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Influence of Metaverse on Building Entrepreneurship Education Ecosystems †

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Abstract

Establishing an entrepreneurship education ecosystem is crucial for the continual nurturing of young entrepreneurs and, consequently, the enhancement of economic development. Beyond the expansion of entrepreneurship programs, the active involvement and support from relevant resources and external stakeholders are pivotal to constructing such ecosystems. However, obstacles arise from the lower intention of external stakeholders to participate, and constraints imposed by information technology, hindering the ecosystem's development. The Metaverse, an innovative technology amalgamating three-dimensional virtual technologies with blockchain and artificial intelligence, emerges as a potential solution to overcome these barriers and construct an entrepreneurship education ecosystem. Despite this potential, there is a lack of analysis explaining how the Metaverse achieves this. To address this gap, a framework for entrepreneurship education ecosystems is established in this study, highlighting two barriers and elucidating how these barriers impede ecosystem construction. Furthermore, four efficiencies of the Metaverse are identified as key factors with positive effects in terms of surmounting barriers to ensure the successful establishment of an entrepreneurship education ecosystem: communication convenience, enhanced simulation environment, information filtering, and the creation of valuable information.

Keywords: metaverse; ecosystem; entrepreneurship education; edu-metaverse

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1. Introduction

Improving entrepreneurship education in higher education institutions can significantly contribute to economic development [1]. Therefore, many North American and Asian colleges and universities have actively developed entrepreneurship programs to foster innovation and economic growth.

Entrepreneurship programs typically consist of three core components: theoretical learning, entrepreneurship simulations, experiential activities, and support for entrepreneurship planning [2,3]. For optimal outcomes, bridging theoretical knowledge with practical applications through collaboration with external experts is essential. Mentorship from experienced individuals, such as successful entrepreneurs, coaches, and mentors, further enhances experiential learning by guiding students during entrepreneurship simulations. Additionally, to facilitate the planning and execution of entrepreneurial initiatives, these programs integrate diverse funding and incubation opportunities [4,5] to support students in launching their ventures.

Building connections with relevant resources and stakeholders, such as financial backers, incubation services, and expert mentors, is critical for the success of entrepreneurship programs. These partnerships enhance program efficiency and form the foundation of an entrepreneurship education ecosystem, sustaining such initiatives' effectiveness over time. The foundational concept of the entrepreneurship education ecosystem is illustrated in Figure 1.

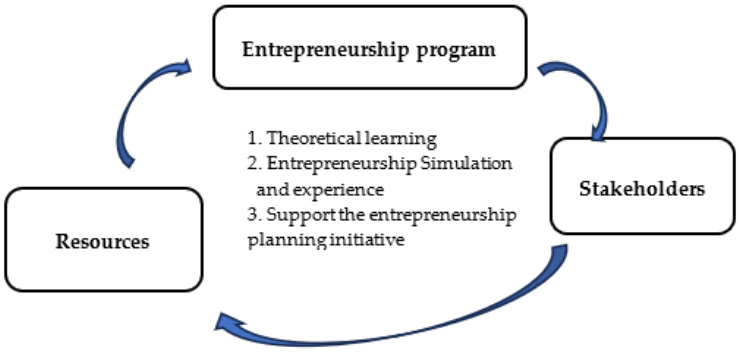


Figure 1. Basic concept of entrepreneurship education ecosystem.

However, constructing an effective entrepreneurship education ecosystem is challenging. It is difficult to engage and sustain external resources and stakeholders, leading to fragmentation and inefficiencies. Addressing this issue requires strategic approaches or tools, yet no comprehensive solutions have been widely adopted.

The Metaverse, a term originating from Stephenson's 1992 novel *Snow Crash*, refers to a 3D virtual space where users interact. Built on extended reality (XR) technologies—including virtual reality (VR), augmented reality (AR), mixed reality (MR), and 360-degree media—the Metaverse incorporates artificial intelligence (AI) and blockchain, enabling extensive possibilities for integration and collaboration [6]. Bamkole et al. [7], Crammond [8], and Fossatti et al. [9] indicated that the Metaverse has developed entrepreneurship education ecosystems significantly.

Empirical evidence supports this potential. For instance, the University of Auckland has used the Metaverse to enhance entrepreneurial simulations, while Munich University and its partners have leveraged it to integrate resources and stakeholders. By ensuring sustained support from these entities, the Metaverse strengthens entrepreneurship programs, fosters ecosystem development, and enhances efforts to nurture future entrepreneurs.

