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Research Article

The Disruptive Innovation and Entrepreneurship Education: The Literature Review and Current Practices

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Abstract.

Entrepreneurship education is changing dramatically due to rapid technological advancements and transformative business models. This study investigates the interactions and implications of existing frameworks and practices that link disruptive innovation with entrepreneurship education. The research employs a comprehensive literature review from 2019 to 2023, to synthesize detailed analyses for investigating the interplay of these concepts. Entrepreneurship education fosters the ability to recognize and capitalize on innovative opportunities, whereas disruptive innovation emphasizes value creation through norm-breaking when aligned with entrepreneurial principles. Effective entrepreneurship education can drive new businesses and revitalize existing ones by enabling individuals to capitalize on disruptive breakthroughs. However, incorporating disruptive innovation into courses is challenging. Traditional education may fail to capture the dynamic nature of disruptive innovation, and risk-averse academic environments may stifle experimentation. Innovative teaching methods that balance basic business concepts with disruptive thinking are essential. Finally, a new generation of entrepreneurs can be developed by combining disruptive innovation and entrepreneurship education. Individuals can capitalize on opportunities for economic growth by infusing programmers with disruptive principles. The study identifies five key components of convergence: (i) technology-enabled virtual learning environments (VLEs), (ii) online distance learning (ODL), (iii) digitalization in entrepreneurship education, (iv) competency-based education (CBE) that fosters Business Model Innovation, and (v) experience-based learning in entrepreneurial education. This paper examines the role of disruptive innovation in entrepreneurial education, proposing research directions and highlighting unresolved areas for investigation.

Keywords: business model, disruptive innovation, entrepreneurship education, technology, online distance learning

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1. Introduction

In 1997, Christensen [1] coined the phrase “disruptive innovation,” which has since become a core concept for understanding how new technologies and ideas affect industries and markets. This case demonstrates the transformative power of technologies, which frequently emerge from underserved or underdeveloped market segments. On the other hand, entrepreneurship education has been viewed as a catalyst for instilling an entrepreneurial mindset in students and equipping them with the skills needed to thrive in a dynamic and unpredictable business environment [2]. A fascinating study opportunity exists at the intersection of disruptive innovation and entrepreneurial education. Disruptive innovation’s emphasis on challenging current norms and creating value is consistent with entrepreneurship’s goals [3]. Furthermore, entrepreneurship education seeks to foster an innovative, risk-taking, and adaptable mindset, all required for identifying and capitalizing on disruptive opportunities [4]. The potential for integrating disruptive innovation principles into higher education’s entrepreneurship instruction is substantial. Conventional teaching approaches often fail to capture the fluid and nonlinear dynamics inherent in the disruptive innovation process [5].

Consequently, a pressing necessity arises to explore novel pedagogical techniques that equip students to harness and navigate disruptive forces adeptly. Therefore, this literature review aims to explore the mutual relationship between disruptive innovation and entrepreneurial education. It aims to demonstrate how entrepreneurship education can aid individuals in discovering, embracing, and effectively managing disruptive technologies, fostering innovative enterprises’ emergence and contributing to industrial growth.

2. Material and Methods

The primary methodology employed in this study is a systematic literature review. A comprehensive multi-step process was adopted to select relevant publications. The steps are detailed below:

2.1. Initial search

The databases used for the search were Scopus and Google Scholar. The primary keywords used for the search included “disruptive innovation” and “entrepreneurship education.”

2.2. Search outcomes

2.2.1. Scopus

A total of 2,780 documents containing the search terms in their titles, abstracts, or keywords were identified.

2.2.2. Google scholar

An initial result of 1,370 documents was obtained.

2.3. Refinement

2.3.1. Scopus

When filters were applied to include only English language papers, journal final drafts, and those falling within the domains of business management and accounting, the number was reduced to 486 papers.

2.3.2. Google scholar

Limiting the search to articles published between 2019 and 2023 yielded 786 papers.

2.4. Downloads and duplicates removal

149 papers were downloaded from both Google Scholar and Sci-hub. During this download process, duplicates, as well as doctoral theses, were excluded.

2.5. Content evaluation

Of the downloaded literature, 96 articles were excluded due to their limited scope - focusing on only one theme without discussing potential linkages, and hence, only 53 primary articles were left for review, as illustrated in Figure 1.

2.6. Further expansion

The process of in-depth reading led to the identification of additional pertinent literature. Thus, the total number of articles under consideration expanded from 53 to 184, including nine significant book references.

