that it can have at a community level in terms of the generation of social innovation. How, therefore, technology-enhanced learning spaces can help generate a high level of innovation that can impact at an individual, organisational and community level.
Similarly, the first cycle aims at verifying what dimensions of the space, derived from the literature review and the multiple case studies, characterise *Sparkme* and are involved in the various managerial phases.
It aims then at demonstrating the validity, the potential and the effectiveness of technology-enhanced learning spaces to boost continuous innovation dynamics (especially social innovation dynamics) enabling continuously, iterated and validated learning mechanisms.
This first cycle, as described above, takes place within *Sparkme*, Openet's technology-enhanced learning space for innovation.

The phases of the first AR cycle are described below.
Diagnosis 1: This observation phase includes all the activities related to the understanding the current situation or issue within the organisation.
It aims to clearly articulate the research aims to address, ensure that the problem is specific, relevant, and aligns with the organisation's overall goals. The diagnosis phase sets the stage for action research's subsequent action planning and implementation phases. It provides a deep understanding of the problem, engages stakeholders, and lays the groundwork for informed decision-making. Specifically, in this case, the analysis is aimed at understanding the context analysis, implementing a SWOT analysis and involving the actors.

Plan 1: The second phase is the planning phase. This phase is crucial for developing a detailed strategy and action plan to address the identified problem or issue, defyning what may be an opportunity. After a phase aimed at summarising the results of the diagnosis, a divergent phase of brainstorming is activated, involving participants to understand the needs, especially those not satisfied, behind which improvements can be made, identifying potential interventions and strategies. Moreover, the structural characteristics and dimensions of the space are analysed with the lens of the conceptual framework.

Action 1: The third phase is the action phase during which actions and opportunities are converted into solutions. In this phase, the management model has been implemented, monitoring and assessing the progress made. Then, data have been collected to adapt the interventions based on real-time feedback and unexpected challenges. The researcher participated to manifold activities, projects and lessons realized by Openet for the development of the *Sparkme* LS.

Reflection 1: In the final phase, a set of reflections is conducted to solidify the model, discern what proved effective and what did not, and identify areas for improvement. During this stage, contemplation centers on the activation of mechanisms aimed at generating novel and enhanced processes that leverage strengths while transforming weaknesses into key success factors.

This AR project intends to analyse the developement and management of technology-enhanced LS at an organisational level and whether it has impacted the organisation's capacity to engage in continuous innovation dynamics, specifically considering social innovation. Therefore, the focus is on the internal perspective of the companies' CEO and staff. It aims to understand the company's perspective on the effects of taking part in technology-enhanced LS's activities. However, considering that the whole project aims to boost social innovation, and that the technology-enhanced Learning Space for Innovation may act as a critical intermediary and innovation catalyst in the community, the external perspective is also needed. The focus is also on integrating these advanced technologies into learning spaces, which requires thoughtful planning and ongoing professional development.

Lastly, reflections are made to evaluate innovation based on learning and knowledge dynamics in rural areas aims to empower communities, enhance local capacities, and address specific challenges through a continuous process of knowledge acquisition and application. It recognises the importance of context-specific solutions and the potential for positive transformation through learning-driven initiatives.

The activities were carried out with observation, participant observation, interviews and meetings, analysing how the company prepares to build a technology-enhanced learning space, supporting its management by implementing the model and discussing about the performance assessment.

5.5.Findings

This action research project sought to empirically examine the effectiveness of technology-enhanced learning spaces in enhancing, cultivating, and augmenting the continuous innovation capacity within organisations. Additionally, it aimed to gather valuable insights about the usefulness and validity of the proposed model for managing technology-enhanced learning spaces, specifically assessing its potential application to enhance social innovation, particularly in rural areas.
Above, the action research cycle is detailed, specifically discussing the conducted activities and earned benefits. The aim is to demonstrate the effectiveness of technology-enhanced learning spaces in supporting organisations on their continuous innovation journeys in the Digital Age.

Below, the usefulness and value generated by a technology enhanced learning space are discussed. These dimensions are analysed with regard to the research's goals to

1. Assess the efficacy of the technology enhanced learning space management model ;
2. Focus on implementation and management of advanced technologies
3. Focus on the performance dimensions to assess to understand if the LS is effective in boosting continuous innovation in an organisation.

Among the objectives of this research was to ensure how the technology-enhanced LS could be considered a reasonable solution to stimulate the development of the innovation capacity of organisations and individuals.

