Digital Entrepreneurship Research for Learning and Teaching in Education: A Bibliometric Analysis

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Abstract **– Digital entrepreneurship has heralded a paradigm shift in the business and educational landscape, ushering in an era where creative thinking, problem-solving, and digital prowess are integral curriculum components. This study undertakes a comprehensive bibliometric analysis of digital entrepreneurship in education, delving into its profound influence on the learning and teaching process. Leveraging the extensive Scopus database for data extraction, our research aims to offer a panoramic view of research trends, methodologies, and critical themes encapsulated within the academic literature from 2004 to 2023. Employing a meticulous bibliometric analysis methodology utilizing Bibilioshiny complemented by Microsoft Excel for metadata visualization, our study meticulously identified and analyzed 257 relevant documents. Through this analysis, we delineate the contributions of 743 authors and their affiliations while scrutinizing the geographical distribution of contributing countries. The findings of our study underscore a marked surge in interest surrounding digital entrepreneurship in education, with China emerging as the primary contributor, boasting 108 published articles in this domain. Beyond mere statistics, our research endeavors to equip educators, curriculum developers, and policymakers with invaluable insights into the seamless integration of digital entrepreneurship into educational frameworks. Moreover, it sheds light on specific areas warranting further exploration, elucidating their potential impact on future learning paradigms.**

Keywords **– Digital entrepreneurship, learning, teaching, education, bibliometric analysis.**

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1. Introduction

The development of digital technology has significantly altered the entrepreneurial landscape [1], paving the way for new opportunities in entrepreneurship [2]. With the advent of the Internet, a new era of digital entrepreneurship has emerged [3], enabling entrepreneurs to reach a global audience and operate their businesses from anywhere [4].

Digital entrepreneurship is the creation and management of businesses utilizing digital technology [5]. The trend of digital entrepreneurship began in the 1990s with the advent of the Internet. The Internet opened new opportunities for entrepreneurs to start and grow their businesses [2]. Several factors encourage the development of digital entrepreneurship trends, including the development of digital technology. The development of digital technologies, such as the Internet, social media, and mobile devices, has created new opportunities for entrepreneurs to start and grow their businesses [6].

The next factor is affordable costs. The initial cost of starting a digital business is relatively lower compared to a traditional business. This makes digital entrepreneurship more affordable for the general public [7]. Digital entrepreneurship also offers greater flexibility for entrepreneurs. Digital entrepreneurs can work from anywhere and at any time [8]. The last factor is global opportunities. Digital entrepreneurship allows entrepreneurs to reach global markets. This can open up new opportunities for business growth and success [9].

Digital entrepreneurship, which involves initiatives in creating new ventures and capitalizing on business opportunities through digital media and technology, has gained considerable attention in education [10], [11]. This shift not only reshapes the business world but also influences learning and teaching methodologies within educational environments [12], [13]. By integrating digital entrepreneurship into the curriculum, educational institutions aim to cultivate creative thinking, problem-solving skills, and digital literacy among students [14].

Recognizing entrepreneurship as a crucial competency in the 21st century [15], [16], [17], educational systems worldwide are increasingly exploring how digital tools and platforms can facilitate entrepreneurial learning [18], [19]. Bridging the gap between traditional entrepreneurship studies and modern digital skills, digital entrepreneurship in education equips students with a dual skill set highly sought after in today's job market [20].

However, digital entrepreneurship in education encompasses more than just teaching students how to start an online business; it involves leveraging digital tools and entrepreneurial thinking to enrich the learning experience [21], [22]. This includes utilizing digital platforms for business simulations, employing social media for market research projects, and integrating e-commerce tools for practical exercises [23], [24]. Thus, digital entrepreneurship serves as a conduit for experiential learning, critical thinking, and digital competency development [25].

This research entails conducting an exhaustive bibliometric analysis of digital entrepreneurship in education, particularly its impact on teaching and learning methodologies. The analysis aims to provide a comprehensive overview of academic research by systematically mapping articles, journals, authors, and trends drawn from scholarly databases. This analysis will elucidate how digital entrepreneurship is integrated into educational contexts and its implications for learning and teaching methodologies by identifying key themes, methodologies, and gaps in the existing literature.

The insights derived from this bibliometric analysis carry significant implications for educators, curriculum developers, and policymakers. Understanding current trends and gaps in digital entrepreneurship education research can inform the development of more effective educational programs and policies. Moreover, it underscores the need for further research into the impact of digital entrepreneurship education on student learning outcomes and the most effective methods for integrating digital tools into entrepreneurship learning. This analysis sets the stage for future exploration into how digital entrepreneurship can continue to evolve and positively influence the education sector:

Table 1. Research question (RQ)

No.	Research question (RQ)
1	How has the digital entrepreneurship trend evolved for learning and teaching in education over the last twenty years (2004–2023)?
2	What is the role of digital entrepreneurship in fostering student attitudes and engagement in understanding and applying entrepreneurship?
3	What is the evolutionary trend towards the research field of digital entrepreneurship?
4	How will digital entrepreneurship affect education in the future?

2. Methodology

The methodology section serves as a blueprint for researching while bolstering its credibility. Quantitative studies delineate the process of data collection and mathematical analyses, while qualitative studies focus on gathering and analyzing non-numerical data, such as text, video, or audio, to elucidate concepts, opinions, and experiences.

In this study, we employ a bibliometric approach to scrutinize scientific data, elucidating the methodology's steps for data collection and processing [26], [27], [28], [29]. Bibliometrics, a statistical method, enables the organization of research data, measurement of research impact, identification of knowledge developments, parsing nuances in academic domains, and discerning research themes [30], [31], [32]. Leveraging these techniques, our study systematically offers insights by delineating statistical information in publications, thereby facilitating the analysis of trends and themes within a specific research field.

The bibliometric analysis unfolds in four stages, as depicted in Figure 1. Initially, we identified the topic of interest, conducting a focused search in the Scopus database on January 28, 2024, employing specific search parameters. Subsequently, we filter the results by restricting the publication period to 2004-2023, including only journals or conference proceedings, and selecting publications in English. After applying inclusion and exclusion criteria, our final sample comprises 257 articles, constituting the bibliometric database analyzed in this study.

In the third stage, the bibliometric software biblioshiny was employed to analyze creating visual representations and mappings of the publication data. Biblioshiny employs network analysis techniques to generate visual maps illustrating co-occurrence relationships among various elements, such as authors, publications, keywords, or subject categories.