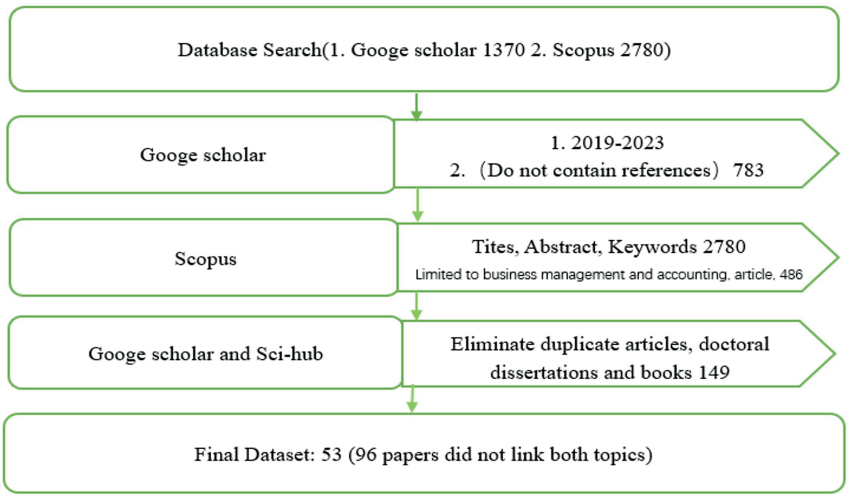

Figure 1: Steps of document search and review process. Source: Author's own work.

3. Literature Review

3.1. Disruptive innovation

Cost-effective business models are central to disruption [6, 7], providing a practical strategy for emerging enterprises seeking to gain a competitive edge in a balanced market landscape [8]. Innovation is the primary driver of startup growth [9]. Notably, Apple is a prime example of disruptive innovation, owing to the company's inherent need to embrace new technologies and consistently target new clientele and markets [10].

Additionally, scholars have probed factors that drive or hinder disruptive innovations, including organizational culture [11], technological trajectories [12], ecosystem roles [13], implementation of processes or operations, sustainable organizational growth, and social responsibility [14, 15], thereby shaping the bedrock for a novel competitive paradigm. Such studies shed light on the complex interplay between technological advancement, market dynamics, and the emergence of disruptive technologies.

Disruptive (revolutionary) innovation destroys and replaces established markets, services, and products [16], ICT, financial services, energy through commercializing a whole new set of concepts and applications, consumer-related industries commodities, and

the automobile industry [17]. Digital cameras, touch-screen phones, electric cars, the Internet, Uber, and shale gas are just a few examples. Disruptive innovation, sometimes described as a force within the corporate, product, or service sectors that either takes over or significantly disrupts an existing market [18], tends to go through development stages that are more turbulent and uncertain than those of incremental innovations. Nevertheless, when managed effectively, such innovation often results in significantly higher revenues and returns [19]. Such innovation necessitates a significantly more complex ecosystem in contrast to incremental innovation. This ecosystem includes access to venture capital, a highly skilled workforce, robust research and development, secure intellectual property rights, and seamless access to end markets [20].

Disruptive innovation frameworks have recently gained popularity [21], and their acceptance within academic circles is growing [22, 23]. Disruptive innovation frameworks have been recognized for their ability to improve entrepreneurial outcomes in contexts with balanced market dynamics, particularly among tech entrepreneurs [15, 22, 24, 25]. The changes brought about by a disruptive innovation framework in product design and business models can result in cost savings. As a result, entrepreneurs in balance-of-payments contexts have more opportunities and incentives to create low-cost products aimed at underserved or overlooked segments of the population [21]. This framework enables the introduction of low-cost, innovative products that meet customers' needs, create new markets, or implement novel business strategies [26]. Entrepreneurial pursuits fueled by disruptive innovation are increasingly recognized as a strategic avenue for fostering long-term innovation-led growth in low-income settings [22]. According to Wan et al. [27], using the disruptive innovation framework facilitates the expansion of developing markets and increases the likelihood of firm survival. Non-consumer entrepreneurs should actively cultivate new markets to uncover disruptive potential within targeted domains, ultimately benefiting established players [28].