As previously described, knowledge is recognised as having a pivotal role in the long-term success of an organisation and, more specifically, the creation and management of knowledge and learning dynamics are milestones that stimulate innovativeness, innovation capacity and innovation climate within an organisation (Yieldiz et al., 2021; Nonaka & Takeuchi, 2019; Abukhait & Pillai, 2017).

The AR Project conducted, in this sense, demonstrates how the technology-enhanced LS contributes to the development and reinforcement of continuous innovation capacity and social innovation.

The cooperation with the organisation and the first phase of the action research project started in May 2022, when the technology-enhanced learning space was at its first stages of development and continued during February 2023. During this phase, a context analysis was carried out. The main challenges emerged from the context concerned the innovation in rural areas, among SMEs. Scarce financial resources, limited access to skilled labor, and inadequate infrastructure often impede the initiation and sustainability of innovative projects. In addition, inadequate digital infrastructure, conservative cultural attitudes, and resistance to change can impede the adoption of new technologies and ideas. The sparse population density in rural areas poses challenges in attracting and retaining skilled talents, while poor transportation infrastructure hinders the movement of goods, people, and information. Limited market opportunities and lower demand for innovative products, coupled with dependence on specific industries, may discourage investment in innovation. Regulatory and policy challenges, including bureaucratic hurdles and outdated regulations, further complicate the innovation landscape. Natural resource dependency, susceptibility to environmental factors, and limited access to healthcare and social services also contribute to the complexities of fostering innovation in rural areas. The fragmentation of rural markets makes it challenging for innovators to reach and serve their target audience effectively. However, despite the difficulties in the territories around the main cities, Matera provides a particularly dynamic territorial context characterised by a dense concentration of businesses, production districts, economic and territorial governance entities, research institutes, and a university system. This context enhances constructive dialogue among academic, entrepreneurial, public institutions (mainly schools) and scientific communities. In this vein, the technology-enhanced learning space seemed the right solution to boost a virtuous knowledge exchange, learning and innovation because its capacity to act as a catalyst within a community.

During the following phases of the action research, three perspectives were deeply investigated:

- Advanced technology implementation
- Management of the technology-enhanced learning space
- Performance dimensions to assess

5.5.1. . Advanced technology implementation

The hybrid learning spaces under consideration is meticulously designed with a thematic emphasis on space exploration, specifically tailored for educational endeavors centered around the Moon and Mars. These flexible, adaptable rooms are characterised by minimalistic furnishings, adorned with murals and artistic depictions illustrating space-related themes. Within this learning space, distinct rooms are allocated for specific purposes, each with a different technology and advanced technology. During the AR cycle, the company tested the implementation of manifold technological tools. In the following, a technology matrix of the Sparkme LS is presented.

TECHNOLOGIES IN A LEARNING SPACE FOR INNOVATION		
	Basic technologies	**Advanced technologies**
NATURE OF THE TECHNOLOGIES - *WHAT*	• Digital platforms (Support to learning processes). • Dedicated space for recording, radio, and web radio activities (Support to learning processes). • "Kahoot!"- Serious game (Support to learning processes). • 3D and Videoconferencing Room (Support to learning processes). •	• Coding Drones and robots are used as learning object (Learning object). • VR/AR visors This high-tech cinema hall is equipped with immersive reality visors. The seats, mounted on a moving platform, enhance the cinematic experience through special effects, ensuring a fully immersive experience (Support to learning processes). • Planetarium delivering an immersive spectacle of the universe (Learning object).
BARRIERS	• Privacy and security; • High costs	
***WHY* ARE USED**	• Support to organisational processes • Support to learning processes • As learning objects	
***HOW* ARE EMBEDDED**	• Internally • Through external specialized partners	
***WHEN* ARE USED**	• In every project/daily	

Table 10. Sparkme technology matrix

Their strategic approach, concerning the advanced technology implementation, primarily leaned on forming partnerships with qualified technology experts, ensuring the involvement of experienced professionals in the sector. After this, they conducted technical training sessions to establish collaborative relationships. Within this framework, various training courses were organized, including sessions in mid-July and August, with a particular focus on science communication. These courses not only delved into technological aspects but also underscored the importance of effective communication and storytelling as a methodology supporting the advanced technology implementation.