Despite its recognized benefits, studies and case examples provide only limited and fragmented insights into how the Metaverse supports ecosystem construction. Therefore, this study aims to address this gap by exploring the phenomenon in greater depth. To achieve this objective, the relevant literature was reviewed to establish a conceptual framework for the entrepreneurship education ecosystem, identify key resources and stakeholders, and examine their roles in enhancing entrepreneurship programs. The review results were analyzed to explore how the Metaverse's potential fosters ecosystem development and ensures sustained support.

The results of this study provide a reference to expand the existing body of knowledge and improve entrepreneurship education in higher education. Despite the Metaverse's positive influence, detailed explanations of its mechanisms and impact remain scarce. The gap is filled by providing a comprehensive analysis result to address deficiencies in the current literature and substantiate the Metaverse's role in enhancing and sustaining entrepreneurship education ecosystems.

2. Foundation and Technologies of Metaverse

The foundational theory behind the Metaverse is immersive learning, primarily leveraging XR technology and lifelogging technologies to craft a fully engaging experience for users [10]. Another associated concept is the mirror world, where virtual worlds are established through digital twins or avatars [11]. Lifelogging technologies, a form of pervasive computing, involve a comprehensive digital record of an individual's holistic experiences, captured by digital sensors in a multi-modal manner, and permanently stored as a personal multimedia archive [12] (p. 1).

Furthermore, the Metaverse seamlessly integrates two technologies—generative AI, such as ChatGPT 4 and 4o, and blockchain—to create a more intelligent teaching and learning environment [13]. According to Schank [14], AI is defined as "the machine trying to explain the behavior of the human system it simulates" [14] (p. 38). Machine learning empowers AI with an enhanced capacity to integrate pertinent data and conduct valuable analyses. The collaboration between humans and AI guides users in formulating solutions, making informed decisions, and dynamically updating plans based on real-time input [2,11].

Blockchain, a distributed ledger technology, serves as a record of digital events [15]. It establishes a fair and secure digital data environment based on the principles of decentralization and immutability [16]. Blockchain data provides a foundation for AI analysis. The combination of AI and blockchain yields two interconnected outcomes, as highlighted by Jeon et al. [17] and Badruddoja et al. [18]. Firstly, AI generates high-quality data through technologically enabled analyses, forming a basis for strategy development and problem-solving approaches in the Metaverse. Secondly, AI data undergo continuous updates, minimizing the risk of erroneous conclusions, thereby ensuring more precise suggestions in the Metaverse. Consequently, AI fulfills user requirements and purposes and enhances the virtual world's effectiveness in delivering an immersive experience [19].

3. Framework of Entrepreneurship Education Ecosystem

To provide a detailed explanation of why the Metaverse enables the entrepreneurship education ecosystem, the established framework and the practical processes involved need to be understood.

3.1. Network Theory in Entrepreneurship Education Ecosystem Development

The fundamental concept in constructing an entrepreneurship education ecosystem revolves around entrepreneurship programs, resources, and stakeholders. When these related resources and stakeholders consistently support and enhance the entrepreneurship program, it ensures greater efficiency in nurturing young entrepreneurs. The program encompasses various modules, including theoretical learning and simulated entrepreneurship experiences, guiding students in realizing their entrepreneurial plans. Different modules require diverse resources and stakeholder support, forming a comprehensive network within the ecosystem. The development of an entrepreneurship education ecosystem resembles a network environment and can be elucidated through network theory [20].

Network theory is defined as "the proposed processes and mechanism that relate network properties to outcomes of interest" [21]. Essentially, complex systems, such as entrepreneurship education ecosystems, function akin to networks. Over the past two decades, various research areas, including education, have embraced the network theory to construct complex system networks and provide explanations for their functioning. In the context of networks, interactions between components are integral [22]. The mechanisms and processes of interaction within the network structure are utilized by individuals, organizations, and societies [21–23].

Concerning the construction of the ecosystem in network theory, nodes and ties are critical elements [21]. Nodes represent individuals, organizations, or resource providers [24], and ties denote the links or relationships between nodes. The formation of numerous ties results in the creation of a network. Purbasari et al. [24] emphasized the need to identify relevant nodes and ties during the development of an entrepreneurship education ecosystem.