According to the disruptive innovation paradigm, newcomers win through disruptive innovation by taking unconventional paths from marginal, low-end markets, which are the least profitable parts of incumbents' businesses. It also emphasizes creating new markets and low-cost goods, increasing the capacity of low-end markets [21], and improving innovation skills [9]. During the disruption phase, startups with limited resources may effectively challenge existing major market rivals, eventually changing the industry status quo [1, 29]. Disruptive innovation has progressed from its foundations in business theory to a widely accepted paradigm for understanding how innovation affects industries and economies. Finally, "disruptive innovation" has emerged as a cornerstone of the innovation literature, providing insights into the dynamics of technological growth and its impact on markets. Extensive research on this concept has

elucidated its methods, ramifications, and motivations, providing a thorough understanding of how disruptive innovations transform sectors and create opportunities for new entrants. Table 1 presents the definition of Disruptive Innovation.

3.2. Entrepreneurship education

Significant attention has been directed toward integrating entrepreneurship education within the contemporary educational framework. This dynamic aspect of learning equips students with the essential knowledge and skills and cultivates the necessary mindset for navigating today's complex entrepreneurial landscape. Entrepreneurship education has piqued academic interest due to its potential to fuel innovation, propel economic progress, and cultivate a pervasive entrepreneurial ethos [2]. Scholars have been drawn to investigate its implications in this context, with some claiming that it has the ability to instill traits conducive to entrepreneurial success. This idea implies the plausible notion that entrepreneurship can be taught or, at the very least, stimulated through education [45].

At its core, formal entrepreneurship education can profoundly shape students' perspectives and set the trajectory for their entrepreneurial pursuits after graduation. According to Ahn et al. [46], entrepreneurship education has a direct and positive impact on fostering an entrepreneurial spirit and increasing self-efficacy among college students. Notably, when individuals lack exposure to business experiences, this educational avenue proves even more impactful, amplifying the positive outcomes of Entrepreneurship Education Programmes (EEPs), as observed by Fayolle [47]. Bullough et al. [48] are part of a broader group of experts who have recognized the tangible benefits of entrepreneurial education and training programs, and this perspective findings were supported by the work of Raposo and Paço [49].

Entrepreneurship education is important in both business schools and a variety of non-business settings. This is supported by research used Theory of Planned Behavior to examine students' entrepreneurial intentions, revealing that entrepreneurship education empowers more youth to start businesses while developing general entrepreneurial skills for their future [49-51]. According to Kourilsky [52], the importance of entrepreneurship education revolves around three key themes: the need for such education, the availability of educational avenues for fostering "job creation," and the resulting economic growth through employment creation. As Kedward et al. [53] emphasize, entrepreneurship education plays a critical role in shaping students' career decisions in the twenty-first century.

Table 1: The definition of disruptive innovation (DI).

Characteristic	Definition	Author (year)
Targeting Underserved Markets	DI capability is the capability of a company to use external and internal resources, DI capitalizes on opportunities that exist in new, underserved, and neglected market segments by transforming knowledge and ideas into competitive DI, DI is able to gain a competitive advantage.	Dzimba and van der Poll (2022) [21]
	DI is defined as a product, service, or business model that creates a new market or enters an existing market from the bottom up.	Downes and Nunes (2013) [30], Christensen et al. (2018) [26]
	DI is referred to as disruptive product innovation, creating simpler, less feature-rich, and more affordable products yet adequately meeting the needs of a market segment often neglected by established mainstream offerings.	Gilbert and Bower (2002) [31], Christensen and Raynor (2003) [29], Govindarajan et al. (2011) [32]
Lower Performance	Disruptive technologies initially offer lower performance compared to established solutions. However, they possess other advantages that appeal to specific customer segments, such as affordability, simplicity, or accessibility.	Anthony et al. (2008) [33]
Innovation & Technology	As an innovation type and strategy, the DI framework is considered the answer to the growth imperatives that most small businesses and startups face during their formative years.	Christensen and Raynor (2003) [29], Markides (2013) [34], Christense (2015) [35]
	DI, known as implicit innovation, involves the application of technology to form new markets. Such innovations often attempt to understand and anticipate changing market cycles and transform businesses to adapt to changing times.	Dora et al. (2021) [36]
	DI is referred to as utilizing new technologies to add value to customers.	Ahmad 2019) [37]
Simplicity and Convenience	DI is often simple, small-scale, convenient, and cheap to appeal to new or lower-demand customers. DI provides simplicity and standardization to the whole process, lowering launch costs if they demonstrate reliability and good performance.	Chen et al. (2017) [38], Sandström et al. (2014) [39], Rodriguez-Donaire et al. (2020) [40]
Process	The process of DI involves four steps: (i) identify the opportunity, (ii) development based on analysis, (iii) introduction of new solutions, and (iv) exploitation of the market.	Choudhary and Muralidharan (2014) [41]
	The three-step approach of DI is defined as follows: “Innovations with radical capabilities, discontinuous technology standards, and/or new forms of ownership that redefine market expectations.”	Nagy et al. (2016) [42]

Table 1: Continued.