The overarching strategy involved disseminating skills throughout the organisation, involving individuals with diverse backgrounds, including those with non-technical profiles. The objective was

to empower all staff members with the ability to engage in informative storytelling, irrespective of their existing technical expertise.

Openet, serving as the conduit for these courses, offered participants opportunities for hands-on workshop activities.

Feedbacks from both academic and private audiences has been positive, particularly towards technological attractions, particularly the virtual reality cinema and the robots. These interactive and digital elements are considered engaging and motivating. A high levels of digital competence is optional due to the accompanied and interactive nature of the experiences.

While the role of Sparkme staff as a facilitator in bringing the community closer to scientific subjects through technology has been successful, there remains a focus on expanding advanced technologies workshops for high school and university students as well as for companies' managers and employers. These advanced workshops may delve deeper into the use of technology, necessitating a higher level of digital competence.

Despite the high costs and privacy concerns, the cultural approach has not been considered a barrier. In contrast, it has motivated individuals, regardless of their initial technical expertise. The Sparkme's staff act as facilitator, successfully integrating technology into immersive experiences, making it an integral part of the storytelling process. This strategy ensures that individuals, even those unfamiliar with technology, become active participants in an experiential journey, demystifying and integrating technology seamlessly.

In conclusion, their strategy revolves around implementing technology as an inherent aspect of a narrative project, wherein individuals engage with technology organically within immersive experiences, aligning with their mission and value proposition.

5.5.2. Management of the technology-enhanced learning space

From the management perspective, the technology-enhanced LS management model resulted a valuable support for organisations to better managing the learning space, making it effective in developing continuous innovative capacity.

From this point of view, the project entails a continuous effort to carry out the "analyse" phase, to discern community needs, drawing from their own initiative and substantial sector experience. An integral part of their operational approach involves ongoing inquiry, feedback solicitation, and activities monitoring during the activities developed. Insights and feedback are continuously collected from early visitors and lead to valuable adjustments in decision-making.

The *Sparkme* landscape encompasses both fixed and temporary elements, and dynamic environment requires an ongoing process of intercepting opportunities at national and international levels, aligning them with the demands of the local territory.

Adaptation is a recurring theme in this innovative context, emphasizing a forward-looking narrative that integrates historical roots with innovative experiences.

The "define" and "cultivate" phases included a structured program of events, such as academy activities (realized also in cooperation with external partners), seminars, workshops, informal lectures, culminated in specific thematic events. These initiatives, were also aimed to raise awareness

about the project. The initiatives were analysed with a participant observation, where the researcher provided insights derived from the model.

Integral to this process was the "involve and include" phase. Their ongoing commitment to promotional, marketing, and communication activities was primarily conducted through social tools and a dedicated website. The fluid and dynamic nature of these initiatives emphasises the enduring and continuous character of their efforts in attracting and involving several different actors as learners, namely students, citizens, employers, and researchers. Moreover, during the research, the company was able to activate new collaborations with external
actors and reinforce their partnerships. This made it possible to optimise internal processes and create a community where to spread social innovation dynamics.
Concerning the financing activities, the public project's contribution was supplied only in the initial phases. Then, all the investments made since October 2021 are entirely privately funded. For certain activities or technological investments, there is eligibility for tax credits provided by the state, particularly for contributions to research activities initiated before the research project. However, these benefits are relatively modest, as many of the initiatives often rely on subsidised rate financing, which necessitates repayment. As a private initiative, the project is more significantly impacted, especially when seeking to strengthen the staff, incurring associated costs. Achieving a careful balance becomes essential. While assistance or support for such initiatives would be beneficial, considering their positive impact on the local area and tourism market, it is crucial to acknowledge that, currently, the project stands as a self-funded endeavour.

5.5.3. Performance dimensions to assess

Concerning the performance assessment, that are the specific dimensions or criteria used to evaluate and measure the effectiveness or success of the LS, the insights derived from the action research are manifold. Literature about learning spaces, as previously mentioned, focuses the discussions about learning spaces's performances predominantly on the external perspective, examining the competencies of learners and measuring their satisfaction levels. However, from the action research, and triangulating the data with the multiple case study, it emerged that the evaluation process should encompass multiple perspectives and several dimensions. This includes not only the learners' skills but also potential behaviour changes, particularly within an organisation. For instance, a learner aspiring to become a future astronaut might view these acquired skills not as an end but as a starting point for further development.