3.2. Nodes, Ties, and Framework of Entrepreneurship Education Ecosystem

In developing the entrepreneurship education ecosystem, it is essential to identify the "nodes" and "ties" within the ecosystem. The conceptual framework involves entrepreneurship programs, resources, and stakeholders. Additionally, the entrepreneurship program comprises three course modules: theoretical learning, entrepreneurship simulation and experience (extracurricular activities), and support for entrepreneurship planning initiatives. These modules represent nodes, and the numerous ties existing between them need detailed identification to construct a comprehensive entrepreneurship education ecosystem framework.

Exploring the nodes involves integrating the relevant literature to gain a more nuanced understanding. Notably, previous studies offer detailed insights into nodes. For instance, Brush [20] emphasized that the construction and framework of the entrepreneurship education ecosystem constitute a network of connections between stakeholders (faculty, staff, and students), technological resources (technological platforms and support channels), and internal and external resources (financial, technological, physical facilities, and social capital).

Wraae and Thomsen [25] developed an entrepreneurship education ecosystem, identifying six key nodes using network theory: students (primary stakeholders), educators (directly interacting with students through teaching and mentoring), institutions (providing incubation), external stakeholders in the community (offering indirect support), educational processes (entrepreneurship guiding and co-curricular activities), and the surrounding society with abundant resources supporting entrepreneurship training.

Wang and Yu [26] employed network theory and highlighted the significance of a computer network platform to overcome the limitations of traditional course infrastructure. Their ecosystem incorporates components including a micro-curricular resource library, teaching material development, online and offline course resources, a courseware resource library, boutique online open courses, and a question bank. These components are categorized into stakeholders (teachers and students), curricula, and learning resources, facilitated by the computer network platform.

Additionally, Bhat and Khan [27] and Regele and Neck [28] underscored the importance of curricula in the construction of the entrepreneurship education ecosystem. A robust curriculum is considered crucial for guiding and fostering successful entrepreneurs who possess extensive knowledge, skills, stress resistance, and self-motivation. In practice, curricula for nurturing young entrepreneurs typically encompass theoretical learning, simulation entrepreneurship experience, and supporting students in their entrepreneurship planning initiatives—mirroring the basic concept of the ecosystem.

The integration of the aforementioned analyses enabled the identification of nodes in the entrepreneurship education ecosystem.

1. Stakeholders

Stakeholders encompass all participants within the entrepreneurship education ecosystem, comprising students, teachers, staff, and various educators such as coaches and successful entrepreneurs from external and social contexts. Additionally, financial resource providers and external incubators are integral stakeholders. Stakeholders are categorized into internal and external groups, where students represent the core of internal stakeholders, and teachers or faculty and staff serve as internal teaching providers. External stakeholders include coaches, successful entrepreneurs, and resource providers such as

financiers and incubators. These stakeholders form important nodes within the ecosystem, with a collaborative relationship existing between internal and external stakeholders.

2. Resources

Resources play a crucial role in supporting teaching, entrepreneurship simulation and experiences, and aiding students in their startup processes. Based on existing findings, resources encompass information technology and platforms (providing knowledge and information and facilitating interactions with stakeholders), financial support (including social capital), and incubation (involving physical facilities). Resources are classified into tangible and intangible categories, and these are provided by various stakeholders.

3. Curricula for the entrepreneurship program

Curricula are an integral part of the entrepreneurship program, incorporating theoretical courses, simulation entrepreneurship experience courses, and processes supporting students in entrepreneurship planning initiatives. Learning entrepreneurship knowledge and skills, as well as realizing entrepreneurship planning, relies on robust curricular support. Therefore, the quality of curricula significantly impacts the outcomes and overall quality of entrepreneurship education. As a result, curricula are considered crucial nodes within the ecosystem.

Subsequently, by integrating this information with the basic concept of the entrepreneurship education ecosystem, nodes, and the connections between nodes, a detailed framework for the ecosystem is formulated and presented, as depicted in Figure 2.