Characteristic	Definition	Author (year)
	DI is when systemic change occurs, which involves changes in power relations, social hierarchies, and framing specific issues for disadvantaged groups' benefit. It may or may not involve social movements.	Nicholls et al. (2015) [43]
	To succeed in the face of disruptive change requires established firms to master three distinct disciplines: ideation, to generate potential new business ideas; incubation, to validate these ideas in the market; and scaling, to reallocate the assets and capabilities needed to grow the new business.	O'Reilly and Binns (2019) [44]

Source: Author's own work

Ministry of Education recognized the importance of imparting entrepreneurship education at the start of the twenty-first century. It required all higher education institutions to include entrepreneurship courses to foster long-term commercial success Kedward et al. [53]. As a result of well-established entrepreneurial education in Europe and North America, scholars have a vast library of pragmatic expertise [54]. Strategy, globalization, lifelong learning, nationalization, and systematization have evolved distinct tendencies in European and American entrepreneurial education. Stanford University, MIT, and Babson College have all performed significant studies on this topic [55]. Stanford University, for example, has spent many years developing a curriculum framework that spans multiple disciplines, including the arts and sciences, while seamlessly integrating theoretical insights with practical application in the domains of innovation and entrepreneurship education. The overarching goal is to inspire and motivate students to pursue careers as creators and entrepreneurs. As the primary modality, case-based learning is at the heart of instruction and supplemented by informative entrepreneur-led lectures and hands-on business practice sessions [56]. Furthermore, the skills learned through entrepreneurial education have a remarkable transferability and relevance across a wide range of scenarios, making their application an even more fertile area for research [57].

Among them, entrepreneurship education is thought to bridge the gap between individual characteristics and entrepreneurial goals [58]. According to Pittaway and Cope [59], "these contextual aspects (i.e., entrepreneurship education) are constantly influenced." According to Wilson et al. [60], women benefit more from entrepreneurship education in terms of entrepreneurial self-efficacy and career. Several studies have found that entrepreneurs' self-efficacy, aspirations, and desires can be increased through entrepreneurship education [2, 61]. Additionally, entrepreneurship education

has been linked to developing entrepreneurial awareness and skills such as opportunity recognition, creativity, and risk-taking [62].

On the other hand, some experts believe cultivating an entrepreneurial mindset in the next generation is critical [63]. According to Ruskovaara and Pihkala [64], educators must integrate entrepreneurship education into their teaching methodologies seamlessly. This integration is especially important given the complex nature of pedagogical concepts related to entrepreneurship education, prompting the recommendation to carefully select the most effective and beneficial models. Without a doubt, entrepreneurship education plays a critical role in enhancing a country's competitive edge [65], fostering a more comprehensive and competitive educational landscape at all levels [66]. A notable debate in entrepreneurship education is the integration of coaching mechanisms with entrepreneurial advancement, which is the foundation for developing interdisciplinary coaching programs [67]. On a policy level, the Ministry of National Education has mandated that courses centered on entrepreneurship education be included in educational institutions [68]. Concurrently, Setiono et al. [69] advocate a forward-thinking stance, emphasizing the aspiration for students to achieve self-sufficiency and to channel their focus towards work prospects rather than mere job pursuits.

Numerous studies show that learning about entrepreneurship enhances students' inclination toward entrepreneurship, which involves setting entrepreneurial goals [2, 70, 71]. Also, it includes adopting entrepreneurial behavior [72-74]. Moreover, involving AI-assisted learning techniques can potentially enhance and nurture entrepreneurial drive and focus [75]. Business education and entrepreneurship play a vital role in developing innovative and well-versed graduates in the digital landscape. Integrating AI techniques into education and making necessary adjustments can help adapt to and harness the potential of the AI revolution [76], and has the potential to advance technology and foster entrepreneurship, creating a skilled workforce [77].

These studies have shown that creativity and innovation are not limited to high school business students; entrepreneurship education has a broader impact on institutional outcomes [78]. Academics have even created courses specifically for STEM students, particularly engineering students, highlighting the importance of entrepreneurial education in higher education settings [79-81]. Furthermore, in innovation-driven countries such as the United States [82-84], Scandinavian nations [85], and the United Kingdom, entrepreneurship education is used alongside traditional business education [86].