The speaker notes that there currently needs to be more internal tools for handling performance assessment of technology-enhanced learning spaces for innovation. While their focus is primarily on external processes, such as favourable reviews and feedback that contribute to word-of-mouth promotion, there is acknowledgment that data collection tools are needed for comprehensive evaluation.
Openet collects data at the end of each activity, about user satisfaction and, sometimes, it also receives spontaneous feedback. They also collect feedback about observations during this period, including considerations such as peak days, engagement, and user response to various formats. This iterative process acknowledges the dynamic nature of the project, which evolves continuous adjustments.

However, the challenge lies in tracking and assessing the long-term impact on learners and also on the community. The difficulty arises from the lack of traceability, and the speaker proposes that collaboration with schools could provide a solution. However, the speaker emphasizes that the responsibility for evaluating learning and competencies should be carried out in cooperation with external institutions. The idea is that public and private organisation cooperating with the technology-enhanced learning space and participating to their activities should generate data illustrating how these learning experiences impact on their competences, behavior and innovation capacity, providing valuable insights for the learning space providers.

It is acknowledged that tracking learners' achievement over the long term is challenging, but it is even more challenging to evaluate the impact on the speaker suggests waiting for public administration offices and companies involved in the project to take the lead in implementing comprehensive evaluation systems that provide long-term insights. Collecting initial feedback is possible, especially if an institute facilitates the process, but sustained tracking would depend on broader institutional involvement.

The primary objective of this performance assessment is to systematically evaluate the effectiveness and efficiency of the technology-enhanced learning space in boosting innovation and social innovation. The comprehensive assessment seeks to discern the strengths, weaknesses, and areas requiring improvement, considering also the implementation and utilization of technology within the learning space.

According to the action research approach, the performance dimensions to monitor, beyond the financial and economic indicators, are summarized in the following table:

PERFORMANCE DIMENSIONS	INSIGHTS
Reliability of the technological infrastructure:	• Reliability of hardware and software • Accessibility and usability of technology tools.
Learner experience and competences:	• User satisfaction • Learning outcomes.
Quality relationships:	• Communication Openness • Trust and Mutual Respect • Conflict Resolution • Empathy and Understanding • Collaboration and Teamwork • Effectiveness in working together towards • Shared Values and Goals.
Data Security and Privacy:	• Critical considerations encompass the security of data storage and transmission, compliance with data protection regulations, safeguarding user privacy and confidentiality, innovative approaches to

	enhancing data security measures, and considerations for social innovation in data governance.
Innovation Capacity:	• Capacity to adapt and innovate in response to the challenges of the external scenario. • Specific indicators related to social innovation (community engagement, the promotion of collaborative projects addressing societal challenges, integration of technologies supporting social impact, measurement of the learning space). (Lanzarotti&Manzini, 2008)

Table 11. Performance dimensions

Assessment methods to implement may encompass the collection of surveys and feedback from learners, analysis of learning outcomes and performance metrics, observations of user interactions within the learning space, and technical assessments of infrastructure and security measures. To understand whether the LS is the mean that impact on innovation dynamics it could be also useful compare the results of the learning space in question with a control group. The overarching goal is to enhance the overall performance of the learning space, ensuring an optimal and enriching educational experience for all users, while contributing to positive social change.

The II action research cycle will implement indicators related to the performance dimensions identified in a joint analysis with the COO, CEO and the staff of Openet. The project started in march 2023, there is then the need to collect data in a longer time – horizon perspective in order to complete the II cycle. This will be considered as a limitation of the research.

5.5.4. . Innovate in rural areas with technology enhanced learning spaces

Some others insights derived from the action research concern the usefulness of these kind of spaces in supporting innovation, fertilization, and co-creation dynamics in rural areas and among Small and medium enterprises. Rural areas are often complex and diversified realities, characterized by a range of unique challenges and opportunities (Wiggins & Proctor, 2001). Supporting and promoting innovation, sustainability, and economic diversification are key elements to ensure the long-term prosperity of rural areas and, in this vein, the technology enhanced learning space for innovation may act as a central hub, well-equipped and strategically positioned, serves as a coordinator for smaller, dispersed sites throughout the territory. These localized spaces, deeply rooted in the community, operate in a state of continual interaction with the territory.