By portraying these relationships in distance-based graphs, biblioshiny facilitates the analysis of patterns and trends in academic literature, offering insights that may not be readily discernible solely through quantitative indicators.

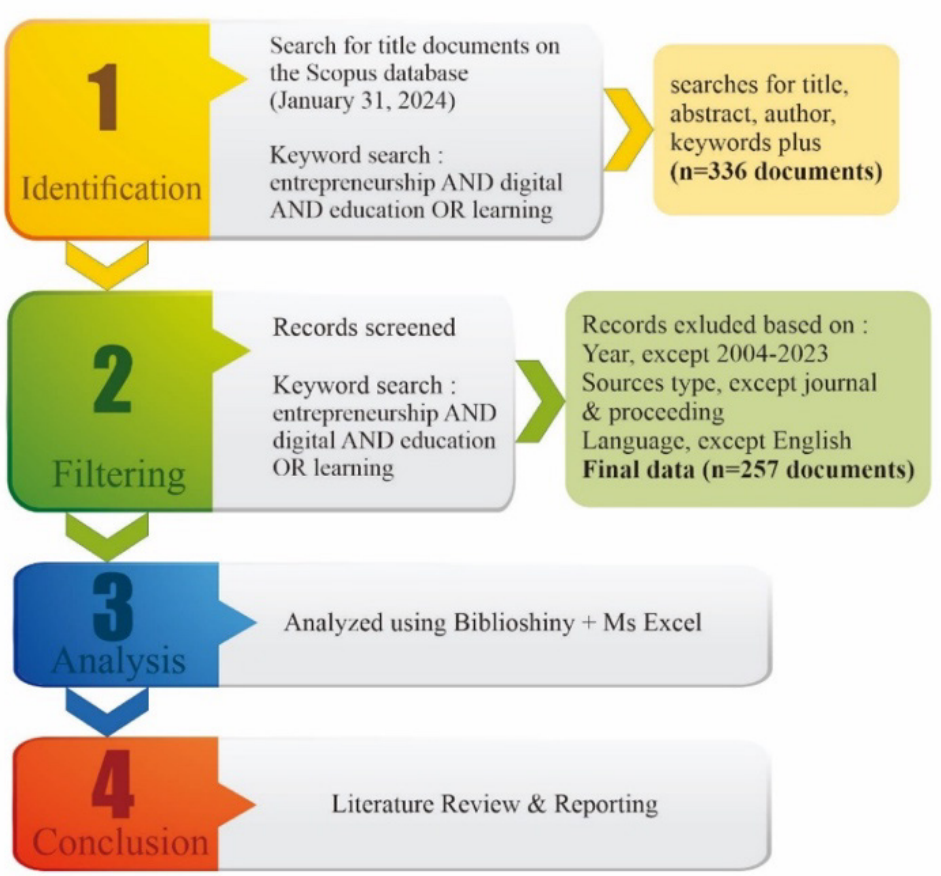

Figure 1. Stages of the bibliometric analysis method

The third stage of the analysis entails utilizing the Bibilioshiny software [33], [34] to visually represent various bibliographic pairs, including country, institution, journal, publication, author, and author keywords. This tool efficiently processes descriptive data and offers advanced conceptual analysis capabilities, enabling a nuanced exploration of the collected data. Biblioshiny yields dynamic and informative analysis results, facilitating more straightforward data interpretation and providing deeper insights into the key themes and issues arising from research on digital entrepreneurship in education. Subsequently, the data is translated into graphical representations using Microsoft Excel.

In the fourth stage, also known as the final or conclusion stage, the results derived from the third stage analysis are expounded upon by discussing the findings and their implications. The insights garnered from this study serve as a valuable resource for researchers and readers keen on delving further into this domain.

At the heart of this bibliometric endeavor lies the aspiration to explore and comprehensively grasp the academic literature about digital entrepreneurship in the education sector.

The primary aim of this analysis is to furnish a comprehensive overview of the trends and scope of research in digital entrepreneurship within education, pinpointing areas necessitating further exploration or where research gaps persist. Following the search process, 257 documents meeting the criteria were identified. These documents will be scrutinized to discern trends, key topics, and significant contributions to digital entrepreneurship in education.

3. Results - Summary of Findings

Based on Figure 2, this study has identified 257 publications pertinent to the theme of digital entrepreneurship within an educational context spanning from 2004 to 2023. The data encompasses a diverse array of 177 sources, comprising journals and books. Over this period, an average annual increase of approximately 29.68 publications has been observed, underscoring a notable surge in interest among researchers and academics in digital entrepreneurship in education.

Furthermore, the research has revealed the involvement of 743 authors in contributing to this field, indicating a profound level of engagement and interest therein. In the forthcoming sections covering research results and discussions, an array of sub-topics will be explored, encompassing an analysis of publication trends and a deeper examination thereof. Specifically, attention will be directed toward the examination of the top ten most prolific authors, top 10 affiliations, top 10 primary sources, top 5 leading countries, and the ten most frequently cited articles. Such comprehensive insights will afford a more nuanced understanding of the outcomes derived from the bibliometric analysis of publications about digital entrepreneurship in education, thereby furnishing an indispensable foundation for charting future research trajectories in this domain.