Educators have conducted extensive research on the efficacy of various instructional methodologies in the field of entrepreneurship education. Experiential learning is one approach in which students participate in hands-on activities and real-world

projects. According to research, such as that conducted by Jones and Matlay [87] and Neck et al. [4], this pedagogical strategy effectively captivates students' interest and fosters the acquisition of practical entrepreneurial competencies. This approach improves students' understanding and cultivates skills that can be directly applied to entrepreneurial endeavors by immersing them in tangible entrepreneurial experiences. In contrast, one distinct avenue investigated in entrepreneurship education is collaborative and interdisciplinary approaches. This approach resembles real-world business settings by encouraging teamwork and integrating insights from various fields. Foliard et al. [88] conducted research on this method to simulate real-world business dynamics. This approach emulates the multifaceted nature of entrepreneurial ventures by encouraging interaction among students from diverse backgrounds, potentially fostering cross-disciplinary knowledge exchange. On the other hand, certain critics argue that emphasizing experiential learning may overshadow theoretical foundations, potentially leaving students without a solid theoretical framework. Similarly, while collaborative and interdisciplinary approaches promote knowledge exchange, they may also pose communication challenges among students from various academic disciplines.

However, exploring diverse instructional methodologies, including experiential learning and interdisciplinary collaboration, is crucial for enhancing the effectiveness of approaches in entrepreneurship education. These strategies contribute to a dynamic educational landscape that balances the development of practical skills with theoretical understanding, ultimately preparing students for the multifaceted challenges of the entrepreneurial world.

Due to limited resources, technological advancements, and shifts to new educational paradigms, teachers and other higher education institutions must study more engaging modes of teaching [89, 90]. Blended learning refers to courses that combine online learning with face-to-face instruction, and its application in higher education has grown in recent years [91-93]. It mixes traditional education (face-to-face instruction) with technology-assisted learning activities [94]. The Education University of Hong Kong's technology-driven approach to professional development had positive results by encouraging teaching professionals to use blended learning in their courses [95]. Pisoni [96] identifies traditions in innovation and entrepreneurship education as well as their current use of IT technologies for their job processes, which differ in terms of their requirement for a blended educational standard.

On the other hand, experiential learning is a teaching method that promotes the development of students' knowledge, skills, values, and attitudes through direct student experience [97]. According to the evidence, students play an important role in the development of entrepreneurial courses, gaining direct knowledge of the "meaning" of

course development. This strategy gives students a thorough understanding of their skills and their utility in the future [98]. Baron and Henry [99] conducted a review of the research on entrepreneurial learning and proposed two methods of learning: (i) experiential and (ii) alternative learning. Some academics believe that excellent entrepreneurship education is founded on experience and theory. This method emphasizes the complete integration of theory and practice [100]. Design thinking is similar to the concept of lean entrepreneurship, which is currently being used by entrepreneurship programmers at top universities worldwide. Colleges such as Harvard and Stanford have used case teaching as an alternative learning style for entrepreneurship education. As an effective method for experiential learning in entrepreneurship education, Babson Business School advocates a five-step experiential teaching approach that encompasses elements such as play, empathy, creativity, experimentation, and reflection, as outlined by Neck and Greene in 2011 [101]. A broad teaching approach is required to support the transition of creative and entrepreneurial talent training in innovation and entrepreneurship [56].

Finally, "entrepreneurship education" is critical in developing entrepreneurial attitudes and behaviors in people. Literature emphasizes the power of literature to influence entrepreneurial attitudes, intentions, and talents, thereby encouraging the establishment of innovative businesses and the development of an entrepreneurial culture. Table 2 present the various definition of entrepreneurship education.

Table 2: The definition of entrepreneurship education.

Author (year)	Definition
Mentoor and Friedrich (2007) [102]	Entrepreneurship education is described as the study of teaching skills for establishing and operating a firm.
Suherman (2008) [103]	Entrepreneurship education teaches individuals how to create their own firms.
Mulyani (2010) [104]	The success of an entrepreneurship education programmer can be measured by the standards/indicators attained by students, which include highly independent, highly creative, risk-taking, action-oriented, leadership qualities, work disposition, understanding of the concept of entrepreneurship, and having entrepreneurial skills in school, particularly entrepreneurship.
Saroni (2012) [105]	Entrepreneurship education is an educational program that emphasizes the entrepreneurial component of empowering students.
Xiong et al. (2017) [106]	Entrepreneurship education is a curriculum universities and colleges offer to students and other persons to increase entrepreneurial awareness, capacities, and skills.
Setiono et al. (2023) [69]	Entrepreneurship education builds character and greatness, the capacity to clear bad psychological attitudes, competitiveness, combat effectiveness, and reasonable and constructive thinking methods.