In this vein, a technology-enhanced learning space assumes a pivotal role in fostering innovation within rural areas through multifaceted mechanisms. One of the main advantages is overcoming geographical constraints, thanks to technology solutions that enable individuals residing in rural locales to access in a place where they can be involved in. For example, during the pandemic, Openet

implemented an online platform to facilite continuous skill development and knowledge acquisition. In this vein, they continue to use this platform even within their learning space. Specifically, they developed a platform that enabled learners to virtually explore locations from the comfort of their homes. In contrast to passive tours commonly available on different platforms and museums, they incorporated interactive elements with a guide leading the group. This allowed participants to engage by posing questions and interacting during the virtual tour.

Moreover, they also try to facilitate the integration of STEM education in rural schools, cultivating an early interest in scientific fields. The provision of virtual research collaborations and remote access to scientific resources encourages local research initiatives, contributing to the innovation landscape in rural areas.

Furthermore, digital platforms for knowledge sharing and community engagement amplify the impact of technology-enhanced learning. These platforms enable rural communities to share knowledge, experiences, and local innovations. Virtual workshops and seminars hosted in such learning spaces bring experts and innovators to rural communities, fostering a culture of knowledge exchange.

Concerning the SMEs, as already mentioned, they are always committed to enhancing their ability to provide customers with better and innovative products and services but often operate with limited resources, including financial, human, and time-related assets (Carlucci et al., 2022; Lai et al., 2021; Cerchione et al., 2020; Corso et al., 2003). The support provided by technology-enhanced learning spaces empowers SMEs by offering access to specialized knowledge, fostering skill development, facilitating collaboration, encouraging experimentation, providing networking opportunities, keeping abreast of market trends, offering cost-effective solutions, and allowing for flexible learning paths. These factors collectively contribute to the exploration and realization of innovation paths for small and medium enterprises. In this vein, Openet has initiated numerous partnerships and engaged multiple SMEs through its technology-enhanced learning space for innovation. This initiative provides SMEs with the opportunity to engage in virtuous cycles of innovation, learning, knowledge exchange, improvement, and cross-fertilization dynamics.

In conclusion, a meticulously designed and managed technology-enhanced learning environment serves as a catalyst for spreading relevant knowledge, and cultivating an innovation-friendly ecosystem within diverse sectors of rural communities and among SMEs.

The research has illustrated the role of technology-enhanced learning spaces in enhancing innovation and social innovation dynamics within an organisation and extending beyond its boundaries. The action research further analyzes methods to ensure and evaluate their effectiveness in fostering these innovation dynamics. This demonstrates that the management phases, along with performance assessment, play a supportive and facilitative role in this process.

VI. DISCUSSION

In this chapter, findings are discussed by RQs, thus articulating considerations concerning the challenges that organisations face in the Digital Age, and addressing them. Then, entailing the RQ1, RQ2, and RQ3 reasons leading considering technology- enhanced learning spaces for innovation as a valuable solution to foster continuous innovation, looking at critical features, aims, advanced technology implementation and proposing, as outputs, two working definitions, a conceptual model, a management model and the performances to assess the spaces' effectiveness.

The research starts from a broad issue: How learning spaces based on advanced technologies can foster innovation in the digital age? And how to understand if they are effective?

The current scenario is characterised by complexity, volatility, and unpredictability, influenced by events like the pandemic and technological advancements. Industry 4.0 and 5.0 have reshaped work tasks, necessitating businesses to embrace digital transformation for survival and success. Continuous innovation is crucial for competitiveness and long-term growth, requiring active involvement of all stakeholders and a deliberate, structured approach.
Knowledge dynamics play a vital role in innovation, emphasising the need for spaces that encourage iterative refinement of knowledge and application of innovative methodologies. However, the fast spread of technologies, while enhancing accessibility, also poses challenges.
To address these challenges, organisations need versatile strategies that balance technology, actor interactions, and knowledge dynamics. One solution may be the development of spaces supporting learning and knowledge dynamics. The term "space", however, encompasses various dimensions, including architectural, social, psychological, and technological aspects. While various spaces like learning organisations and innovation labs are proposed, there is a lack of practical frameworks for their design and management, as well as an umbrella definition that may include different configurations of spaces.
The study first focuses on educational learning spaces to provide a definition, derived from the Constructivism theory of learning. An educational learning space is, indeed, "a physical space which supports multiple learning and innovation through different teaching methods, including emerging digital technologies, functional and stable physical infrastructures and a good cost-effectiveness balance that respects the environment and is in harmony with it, by also encouraging social participation, providing a safe, comfortable and stimulating environment." (Kuuskorpi, K. e Gonzàlez, 2011).
Educational learning spaces, whether physical or virtual, must be effective, respecting physical, virtual, and social requirements.