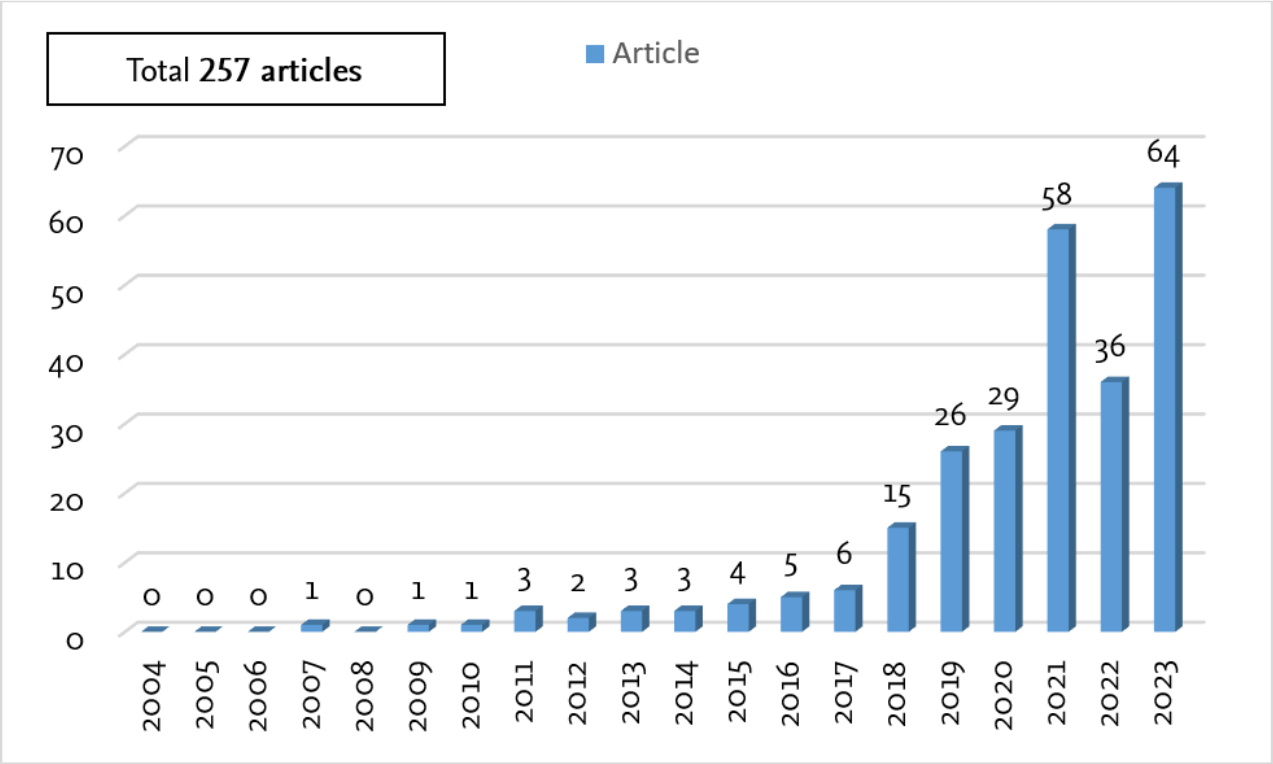

Figure 2. Total of articles by year (2004–2023)

3.1. Trends of Digital Entrepreneurship for Learning and Teaching in Education

RQ1: *How has the digital entrepreneurship trend evolved for learning and teaching in education over the last twenty years (2004–2023)?*

Exploring the uncharted territories within digital entrepreneurship research for education and pedagogy through bibliometric analysis is paramount for identifying critical gaps and emerging trends in the field. This meticulous process entails a comprehensive literature review to meticulously chart various research themes' frequency, interrelationships, and evolution. Within the realm of digital entrepreneurship in education, such exploration may encompass inquiries into the efficacy of digital learning strategies, the transformative influence of emerging technologies on educational paradigms, and the nuanced impact of social media on instructional methodologies.

The utilization of the Scopus database served as the cornerstone for gathering pertinent publication data in conducting the bibliometric analysis focused on digital entrepreneurship in education. This analysis was geared towards elucidating several key facets, including the temporal evolution of publications to discern discernible trends, an in-depth examination of prolific sources or journals, an exploration of countries making substantial contributions to this field of research, citation analysis to gauge the influence of seminal works, and the delineation of author networks and collaborative patterns to unravel the intricate academic landscape within this domain. Moreover, a meticulous keyword frequency analysis was conducted to unearth nascent themes and areas ripe for exploration. The outcomes derived from this multifaceted analysis hold immense value for researchers, educators, and practitioners engaged in digital entrepreneurship education, serving as a compass to steer future research endeavors, inform pedagogical strategies, and ensure that salient issues are comprehensively addressed.

The interplay between publication trends and the nexus of authors, affiliations, sources, and most cited articles underscores the intricate dynamics inherent in digital entrepreneurship in education. These trends are indelibly shaped by the collective contributions of prolific authors, steadfast affiliations, and revered sources chosen as conduits for disseminating research findings. Pioneering authors and steadfast affiliations wield considerable influence in sculpting the trajectory of these trends, while influential sources serve as lodestars, guiding researchers toward areas of paramount importance. Moreover, frequently cited articles, oftentimes authored by prolific scholars or showcased in eminent publications, wield considerable sway in shaping research agendas, catalyzing scholarly discourse, and fostering continued exploration into cognate themes.

In our initial analysis of publication trends, we spotlight the contributions of the most prolific authors in digital entrepreneurship for education and pedagogy. Table 2 illuminates five scholars who have made substantial strides in producing seminal publications related to digital entrepreneurship research themes. This elucidative analysis serves as a beacon for researchers, offering insights into prolific authors whose scholarly endeavors serve as guiding lights within this burgeoning field. With 743 authors identified through our analysis, these selected individuals epitomize the vanguard of research in digital entrepreneurship education, contributing significantly to the scholarly discourse and advancing our collective understanding of this transformative domain.

Investigating the under-explored areas of digital entrepreneurship research for education and teaching through a bibliometric analysis approach is crucial to identifying gaps and emerging trends in the field. This process generally involves thoroughly reviewing the existing literature to map various research themes' frequency, relationships, and development. In the context of digital entrepreneurship in education, this might include topics such as the effectiveness of digital learning strategies, the influence of new technologies in education, and the impact of social media on teaching methods.

The researcher used the Scopus database to collect relevant publication data in the bibliometric analysis for digital entrepreneurship in education. The focus of this analysis includes aspects such as the number of publications over time to determine trends, analysis of sources or journals that often publish a lot, analysis of countries that contribute many research results related to this field, citation analysis to measure the influence of specific works, and author networks and collaborations to understand the academic landscape in this field. In addition, keyword frequency analysis will detect new themes and under-explored areas. The results from this analysis will be of great use to researchers, educators, and practitioners in digital entrepreneurship education. The findings will guide future research directions, inform learning strategies, and ensure that important issues are thoroughly addressed.

The relationship between publication trends and authors, affiliations, sources, and most cited articles reflects the complex dynamics within digital entrepreneurship in education. The trends are influenced by the collective contributions of prolific authors, affiliations, and sources chosen to publish research. Prolific authors and consistent affiliations contribute significantly to shaping the direction of these trends. In addition, influential sources are essential in determining the focus of researchers' attention. Frequently cited articles, often written by prolific authors or published in key sources, significantly influence the direction of the research. These articles often introduce new concepts, methodologies, or findings that attract attention and encourage further research in related themes.