Source: Author's own work

3.3. Disruptive innovation and entrepreneurship education practices

The combination of “disruptive innovation” and “entrepreneurship education” has far-reaching implications for adapting to the changing needs of the current business climate. Christensen’s concept [1] of disruptive innovation emphasizes the transformative potential of new technologies and business models that emerge unexpectedly. Entrepreneurship education, on the other hand, equips students with the knowledge, mindset, and temperament to identify, understand, and capitalize on disruptive opportunities [2]. Entrepreneurship education has recently gained popularity [107-109].

In the context of examining university adaptation in the 21st century, Christensen and Eyring [110] suggest the application of the theory of disruptive innovation. This theory emphasizes two categories of innovation: firstly, sustaining innovation, which involves enhancing an existing product, and secondly, disruptive innovation, which introduces an economical alternative to the market. This alternative may not match the quality of the traditional or original version but offers greater user-friendliness, thereby disrupting the conventional cycle of “bigger and better.”

Subsequently, as outlined by Irene et al. [111], disruptive innovation creates an enticing substitute tailored for underserved or non-consuming customers instead of engaging in direct competition with the established mainstream market. Disruptive innovations consist of four interconnected components:

Technology that enables automated and integrated processes.

Business model transformation through innovative measures that lead to increased operational efficiency and cost-effectiveness.

A new value network that demonstrates the potential of the innovation to supplement other business services, and

Inter-collaboration on industry standards.

Until now, the emphasis in the field of Disruptive Innovation and Entrepreneurship Education practices has primarily been on the comprehensive design and execution of curricula, which includes the following aspects:

3.3.1. Technology enabler creates virtual learning environments (VLEs)

Certainly, the twenty-first century has witnessed the technological disruption of both higher education institutions and global corporations [112]. Among these changes, online education has emerged as a prominent trend in higher education [113] and it is also considered a disturber in entrepreneurship education. This approach, referred to as

online or remote learning, new tools, and virtual learning environments (VLEs), involves independent study by students and instructors, utilizing the Internet, online materials, and advanced communication technology, often supported by established media platforms [114]. According to Christensen [115], HEIs are improving quality while falling out of step with mainstream trends. They are experiencing “disruptive innovation and catalytic change.” According to Kristensen and Bjerkedal [116], the theory of disruptive innovation effectively explains the challenges and changes confronting higher education.

Another technological disruptor is the rise of massive open online courses (MOOCs), which are globally accessible and encourage peer learning, with certificates awarded upon successful completion [114]. MOOCs have the added benefit of unrestricted enrollment, which makes them feasible for all parties involved - institutions benefit from increased returns, and students find a cost-effective solution. MOOCs in entrepreneurship education. MOOCs represent one of the most visible trends [117] in the field of digital entrepreneurship education tools, exerting significant influence over both the content and the dynamics of instructional processes [118]. Given the foregoing, MOOCs could be viewed as a highly beneficial avenue for many participants in informal settings, allowing them to achieve educational goals such as cultivating an entrepreneurial mindset [119]. MOOCs, experimentation, and case studies are meticulously designed and developed to cater to the diverse needs of students with varying levels and backgrounds. They are tailored to varying innovation and entrepreneurship processes and tiers. The “MOOC-experimental teaching - case teaching - project cultivation (MECP)” model, as depicted in Figure 1, represents an ongoing effort to improve this MOOC framework at Beihang University. The goal is to provide useful, practical insights for furthering China’s innovation and entrepreneurship education in the modern era [56].

In addition, a recent trend has emerged wherein Micro-credentials are gaining significant traction in the realm of Entrepreneurship Education. These credentials are intended to provide adaptable and targeted learning experiences that are inextricably linked to entrepreneurship’s dynamic and pragmatic essence. They specifically focus on instilling well-defined skills and competencies directly applicable to the entrepreneurial domain. This adaptability is especially useful for individuals seeking specific knowledge without committing to an entire degree program. Furthermore, micro-credentials enable on-the-spot learning, allowing entrepreneurs to quickly access the precise information they need when they need it. Besides, micro-credentials are frequently in the form of digital badges or certificates. These badges and certificates can be easily shared on online platforms like LinkedIn, effectively showcasing learners’ achievements to potential investors, collaborators, or employers [120].