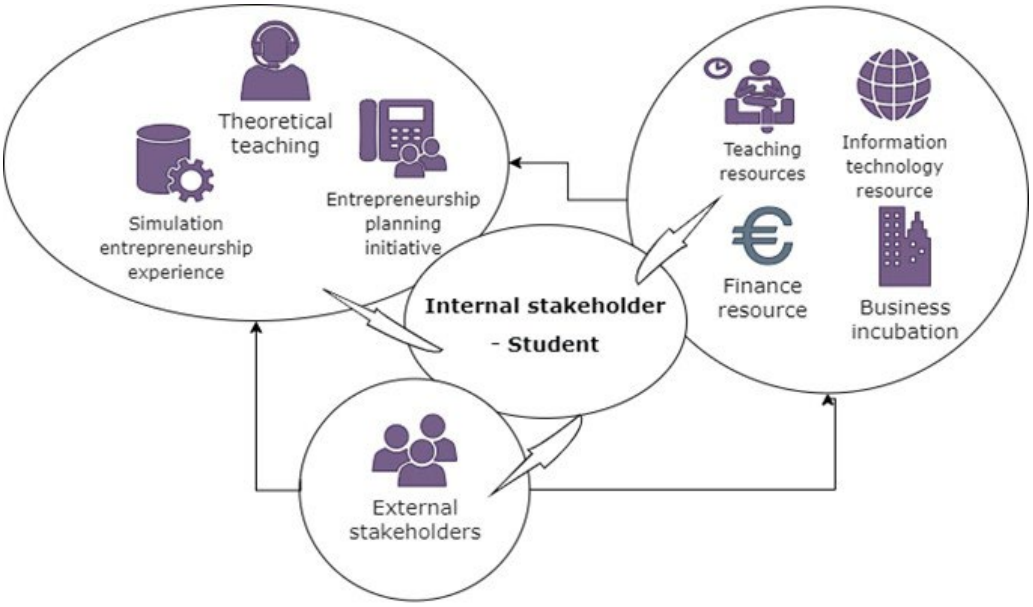


Figure 2. Framework of entrepreneurship education ecosystem.

4. Barriers to Construction of Entrepreneurship Education Ecosystem

Establishing an entrepreneurship education ecosystem enhances the effectiveness of entrepreneurship programs and fosters young entrepreneurs who contribute to economic growth. However, several barriers hinder its construction.

First, external stakeholders, such as experts, mentors, and entrepreneurs, often face challenges sustaining their involvement due to time and distance constraints. While their collaboration enriches theoretical learning and guides students in applying theory to practice, their engagement tends to wane over time. Similarly, inviting stakeholders to support simulated entrepreneurship experiences is difficult, given their professional

commitments. This lack of consistent participation affects both theoretical teaching and simulation experiences.

Second, connecting students with funding and incubation providers is another hurdle. Time-intensive processes of searching, evaluating, and negotiating partnerships create barriers for resource providers, limiting the flow of financial and incubation support. This challenge impedes the practical application of entrepreneurship planning initiatives and weakens program outcomes.

Third, limitations in information technology resources exacerbate these issues. While IT platforms facilitate the collection of teaching materials, they often lack the depth to derive meaningful insights, especially for faculty with limited entrepreneurial experience. This leads to superficial teaching content and the inadvertent incorporation of misinformation, which risks misguiding students. Furthermore, although IT advancements enable simulated entrepreneurship environments, they fall short of replicating the complexity of real-world scenarios, affecting the quality of experiential learning.

These barriers manifest in two key problems: (1) reduced stakeholder engagement, impacting theoretical and simulation-based teaching, and (2) limited support for entrepreneurship planning initiatives and high-quality simulation environments. While information technology remains a valuable resource, its limitations hinder the enhancement of teaching content and the design of realistic simulated entrepreneurship experiences.

5. Efficiency of Metaverse for Construction of Entrepreneurship Education Ecosystem

Two barriers from external stakeholders and information technology resources lead to different problems to be solved. According to the related literature and a few cases, the Metaverse has the efficiency to overcome the barriers and problems and ensures the construction of the entrepreneurship education ecosystem. Therefore, it is necessary to explore if the Metaverse maintains the attending intention of external stakeholders and how it is possible to overcome the limitations of information technology to benefit the curricula and further ensure ecosystem construction and practice.

5.1. Intelligent Functions of Metaverse

The evolution of the Metaverse is rooted in AI, boasting two pivotal functions crucial for surmounting the challenges in establishing an entrepreneurship education ecosystem. Firstly, it encompasses the generation of virtual space, leveraging technologies such as VR/AR, lifelogging, and mirror world technology [29]. This virtual space transcends limitations in communication such as distance, time, and space, facilitating seamless interaction among users, including both internal and external stakeholders [7]. Additionally, virtual space technology enables the creation of immersive simulation environments tailored to user needs, often integrating with blockchain and AI to ensure a closer alignment with the real world. The first function's efficiencies lie in "communication convenience" and in "creating a rich simulation environment" [29].