This first analysis of publication trends discusses the most prolific authors on the research topic of digital entrepreneurship for education and teaching. Table 2 presents five authors who have produced many publications on digital entrepreneurship research topics. This analysis can help researchers in making the author who contributes the most to conducting this research as a reference. The total number of authors obtained from the analysis is 743 authors. In Table 2, 5 authors have been filtered as productive authors in conducting and publishing research related to digital entrepreneurship for education and teaching.

Table 2. The top five most productive authors

No.	Authors	Articles	Affiliation
1	Vanessa Ratten	5	La Trobe Business School, Melbourne, Australia
2	Mário Franco	4	Department of Management and Economics, CEFAGE-UBI Research Center, University of Beira Interior, Estrada do Sineiro
3	Ana Garcez	4	University of Beira Interior, Estrada do Sineiro
4	Yangjie Huang	4	JingHengyi School of Education, Hangzhou Normal University, Hangzhou
5	Zehai Long	4	School of Innovation and Entrepreneurship Education, Wenzhou Medical University, Wenzhou

As per the findings derived from the bibliometric analysis, Table 2 offers a glimpse into the top five prolific authors spearheading digital entrepreneurship research endeavors about learning and teaching within the educational domain. At the forefront stands Vanessa Ratten, affiliated with the esteemed La Trobe Business School in Melbourne, Australia, exhibiting a commendable output of five articles. Following closely behind are Mário Franco, Ana Garcez, Yangjie Huang, and Zehai Long, each boasting a noteworthy contribution of four articles from institutions in Portugal, China, and Australia, respectively. This diverse distribution underscores the global engagement and collaborative efforts permeating research in this field, with scholars from disparate regions actively contributing to the academic discourse.

The prolific output demonstrated by these esteemed authors underscores their pivotal role in shaping the scholarly narrative surrounding digital entrepreneurship education. Their multifaceted contributions, spanning a spectrum of articles, are poised to profoundly influence curriculum development, pedagogical methodologies, and theoretical frameworks within this burgeoning domain. Vanessa Ratten's affiliation with La Trobe Business School, situated within a developed nation celebrated for its fervent emphasis on innovation and entrepreneurship, offers invaluable insights into the integration of these pivotal facets within the higher education milieu.

Furthermore, the affiliations of Mário Franco and Ana Garcez with a Portuguese institution provide a unique European perspective on digital entrepreneurship, likely accentuating distinct facets such as policy implications, economic imperatives, or alignment with overarching EU educational strategies. Conversely, the scholarly endeavors of Yangjie Huang and Zehai Long epitomize the burgeoning influence of Chinese academia on global research trajectories, reflective of China's meteoric rise in technological prowess and innovation.

The comprehensive research endeavors undertaken by these distinguished authors encompass a myriad of topics, ranging from the transformative impact of digital technologies on entrepreneurial behavior and education to the cultivation of indispensable digital competencies requisite for navigating the contemporary business landscape. Against the backdrop of an increasingly interconnected world where digital literacy and entrepreneurial acumen are inexorably intertwined, the seminal contributions of these luminaries assume paramount significance. As educators and policymakers endeavor to grapple with integrating digital entrepreneurship within the educational fabric, the insights proffered by these eminent scholars serve as an indispensable compass, guiding pedagogical practices, shaping educational policies, and charting the course for future research endeavors within this dynamic sphere.

In addition to spotlighting the contributions of prolific authors, this study sheds light on the institutional affiliations underpinning research endeavors exploring the intersection of digital technologies and entrepreneurship as a conduit for enriching learning and teaching within the educational landscape. Figure 1 provides a panoramic view of the global dispersion of affiliations engaged in this scholarly pursuit. Through meticulous analysis, a total of 257 affiliations were identified, with Figure 3 delineating the top 10 entities making significant strides in fostering research endeavors germane to digital entrepreneurship within the context of learning and teaching in education.

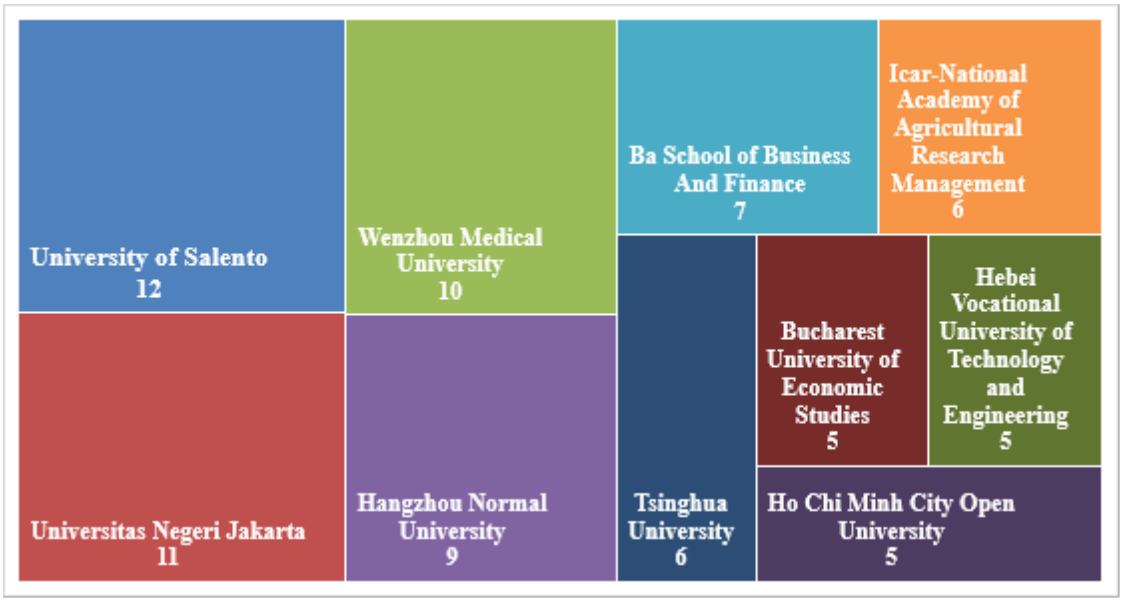

Figure 3. Top ten most productive affiliations

Figure 3 presents the TreeMap visualization as an effective method for elucidating the diverse origins of academic affiliates engaged in prolific research endeavors about digital entrepreneurship in education and learning. The TreeMap visualization offers a hierarchical depiction, facilitating quick comparisons of relative productivity through area representation. Each block's size directly correlates with the volume of publications, with larger blocks denoting higher productivity. Furthermore, distinct color coding enhances user discernment between various universities, aiding in swift identification and interpretation.