This broad issue calls for the individuation of more specific elements to describe and understand, namely the following research questions. The next paragraphs provide the results of a systematic literature review carried out to understand and define the key dimensions and features of learning spaces in management literature. The research aims to explore management and assessment of the performances of technology-enhanced learning spaces to foster continuous innovation in the Digital Age.

Discussing RQ1: ***What are the distinctive dimensions of a learning space?*** *What is a learning space? How advanced technologies are impacting on its evolution?*

The systematic literature review analysis contributed to the understanding of the concept of learning space in management literature. This study establishes a comprehensive definition of the concept of "learning space", by identifying critical aspects and interpretative dimensions. Learning spaces are seen as places of interaction between individuals, behaviors, and the external environment, that require a multi-dimensional perspective.

Key structural dimensions identified in literature include i)Actors, ii)Setting, iii) Technologies & Software, iv) Relationships & Networking, and v) Organisational atmosphere, culture, methods & practices, which mutually influence each other.

The evolution of the learning space concept highlights the impossibility of describing it without considering virtual or technological components. Strong technological influences have led to the definition of technology-enhanced learning spaces, encompassing physical, virtual, or hybrid spaces that promote cognitive processes and influence knowledge and learning dynamics. The definition emphasises tangible and intangible components with a strong technological presence. It follows that a technology-enhanced Learning Space 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."*

While the management literature provides some fragmented tools for managing and assessing spaces, there is room for further research. Future investigations focus on defining the management phases, and the performance dimensions, selecting appropriate advanced technologies, monitoring usage and engagement, and continuously improving activities within learning spaces.

To assess the effectiveness of these spaces in driving innovation dynamics, empirical research with multiple case study involving managers of technology-enhanced learning spaces is necessary.

In sum, the systematic literature contributes to understanding learning spaces as multi-dimensional, technology-enhanced environments, emphasising the need for further research in management and assessment dimensions, and the strategic value of knowledge in fostering continuous innovation.

The research, therefore, deeply explored the phenomenon, from an empirical point of view.

In the next section, the results related to RQ2 and RQ3 are discussed, to understand how technology-enhanced learning space effectively fosters continuous innovation in the digital age.

Discussing RQ2 e RQ3: RQ2) *How to manage a technology-enhanced learning space for innovation? How learning spaces' dimensions catalyse learning and knowledge dynamics, particularly for innovation? How to manage advanced technologies in a learning space for innovation?*

RQ3) *How to ensure the effectiveness of the technology-enhanced learning spaces for innovation? What are the performances to consider to assess their effectiveness? How to implement the management model to ensure their effectiveness?*

In this phase, a multiple-case study approach and then an action research have been conducted to investigate better and provide a clear understanding of the phenomenon.
The multiple-case analysis is carried out to address gaps identified in the systematic literature review regarding technology-enhanced Learning Spaces for Innovation. The analysis aimed to confirm design and functioning patterns and explore critical management aspects, leading to the development of a management model for effective innovation-oriented Learning Spaces.

The model comprises three consecutive critical phases: Define, Cultivate, and Collect, along with two transversal phases: Analyse and Involve & Include.

The "Define" phase involves shaping a shared vision, establishing a value proposition, and setting objectives. Planning is crucial, considering core activities, strategic resources (with a focus on technology), and budgeting. The cyclical nature of the model emphasizes the iterative refinement of goals and strategies.

The "Cultivate" phase, linked to the structural dimensions of the space, focuses on executing core activities to activate knowledge and learning dynamics. This involves tailoring methodologies to goals, target audiences, and available resources. The learning space must provide the necessary features and dimensions to support innovation dynamics, including adaptable settings, stable technological infrastructure, and supportive atmospheres.

The "Collect" phase follows, aiming to gather insights for reflection and assessment. Outcomes are compared with initial goals, providing valuable insights to learn from and develop strategies for future innovation activities. This cyclical approach supports continuous improvement and innovation processes.

Two transversal phases, "Analyse" and "Involve & Include," cut across the entire model. The Analyse phase addresses contextual barriers and opportunities through continuous monitoring, fostering adaptability. The Involve & Include phase emphasizes communication and relationship-building, fostering an innovative community and external partnerships.