The second function involves two-way interaction with users, differentiating it from traditional information technology's unidirectional functions of "search" and "provide". Developed through a fusion of blockchain and AI, the Metaverse maintains search capabilities while enhancing information storage, leveraging the blockchain's mechanism to ensure data accuracy and prevent misinformation. AI components enable powerful analysis functions, extracting profound insights from internet and blockchain data, and engaging users in online chat interactions, constituting a two-way driver [30]. The second function's efficiencies encompass "creating valuable information" and "information filtering." The

blockchain, combined with the Metaverse, employs the concept and technology of the distributed ledger, as depicted in Figure 3, to analyze and authenticate information.

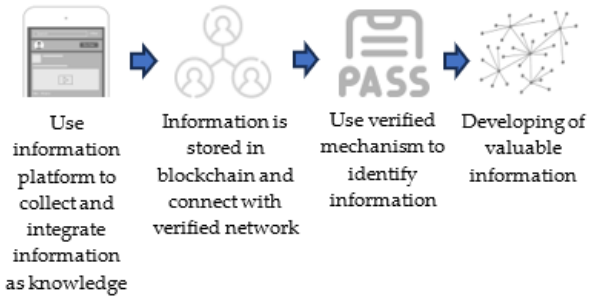


Figure 3. Blockchain verification mechanism.

In summary, the Metaverse's two functions lead to four distinct efficiencies. This article elucidates how these efficiencies address the challenges in constructing an entrepreneurship education ecosystem.

5.2. Efficiency of Metaverse for Stakeholders

The Metaverse enhances communication with external stakeholders, including experts, mentors, and entrepreneurs, addressing challenges of distance and time that often hinder their participation. By providing virtual space for collaboration, the Metaverse allows stakeholders to contribute their expertise to theoretical teaching design and guide students through simulated entrepreneurship experiences without the constraints of scheduling or physical presence [31]. For instance, the University of Auckland's Metaverse platform facilitates seamless engagement, enabling external experts to support teaching design and assist students with complex entrepreneurial challenges.

In addition to improving collaboration, the Metaverse simplifies access to financial and incubator resources, reducing the time and effort typically required for seeking support. It identifies and integrates resource providers, and creates a platform where students with entrepreneurial ideas can connect, communicate, and negotiate with potential supporters [32]. While it does not guarantee negotiation success, it increases resource providers' willingness to engage, overcoming spatial and logistical barriers.

The Metaverse streamlines communication, fosters collaboration, and enhances access to resources, strengthening entrepreneurship curricula that include theoretical courses, simulations, and planning initiatives. By addressing attendance barriers and facilitating resource integration, it supports the development of a robust entrepreneurship education ecosystem.

5.3. Efficiency of Metaverse for Information Technology

The Metaverse is an alternative to traditional information technology, addressing its limitations and enhancing operational efficiency. It excels in creating high-quality simulation environments that closely replicate real-world entrepreneurship scenarios, fostering student engagement and practical learning [33]. Additionally, the Metaverse provides dynamic and immersive virtual experiences tailored to internal stakeholders, effectively overcoming traditional IT shortcomings and resolving barriers in constructing entrepreneurship education ecosystems [34]. It also addresses the challenge of accessing reliable and comprehensive information. The integration of blockchain technology within the Metaverse enables the collection, authentication, and synthesis of information, mitigating the risks of misinformation. Blockchain's distributed ledger technology ensures the accuracy of information, particularly benefiting educators who may lack entrepreneurial experience.

Furthermore, the Metaverse leverages AI to process and transform authenticated data into new knowledge, enriching learning resources for educators and students alike. For

instance, Munich University's Center for Entrepreneurship and its nine partner universities have demonstrated the effectiveness of Metaverse platforms in terms of generating extensive teaching and learning materials. This integration significantly enhances theoretical teaching content and supports the continuous improvement of entrepreneurship education programs [31,35].

5.4. Entrepreneurship Education Ecosystem Based on Metaverse

Building upon the preceding discussion, the efficiencies inherent to the Metaverse unequivocally surmount obstacles in establishing an entrepreneurship education ecosystem. The facilitation of communication convenience effectively addresses the hindrance of external stakeholders' attendance intentions, while creating a rich simulation environment, information filtering, and the generation of valuable information to aptly contend with the constraints posed by information technology.