The University of Salento emerges as the foremost contributor, spearheading the cohort with 12 articles, thus underscoring its pivotal role in advancing research in digital entrepreneurship within an educational milieu. Noteworthy is the presence of myriad institutions spanning diverse domains, ranging from technology and business-oriented entities like the BA School of Business and Finance to domains such as agriculture and medicine, exemplified by the ICAR-National Academy of Agricultural Research Management and Wenzhou Medical University. This interdisciplinary engagement signifies a collective recognition of the pivotal role played by digital entrepreneurship across multifarious sectors, transcending the confines of business and technology alone. It underscores a burgeoning trend wherein entrepreneurial skills are seamlessly integrated with digital platforms across diverse disciplines, equipping students with the acumen to innovate and create value within their respective domains.

Moreover, the global expanse of these institutions, spanning from the University of Salento in Italy to Tsinghua University in China and Jakarta State University in Indonesia, underscores the universal relevance of digital entrepreneurship education. This geographical diversity underscores digital entrepreneurship's local resonance and global impact as a transformative force within higher education. It attests to its indispensable role in furnishing students worldwide with the requisite skills to thrive in the digital economy, thereby reflecting a concerted global endeavor aimed at fostering entrepreneurial prowess through digital avenues—an imperative in a contemporary economy underscored by imperatives of innovation and adaptability.

In addition to scrutinizing the origins of researchers' affiliations, this study also delves into the publication landscape, discerning the prominence of specific journals in disseminating research about digital entrepreneurship education. Such scrutiny proves invaluable, offering vital insights into prospective research trajectories. Notably, Figure 4 delineates ten journals pivotal in disseminating a plethora of publications elucidating the intricacies of digital entrepreneurship research related to learning and teaching within the educational realm.

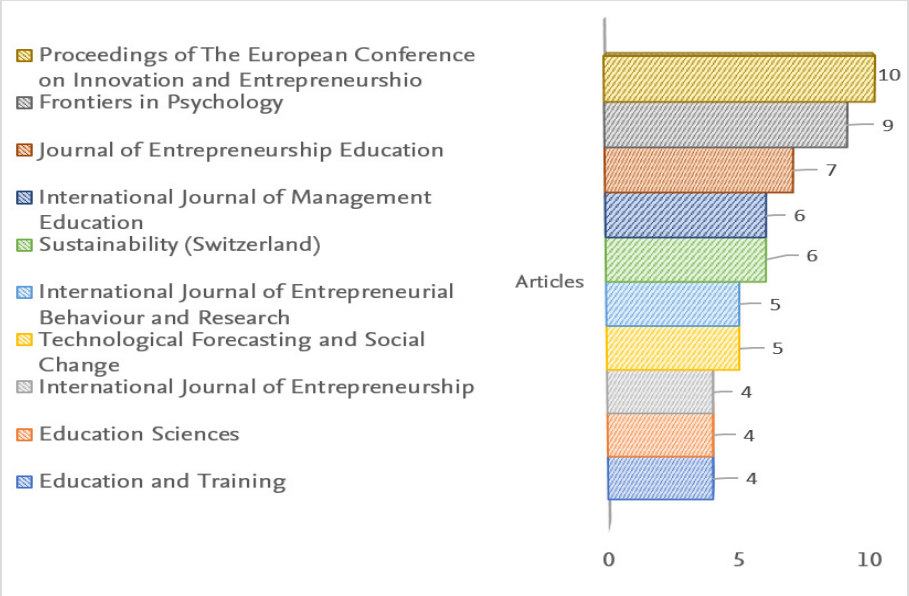

Figure 4. Top ten most productive sources

This analysis is a compass for selecting appropriate journals for disseminating future research findings. Journals aligned with the thematic scope identified herein present strategic options for submitting research articles. From our previous scrutiny, 113 sources were identified. The Proceedings of the European Conference on Innovation and Entrepreneurship (ECIE) emerges as the preeminent source, boasting ten articles, followed closely by Frontiers in Psychology with nine articles and the Journal of Entrepreneurship Education with seven articles.

This robust presence underscores vibrant scholarly exchanges and substantial research outcomes within specialized conferences and journals, accentuating innovation, psychology, and entrepreneurship education themes.

The heterogeneous array of journals spanning diverse disciplines, encompassing psychology, sustainability, and technology forecasting, signifies an inclusive, multidisciplinary approach to studying digital entrepreneurship in education. It elucidates that research in this domain transcends mere business practices, embracing a multifaceted inquiry into the psychological underpinnings of entrepreneurial behavior, the sustainability of entrepreneurial endeavors, and prognostications regarding technology and societal trends. Such interdisciplinary perspicacity is paramount in crafting a comprehensive educational blueprint to equip future entrepreneurs with the acumen and foresight requisite for thriving in the digital epoch.

Moreover, the inclusion of sources such as Education and Training and Education Science underscores a rigorous exploration of the pedagogical facets of digital entrepreneurship. This accentuates the significance of innovative teaching methodologies and educational frameworks adept at seamlessly integrating digital entrepreneurship into the curriculum. The bibliometric analysis encapsulated in this figure underscores the indispensability of a holistic approach to entrepreneurship education, one that amalgamates innovative pedagogical practices, psychological insights, and forward-looking prognostications, thereby priming students for the exigencies of the digital business landscape.

In addition to assessing leading journals, the study delves into a bibliometric analysis of countries making significant contributions to digital entrepreneurship research for learning and teaching in education. This endeavor seeks to deepen comprehension regarding the pivotal role of specific countries in advancing research within this domain and their ramifications on publication trends and prospective research trajectories. Figure 5 depicts a map delineating the geographical distribution of countries fostering research endeavors related to digital entrepreneurship within the pedagogical sphere.

Figure 5 encapsulates a bibliometric analysis table cataloging different countries, the number of articles published, and the total citations garnered in digital entrepreneurship for learning and teaching in education. China emerges as the frontrunner in articles published, boasting 108 contributions. However, the total citations accrued are relatively modest, tallying at 211. This could imply a recent upsurge in publications emanating from China, with the citation impact still in the nascent stages of maturation, or it could signify that despite the voluminous research output, its citation impact is still evolving, indicative of the dynamic nature of scholarly discourse within this domain.