Surprisingly, micro-credentials are being used to teach entrepreneurship education in the engineering domain. Eager and Cook [121], for example, present a case in which they explain the decision-making process behind the design, delivery methods, and evaluation framework of an entrepreneurship micro-credential integrated into a newly developed practice-based engineering degree. This degree was developed in collaboration with industry partners who advocated incorporating entrepreneurial characteristics such as innovation, proactivity, and creativity into engineering education.

3.3.2. Distance Learning in Entrepreneurship Education

Christensen and Eyring [110] brought attention to two pivotal aspects characterizing disruptive innovation within higher education institutions. Online learning is recognized as a technological catalyst, eroding the traditional business models of these institutions and exerting a swift impact on the educational landscape [114]. This online education model embodies disruptive innovation [122]. Notably, nearly half of university professors express skepticism about the credibility and practical application of disruptive technologies [123]. Fundamentally, this signifies a departure from the conventional classroom setup [124]. Based on research conducted by Mavlutova et al. [125], a crucial factor influencing the success of distance learning is its remarkable flexibility, which effectively removes various limitations, and this is just one of the numerous advantages associated with remote education. According to Turchynova et al. [126], distance learning technologies enable educational programs that foster learning approaches independent of daily time constraints, harnessing learners' abilities to study in alignment with their preferences and aptitudes. Moreover, Victor Garcia-Morales et al. [127] put forth significant suggestions to enhance the efficiency of remote learning procedures.

Besides, Online Distance Learning (ODL) is becoming a catalyst for educational and entrepreneurship development in Nigeria [128]. Advances in disruptive information and communications technologies, combined with innovative shifts in teaching methods, will significantly impact the field of education. Traditional higher education models, particularly those associated with lucrative fields such as science, engineering, and management studies, may lose dominance in the coming years. This shift may cause less accomplished and financially disadvantaged students to gravitate towards more affordable online distance learning options, while more accomplished and financially secure students continue to pursue the more expensive traditional higher education offered by physical institutions [129]. As a result, it is clear that Open and Distance Learning (ODL) is poised to emerge as an essential avenue for imparting entrepreneurship

education. The changing educational landscape, influenced by technological advancements and changing pedagogical approaches, emphasizes the growing relevance of ODL in teaching the complexities of entrepreneurship. This mode of learning provides the adaptability and flexibility needed to meet the diverse needs and aspirations of aspiring entrepreneurs.

3.3.3. Digitalization in Entrepreneurship Education

Additionally, the use of technology and information shows that education is now going through a 4.0 revolution, often known as the era of disruptive innovation [130]. According to Sholekhah [131], information is no longer limited in this fast-increasing communications and technology age. Learning in the twenty-first century includes information, media, and technology skills, often known as digital literacy [132]. Sari and Nayır [133] emphasized that for knowledge transfer to continue functioning properly, students must be able to utilize technology to keep in contact with their teachers. Dabbous et al. [134] explored the impact of digitalization on entrepreneurial activity and sustainable competitiveness and nailed that connectivity, Internet use, and digital integration appear to be the main components affecting entrepreneurship education.

Moreover, the utilization of technology and information signifies that education is presently undergoing a revolutionary 4.0 transformation, commonly referred to as the era of disruptive innovation [130]. Sholekhah [131] contends that information has transcended previous limitations within this age of rapidly expanding communication and technology. In the twenty-first century, education encompasses skills in information, media, and technology, often referred to as digital literacy [132]. Sari and Nayır [133] accentuates that for knowledge transfer to persist effectively, students must adeptly harness technology to maintain communication with their educators. Delving into the topic, Dabbous et al. [134] investigate the influence of digitalization on entrepreneurial endeavors and sustainable competitiveness, pinpointing connectivity, Internet utilization, and digital integration as key components shaping entrepreneurship education.

3.3.4. Business Model Innovation: Competency-based education (CBE)

CBE, one of the most recent disruptive technologies, is regarded as a disruptor because it forces HEIs to reconsider their business model innovation strategy. CBE has the potential to disrupt existing educational institution business models and provide a new value proposition to the educational enterprise [110].