6. Discussion

Based on the aforementioned findings, the relevant literature and cases were elucidated to explore how the Metaverse surmounts impediments to the construction of an entrepreneurship education ecosystem. Additionally, the Metaverse exerts a beneficial influence on the establishment of such an ecosystem. Consequently, the attributes of the Metaverse augment the construction of the entrepreneurship education ecosystem.

6.1. Resource Richness

The effectiveness of the Metaverse lies in its ability to provide, integrate, and generate a plethora of teaching and learning resources. This facilitates student access to educational materials and empowers educators to enhance teaching content, quality, and course design by incorporating relevant resources. Additionally, the Metaverse integrates financial and incubation service resources for students in the startup stage, promoting discovery and two-way interaction to offer pertinent support. Moreover, using the functions of blockchain and AI, the Metaverse generates novel teaching and learning resources.

6.2. Well-Established Learning and Teaching Environment

The Metaverse strengthens connections among external experts, coaches, cases, and various stakeholders, incorporating teacher/faculty perspectives to identify essential entrepreneurship competencies. Leveraging blockchain and AI technologies, the Metaverse integrates and reconstructs optimal teaching resources and content for theoretical courses based on these competencies. It further recommends that teachers create engaging learning environments. The integration of virtual environment technology with AI and external stakeholders significantly contributes to the development of a simulated entrepreneurship experience environment, offering lower-risk simulation courses that enhance students' experiential learning.

6.3. Barriers Breaking Between Stakeholders

The envisioned Metaverse facilitates seamless connections between resources, curriculum components, and stakeholders, each contributing distinct aspects to entrepreneurship education. This integration fosters collaboration and resource-sharing, breaking down barriers that previously hindered effective cooperation. Through its user-friendly platform, the Metaverse promotes an environment where stakeholders can interact and collaborate, overcoming previous impediments to cooperation.

6.4. Promotion of Sustainable Entrepreneurship Education

The proposed ecosystem using the Metaverse acts as a guiding force, driving the integration of resources, curricula, and stakeholders. This integration creates a sustainable and continuous improvement in entrepreneurship education. This approach ultimately cultivates a sustainable environment for entrepreneurship education by addressing key factors necessary for enhancing entrepreneurship education.

7. Conclusions

In this study, the effectiveness of the Metaverse in constructing an entrepreneurship education ecosystem was verified. By analyzing its components of curricula, resources, and stakeholders (both internal and external), significant barriers, including declining engagement from external stakeholders and the limitations of existing information technology, which hinder ecosystem development, were identified. Four key efficiencies of the Metaverse were also identified: convenience, simulation environment creation, information filtering, and valuable information generation. Through a literature review and case study, it was demonstrated how these efficiencies address the identified barriers, enabling the successful establishment of entrepreneurship education ecosystems.

The results of this study contribute to the academic discourse by understanding entrepreneurship education ecosystems and emphasizing the impact of barriers during their construction. Being different from previous research that primarily focused on the ecosystem-building process, detailed reviews on how these barriers can be mitigated were provided in this study. While previous studies acknowledged the Metaverse's potential, they lack an explanation of its mechanisms. The results fill this gap by offering a detailed exploration of how the Metaverse facilitates ecosystem development, expanding theoretical perspectives.

Practically, actionable recommendations for educational managers were made, emphasizing the transformative potential of the Metaverse in enhancing entrepreneurship education. Given the importance of entrepreneurship programs in driving economic growth, it is crucial to refine the framework to ensure sustainability. However, the absence of evidence on the effectiveness of tools such as the Metaverse complicates decision-making. Based on compelling evidence of its utility, it is recommended to provide government support to facilitate its implementation in higher education.

Although barriers were identified in this study, other factors must be considered for the ecosystem construction. The reliance on a literature review and limited case studies necessitates further research on implementation, stakeholder engagement, and communication with the Metaverse. It is still necessary to explore these dimensions and employ empirical methods to validate the results of this study. Empirical exploration is necessary to enhance the robustness of this research, uncover new insights, and further advance the understanding of entrepreneurship education ecosystems. However, by bridging theoretical gaps and offering practical recommendations, the results of this study lay a foundation for leveraging the Metaverse to transform entrepreneurship education and foster sustainable ecosystems.

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