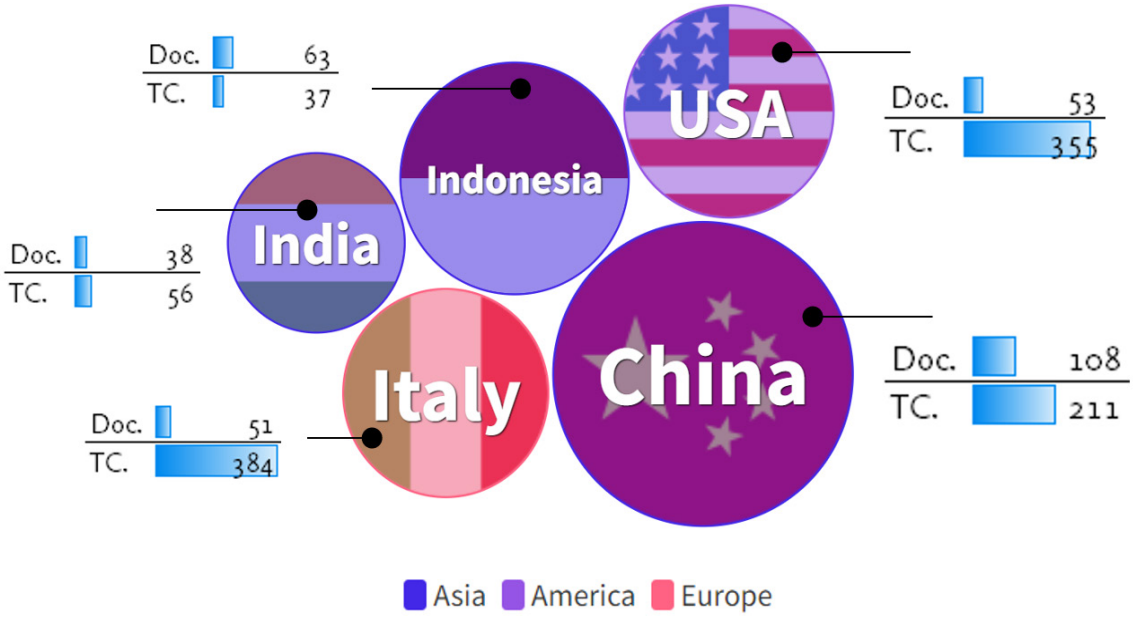

Figure 4. Top Five most productive countries

In contrast, Italy and the United States, boasting 51 and 53 articles, respectively, command higher citation counts than China, underscoring the broader impact of their research on the academic community.

The Italian articles, cited 384 times, and the US articles, cited 355 times, indicate that research originating from these countries wields considerable influence and may serve as foundational pillars in digital entrepreneurship education.

This might be attributed to a more extensive history of research in this domain, a focus on quality and pioneering endeavors, or a more robust integration of this research within international academic discourse.

Countries such as Indonesia and India exhibit relatively high article counts of 63 and 38, respectively, yet lower citation counts. This trend may mirror the burgeoning interest and investment in digital entrepreneurship research within these regions, which could still be in the process of garnering recognition within the broader scientific community. It also signals potential avenues for enhancing the impact and global outreach of research emanating from these countries as they continue to contribute to the field. Overall, the data gleaned from this bibliometric analysis offers a snapshot of the global terrain of digital entrepreneurship research, elucidating the volume of research outputs and their impact via citations, which can serve as a proxy for research quality and relevance.

In addition to assessing countries making significant contributions, Table 3 showcases ten out of the 257 articles wielding the highest number of citations within the research domain of digital entrepreneurship for learning and teaching in education. In the realm of publication trends, articles garnering substantial citations often embody concepts, methodologies, or findings deemed pivotal within a field of inquiry. Thus, the nexus between highly cited articles and publication trends may shed light on how seminal research shapes the focus and trajectory of future academic investigations while also illuminating how contributions from diverse countries enrich and deepen our comprehension of digital entrepreneurship on a global scale, particularly within the milieu of learning and teaching in education.

Table 3. Top ten most cited article

No.	Title	DOI	Citations
1	Digital entrepreneurship: A research agenda on new business models for the twenty-first century [35]	10.1108/IJEBR-06-2018-0425	353
2	Engineering students and entrepreneurship education: Involvement, attitudes, and outcomes [36]	Not found	144
3	Entrepreneurship education: Time for a change in research direction? [37]	10.1016/j.ijme.2020.100367	142
4	Coronavirus (Covid-19) and the entrepreneurship education community [38].	10.1108/JEC-06-2020-0121	129
5	The emergence of the maker movement: Implications for entrepreneurship research [39]	10.1016/j.jbusvent.2019.01.005	119
6	Threat or opportunity? A case study of the digital-enabled redesign of entrepreneurship education in the COVID-19 emergency [40]	10.1016/j.techfore.2020.120565	103
7	How Bricolage Drives Corporate Entrepreneurship: The Roles of Opportunity Identification and Learning Orientation [41]	10.1111/jpim.12377	97
8	Entrepreneurship and management education: Exploring trends and gaps [42]	10.1016/j.ijme.2020.100431	81
9	Digital Academic Entrepreneurship: A Structured Literature Review and Avenue for a Research Agenda [11]	10.1016/j.techfore.2020.120118	76
10	Lean business models change process in digital entrepreneurship [43]	10.1108/BPMJ-07-2018-0194	64

Table 3 displays the top 10 articles by the number of citations pertinent to digital entrepreneurship within learning and teaching in education. This compilation offers invaluable insights for researchers seeking to delve into influential articles within this domain, serving as a foundational resource for future investigations.

Topping the list is the article titled "Digital Entrepreneurship: A Research Agenda on New Business Models for the twenty-first century," authored by Kraus *et al.* [35], with an impressive citation count of 353, underscoring its seminal contribution to the field. This study accentuates the necessity of a dynamic research agenda tailored to accommodate the evolving business landscape of the 21st century, emphasizing the imperative for innovation and adaptability within entrepreneurship education in response to the challenges posed by digital technology. Drawing upon a comprehensive conceptual literature review, the study identifies and elaborates on six pivotal research streams pertinent to digital entrepreneurship, including digital business models, the digital entrepreneurship process, platform strategy, the digital ecosystem, entrepreneurship education, and social, digital entrepreneurship.