Overall, the model presents a cyclical and iterative process, emphasizing the importance of continuous improvement and adaptation to the evolving context. It provides a practical model for managing technology-enhanced Learning Spaces for Innovation, integrating insights from both empirical cases and existing literature.

Moreover, given that the specific value proposition of these spaces is to innovate, they necessitate an updated definition. A technology-enhanced Learning Space for Innovation is the described as *"a dynamic space, physical, virtual, or hybrid, fostering interactions among actors and leveraging tangible and intangible components, especially advanced technologies. Its goal is to promote innovation dynamics, engage with the territory, and stimulate community development."*

Triangulation between literature data and case study analysis reaffirms the relevance of these spaces as effective means for organisations to stimulate innovation through knowledge and learning dynamics. However, operational gaps were identified, particularly in maximising the potential of advanced technologies and evaluating long-term impacts.
In this vein, the Action Research project serves as a practical demonstration of implementing the management model. The action research project aimed then to empirically assess the effectiveness of technology-enhanced learning spaces in enhancing continuous innovation within organisations, with a specific focus on social innovation in rural areas.
The project considered *Sparkme* as a technology-enhanced LS for innovation, developed within an organisation but involving external targets.
SPARKme, situated in Matera, was born as a Technological Accelerator dedicated to fostering "technology transfer and capacity building," specifically aiming to facilitate the integration of space technologies, advanced technologies and satellite systems into innovative commercial applications.
The researcher was prompted to carry out the AR project to the following reasons: i) management model validation; ii) advanced technology implementation; iii) and performance dimensions to evaluate (to understand the impact of such learning spaces).

- *Advanced Technology Implementation:*

The learning space “Sparkme” incorporated various technologies, from digital platforms to virtual reality, drones, and robots. A strategic approach involved partnerships development, training sessions, and workshops was adopted to disseminate technological skills. Positive feedback about the technological implementation were received, emphasizing engagement and motivation, despite challenges like high costs and privacy concerns.
The strategy focused on integrating technology seamlessly into experiential storytelling, making it accessible and engaging to diverse audiences.

- *Management of the Learning Space:*

The management model derived from the RQ2 proved valuable for ensuring the effectiveness of the “Sparkme” learning space. The necessity to carry out an ongoing analysis of community needs was empasized. The learning space involved fixed and dynamic elements, requiring continual adaptation to opportunities and continuous dialogue with the territory and the actors involved.
Marketing and communication activities, primarily through social tools, aimed at involving diverse learners and fostering community engagement. Financing transitioned from public support to private funding, with some eligibility for state tax credits.

- *Performance Dimensions to Assess:*

From the action research, emerged some performance dimensions to consider to assessment the effectiveness of technology enhanced learning spaces in boosting contiuous innovation and social dynamics. The performances emerged from the analysis were reliability of technological infrastructure, learner experience and competences, quality relationships, data security and privacy, and innovation capacity. Challenges in tracking long-term impact were acknowledged, emphasizing the need for collaboration with external institutions and public administration. The goal is to enhance overall learning space performance, ensuring an optimal educational experience while contributing to positive social change.

- *Innovation in Rural Areas:*

Technology-enhanced learning spaces played a pivotal role in fostering innovation in rural areas by overcoming geographical constraints. Virtual platforms facilitated continuous skill development and knowledge acquisition, with a focus on STEM education in rural schools.
SMEs benefited from access to specialized knowledge, skill development, collaboration opportunities, and networking, contributing to innovation paths.

In summary, the action research demonstrated the positive impact of technology-enhanced learning spaces on continuous innovation within and beyond organisations. The integration of advanced technologies, effective management, and a comprehensive performance assessment approach contribute to the success of these spaces, particularly in promoting innovation in rural areas and among SMEs. The ongoing evolution of the learning space and its adaptability to diverse contexts underscore its role as a catalyst for knowledge dissemination, innovation, and social impact.

VII. CONCLUSION

7.1. Practical and theoretical implications

From a theoretical perspective, the project is inserted in the emerging discussion about innovation management and knowledge management. This study, in particular, is focused on developing effective spaces that, relying on knowledge and learning dynamics and implementing advanced technologies, help companies in fueling and supporting continuous innovation paths in the Digital Age. To ensure and evaluate their efficacy in fostering innovation, the emphasis is placed on managing phases and performance dimensions to take into consideration.
The study, thus, investigates the role of Learning Spaces as valuable solutions in this regard.