3.2. The Role of Digital Entrepreneurship for Students

RQ2: *What is the role of digital entrepreneurship in fostering student attitudes and engagement in understanding and applying entrepreneurship?*

Based on Table 3, another noteworthy article with a substantial number of citations delves into the pivotal role of entrepreneurship education in cultivating student attitudes and engagement in entrepreneurship, as evident in the second and third entries in the table. Boasting 144 and 142 citations, these articles underscore the close interplay between entrepreneurship education and practical application, highlighting the perpetual evolution of research within this domain to explore diverse teaching methodologies and approaches.

The study by Duval-Couetil N *et al.* [36] endeavors to scrutinize various facets and outcomes of entrepreneurship education tailored for engineering students, aiming to discern students' characteristics engaged in such courses and related activities, their levels of involvement, the influence of entrepreneurship education on career aspirations, and its impact on self-confidence levels within an entrepreneurial context. Findings revealed that while most engineering students initially intended to pursue careers in large-scale corporations post-education, many recognized the potential for entrepreneurship training to broaden their career horizons. However, integrating entrepreneurial concepts into engineering curricula remains relatively limited, although students who participated in entrepreneurship courses exhibited heightened self-assurance.

Similarly, the research conducted by Ratten V and Usmanij P [37] sheds light on the imperative for a shared understanding of specific outcomes to enhance comprehension regarding the processes conducive to favorable outcomes in entrepreneurship education programs. This necessitates communicating to students the intrinsic benefits of entrepreneurship education and acknowledging that results may not materialize immediately post-course completion. Embedding key learning objectives within entrepreneurship education curricula is pivotal for augmenting student engagement.

Furthermore, the impact of the COVID-19 pandemic on entrepreneurship education emerges as a salient theme, with articles exploring its repercussions on the educational landscape and advocating for the redesign of entrepreneurship education frameworks to navigate this crisis effectively. Insights from Ratten, V [38] underscore the pivotal role of digital entrepreneurship education in equipping learners with the resilience and adaptability requisite in times of uncertainty [38]. The study underscores the necessity of employing augmented reality technology and artificial intelligence to simulate real-world scenarios, fostering a community-based learning approach in comprehending and applying entrepreneurship principles. Similarly, research by Secundo G. *et al*. [39] delineates a redesign process for entrepreneurship programs leveraging digital technology to delineate novel approaches in entrepreneurship, presentation techniques, and business planning and development.

Furthermore, other articles delve into the subtleties of entrepreneurship education, such as the significance of bricolage in corporate entrepreneurship and the exploration of trends and gaps in entrepreneurship and management education. These contributions furnish a deeper comprehension of entrepreneurship education's pedagogical and strategic dimensions. At its core, teaching entrepreneurship encompasses imparting business acumen and nurturing a learning orientation conducive to identifying and capitalizing on opportunities.

In conclusion, the bibliometric analysis encapsulated in this table offers a holistic portrayal of the principal research themes in digital entrepreneurship education. Featuring articles that have shaped scholarly discourse and influenced educational paradigms, the table underscores the indispensability of continual adaptation in entrepreneurship education to prepare students for the dynamic digital business landscape.

These seminal articles are foundational pillars for research, curriculum development, and pedagogical strategies in this ever-evolving field, evident in their widespread citation and enduring scholarly impact.

4. Discussion

4.1. Research Trends of Evolutionary Digital Entrepreneurship

RQ3: *What is the evolutionary trend towards the research field of digital entrepreneurship?*

Trend studies play a pivotal role in unraveling the evolutionary trajectory of a specific research field. These studies unveil the shifting academic interests, evolving research methodologies, and thematic focuses within the domain by scrutinizing emerging patterns in the literature over time. Such analyses serve as indispensable tools for all stakeholders in the research community.

Co-occurrence analysis stands out as a bibliometric technique adept at uncovering trends and patterns in the literature.

This method operates on the premise that the frequency of co-occurrence of keywords or terms in documents signifies a substantive relationship rather than mere coincidence [44], [45]. When applied to trend analysis in marketing research in Indonesia, co-occurrence analysis empowers researchers to pinpoint burgeoning topics, trace the evolution of research themes, and prognosticate future research trajectories. Moreover, insights gleaned from this trend analysis furnish a solid groundwork for identifying research lacunae warranting further exploration.

Illustrated in Figure 6 is a network graph depicting shared word analysis, a method employed to visually depict the structure and interconnectedness of terms in textual bodies such as research articles, policy documents, or educational materials. In this visualization, five distinct clusters emerge, with the central cluster revolving around the term “Facebook.” Additionally, the term “marketing” is prominently featured, underscoring its significance as one of the core keywords associated with this study’s focal areas.

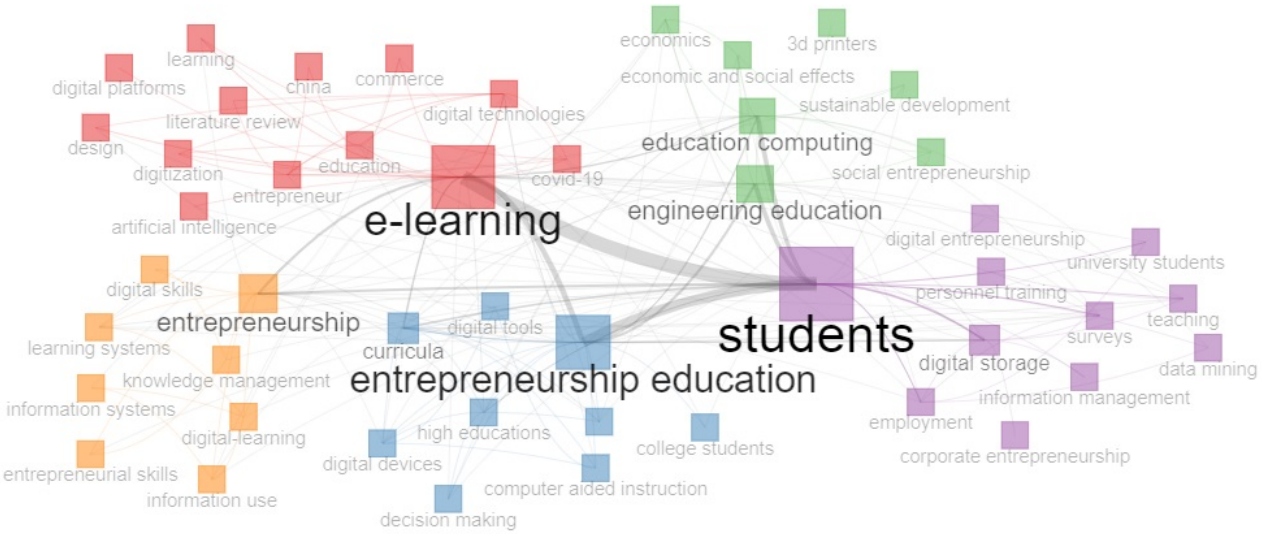

Figure 5. Co-occurrence analysis

Figure 6 showcases the bibliometric analysis focusing on digital entrepreneurship research within learning and teaching in education. Bibliometric analysis, a statistical method, assesses and interprets the level and trends of research activity within a specific domain. This analytical approach scrutinizes academic publications such as articles and conference proceedings. The visualization presented delineates the co-occurrence of keywords within a corpus of literature, with the size of each box denoting the frequency of a particular term and the lines indicating the strength of relationships between terms.