The analysis is conducted providing various original contributions. A systematic literature review enriches knowledge and theory in this field, contributing significantly to the theoretical understanding and practical implementation of technology-enhanced learning spaces to foster innovation in the Digital Age. The theoretical implications are evident in the systematization of the "learning space" concept within management literature, transcending traditional educational confines. By incorporating transdisciplinary insights, this research enhances theoretical discussions and establishes a nuanced conceptual framework with five key dimensions applicable across educational and organisational settings.

Moreover, the study expands theoretical perspectives by examining the integration of advanced technologies into learning spaces. This exploration addresses the evolving role of technology in fostering innovation and broadens discussions on its impact on learning dynamics. Notably, the research bridges a literature gap by presenting comprehensive models for managing and assessing learning spaces, thereby contributing to the broader discourse on innovation management and knowledge management.

Furthermore, the multiple-case study analysis allowed to enrich the insights gathered from the literature. The on-field analysis of nine Learning Spaces allowed a comprehensive empirical validation of above- identified patterns and a more in-depth investigation of Learning Spaces' managerial dynamics. In this regard, an technology-enhanced learning space management model has been proposed to provide scholars and practitioners as well, with theoretical and practical findings on how to develop and manage these spaces.

Specifically, from a practical standpoint, the study furnishes managers, leaders, and knowledge providers with a strategic framework for decision-making regarding the creation, development, management, and assessment of effective learning spaces for innovation. Organisations seeking to cultivate innovation in the digital age can leverage insights into the dimensions and dynamics of learning spaces, formulating strategies to optimize the use of advanced technologies for innovation.

Then, AR is particularly suited to investigate events or issues typical of emergent contexts to transform practices through interventions and build theory from it (Ollila and Yström, 2020).

The practical guidance derived from the action research ensures real-world relevance, facilitating the continuous innovation contribution of learning spaces.
Furthermore, the study offers organisations models for effective management and assessment of these spaces, acknowledging the critical role of advanced technologies. The emphasis here extends beyond technological functionality, encompassing how technology interacts with other elements within the learning space. In essence, this research provides a valuable roadmap for organisations navigating the evolving digital landscape, facilitating the seamless integration of technology-enhanced learning and fostering a culture of continuous innovation.
Organisations can draw on this example to guide their strategic innovation planning, considering the specific context and objectives of their initiatives. In order to make well-informed strategic decisions, they enable the identification of strengths and opportunities to invest in as well as weaknesses and threats to overcome. In this particular case, a management and assessment model might turn out to be useful in identifying the resources to be used in order to improve innovation processes.

7.2. Limitations and Future Research

The research presents some *limitations* mostly related to the methodologies adopted, that need to be acknowledged.
The systematic literature review has been carried out pursuing qualitative approaches and findings. It follows that papers selection and findings may have been affected by subjectivity. However, while systematic reviews aim to minimize bias through rigorous methods, some elements of subjectivity may still be present.

Subjectivity may also occur referring to the multiple-case study analysis. Multiple-case study analysis may limit generalisation and validation. In this regard, despite the nine analysed technology-enhanced learning spaces were developed in two different territorial contexts (Finland and Italy), the may do not ensure the representativeness of a broader population. In this vein, generalising the results to a larger context becomes challenging, as a small sample might not adequately capture the diversity present in the population.

AR also has limitations. Specifically, it would have been appropriate to conduct the second cycle cycle to allow a deeper focus on the performance dimensions, even in the long-term, implementing specific KPIs. To date, it has not been, therefore, possible to assess the long-term performance and impacts generated by *Spark me*.
These limitations can address *future research*.
Further empirical, also quantitative, investigations could be developed to extend the sample and to allow a comprehensive validation of the framework.
In this vein, to provide further advancements to the current research, there is a potential need for either a widespread survey, across different contexts or groups, a new Action Research (AR) cycle or a comprehensive AR project. This subsequent phase could specifically focus on the performance dimensions of technology-enhanced learning spaces for innovation.
Furthermore, the development of robust Key Performance Indicators (KPIs) holds numerous advantages within the realm of organisational management and performance assessment. Some key benefits are clarity and focus that allow the identification of the most critical perspectives of

performance aligned with organisational objectives. Measurable Objectives might also be translated into strategic objectives and quantifiable outcomes. This translation facilitates seamless tracking of progress and the evaluation of the efficacy of various strategies and initiatives.

Lastly, decision-making grounded on robust KPIs provide a foundation for informed and rigorous management processes.

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