Digital entrepreneurship, a swiftly burgeoning field, intersects with education, particularly in e-learning environments [46]. The visual bibliometric analysis depicted here elucidates the conceptual landscape of digital entrepreneurship research within the educational sector. This analysis sheds light on the predominant themes and terms in the literature. These visualizations are crafted from data culled from scientific databases, effectively mapping out the frequency and co-occurrence of specific terms across published articles, conference papers, and other academic contributions.

This methodological approach enables researchers to discern patterns, identify trends, and spot emerging topics within the field, affording a macro-level perspective of the research area.

Prominently featured at the center of the visualization are the terms "e-learning," "entrepreneurship education," and "students," which loom larger than other terms, signifying their prevalence in this study [54], [55]. This prominence underscores a robust emphasis on integrating e-learning into entrepreneurship education and underscores its significance for learners. The relationship between "e-learning" and "entrepreneurship education" suggests a substantial convergence in the literature, wherein digital learning platforms are likely harnessed for imparting entrepreneurial skills.

Drawing from research conducted by Chen L *et al.* [21], a systematic analysis delving into blended and online entrepreneurship learning and teaching was undertaken. The study's findings underscored the utilization of various technologies, including Wiki for discussing entrepreneurial concepts, Facebook as the predominant social platform, FLYGBY and SimVenture for gamification and engagement in serious games, and Coursera offering diverse online entrepreneurship education courses. Technology assumes a pivotal role in entrepreneurship education, with social media platforms fostering collaboration and massive open online courses furnishing flexible learning resources. Instructors and learners alike must select technologies that align with the objectives of the entrepreneurship course [47], [48]. The pronounced presence of these terms underscores the integral role digital platforms play in disseminating entrepreneurship-related content.

4.2. The Importance of Digital Entrepreneurship in Education

RQ4: *How will digital entrepreneurship affect education in the future?*

The keyword "digital entrepreneurship" stands out as a primary node, emphasizing its pivotal role in current research endeavors. This prominence signals a notable shift in entrepreneurship education towards a greater emphasis on digital competencies, knowledge management, and the utilization of digital tools. The network visualization reveals the interdisciplinary nature of digital entrepreneurship education, with connections extending to fields such as "engineering education," "economic and social impact," and "sustainable development." This interdisciplinary integration mirrors a burgeoning trend in research aiming to foster socially responsible businesses leveraging technology for societal benefit [49].

Adjacent to these central terms are clusters of related keywords. For instance, terms like "digital skills," "knowledge management," and "information systems" are closely intertwined with "entrepreneurship," suggesting a focus on the technical competencies requisite for digital entrepreneurship. Research in this sphere likely delves into how entrepreneurship curricula are tailored to incorporate digital literacy—a vital aspect of contemporary entrepreneurs' success [50].

Moreover, terms such as "COVID-19," "digital tools," and "computer-assisted instruction" underscore recent research endeavors investigating the pandemic's impact on technology utilization in education. The pandemic has catalyzed the adoption of e-learning tools and methodologies, a trend echoed in this bibliometric analysis [51].

Furthermore, terms like "higher education" and "students" imply a concentration on university-level education, a critical phase for nurturing entrepreneurial skills. The literature reviewed likely encompasses studies on university programs, teaching methodologies, and student learning outcomes within digital entrepreneurship education [52].

This bibliometric analysis encapsulates the multifaceted landscape of digital entrepreneurship research in an educational context. The interconnected terms delineate how digital tools and pedagogical strategies intersect to cultivate an entrepreneurial mindset among students [53], [54], [55]. The visualization reflects a dynamically evolving field responsive to technological advancements and global exigencies like the COVID-19 pandemic.

Future research trajectories may delve deeper into the efficacy of educational strategies, the integration of emerging technologies, and the enduring impact on students' entrepreneurial trajectories. This analysis underscores the imperative of continually adapting educational practices to align with the evolving demands of the digital economy.

As a snapshot of the present research landscape, this bibliometric analysis lays a groundwork for scholars and practitioners to build upon. As the field progresses, periodic reassessment and updates to this visualization will be crucial to ensure digital entrepreneurship education remains pertinent and impactful for future cohorts of students.

5. Conclusion and Future Work

An extensive bibliometric analysis of digital entrepreneurship within educational contexts underscores a significant evolution in learning and teaching paradigms, showcasing the pivotal role of digital technologies in fostering students' creative thinking, problem-solving abilities, and digital literacy.

As contemporary society and the job market increasingly prioritize digital and entrepreneurial proficiencies, this research elucidates the educational sector's inclination towards integrating digital tools for entrepreneurial ventures and innovative pedagogical tools. Leveraging the Scopus database, our bibliometric analysis has unveiled emerging trends, key themes, and research lacunae, underscoring a remarkable surge in publications and scholarly interest surrounding digital entrepreneurship in educational domains.

The findings spotlight the noteworthy contributions of eminent authors, institutions, and journals, reflecting this domain's global and interdisciplinary nature. They advocate for the adoption of educational strategies that adeptly harness technological advancements and address evolving societal demands. The implications of these insights extend far and wide, offering invaluable guidance to educators, curriculum developers, and policymakers in crafting impactful and responsive educational programs.

However, as digital technology continues its relentless evolution, further investigation is imperative to ensure the dynamism and efficacy of entrepreneurship education. Future research endeavors should focus on elucidating innovative approaches that not only equip students with requisite skills for the competitive job market but also empower them to navigate and thrive amidst future uncertainties and challenges. By remaining attuned to emerging trends and harnessing the potential of digital innovations, entrepreneurship education can continue to evolve as a potent force in shaping the entrepreneurial leaders of tomorrow.

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