CBE is increasingly becoming a viable alternative to the traditional educational model, i.e., the time-based credit hour model. In 2013, the US Department of Education recognized CBE in the form of direct assessment as a learning model that could be accredited, making it eligible for Title IV Financial Aid2 [135]. Various education associations and regional accrediting agencies have joined forces with prominent funding sources (such as the Lumina Foundation and the Bill and Melinda Gates Foundation) to advocate for HEIs to transform CBE into sustainable practice to completely replace the credit hour model with CBE [136]. The CBE model's supporters argue that it gives students a high degree of control over their own learning, allowing them to control their learning experience [135]. It also allows them to 'fast track' course material where they can demonstrate mastery or have existing skills and knowledge and focus more on areas where they lack mastery.

The emergence of CBE in the recent history of post-secondary education has become a topic of academic interest, and it is consistent with the ICT revolution, which has given rise to diverse methods of delivering education and data collection on students' learning experiences [135]. According to Benner et al. [137], the competencies model can be used to assess students' levels of mastery or expertise. The Dreyfus levels of skill performance toward mastery (novice, advanced beginner, competent, proficient, expert, and master) can be the guideline to access the students' skill (see Table 3) [138]. According to Gillies and Howard [139], the model can be used to determine areas and mastery levels in order to identify areas of entrepreneurial skills to prioritize.

TABLE 3: Level of skill performance.

Skill performance level	Explanation
Novice	Just learned or learning skills, Need complete supervision, and Need more understanding
Advanced Beginner	Follow the rules step-by-step, Need less supervision, and Complete simpler tasks without supervision.
Competent	Can learn new techniques, Need no supervision, and Still need refinement in my work
Proficient	Maintain regular high standards, Do not need to follow the rules step-by-step, and Have a deep understanding of the processes
Expert	Work intuitively from my own mind, Creative and spontaneous, Create exceptional designs and work, and Make good use of time without compromising the quality.
Master	Express exceptional creativity, originality, and spontaneity always, Create cutting-edge designs and services effortlessly, and Work well under pressure

Source: Rousse and Dreyfus [138]

Additionally, De Waal & Maritz [140] delve into the potential utilization of Design Thinking and the Lean Startup principles in crafting an innovative approach for delivering

educational programs in higher education. This approach aims to tackle the numerous challenges plaguing the industry while adhering to the principles of frugal innovation and aligning with essential sustainability objectives.

Tierney and Lanford [141] contend that the current global limitations on higher education call for novel research endeavors, distinct teaching approaches, and inventive organizational frameworks. In response to these challenges, alternative learning methodologies are imperative, as the existing educational paradigms "fall short in equipping contemporary learners with the essential skills to navigate the digital age," as pointed out by Christensen et al. [142]. This necessitates reevaluating educational strategies to ensure they effectively address the demands of the evolving digital society.

3.3.5. Experience Entrepreneurial Education: Entrepreneurship-based learning

Experience Entrepreneurial Education, also known as Entrepreneurship-based learning, is an educational approach that centers on providing students with hands-on, experiential opportunities to learn about entrepreneurship. Instead of relying solely on traditional classroom lectures and theoretical instruction, this approach immerses students in real-world entrepreneurial activities, challenges, and scenarios. As highlighted in a comparative study of four European programs by Dieguez et al. [143], experience-based learning is increasingly emphasized as a critical component in entrepreneurship education. The findings of this study highlight the interconnectedness of learning, innovation, and social innovation. Students who participate in such programs cultivate a more comprehensive integration with the world and develop a diverse range of skills that will set them apart in the future if they take a more sustainable approach.

Parallel to these discussions, Hägg and Gabrielsson [144] outline the theoretical and philosophical foundations of experience-based learning as a central topic of contemporary exploration. According to the research conducted by Hägg and Kurczewska [145], knowledge gained from entrepreneurial experiences is a cornerstone of teaching and learning in entrepreneurship education. Furthermore, Winkler et al. [146] recently presented a systematic approach demonstrating that developing entrepreneurial expertise increases the likelihood of entrepreneurial success. They identify pivotal self-regulatory learning processes critical to entrepreneurial learning using their Self-Regulated Entrepreneurial Learning (SREL), offering practical applications to the entrepreneurial domain.

The convergence of these insights emphasizes disruptive innovation's transformative impact on societal norms, encompassing aspects of work, lifestyle, and education. As

discussed by Irene [112], in the context of entrepreneurship education, engaging students in entrepreneurial activities and providing meaningful experiential opportunities have grown in importance. Furthermore, incorporating disruptive innovation principles into entrepreneurship education courses can potentially increase the learning experience's practical relevance. Students familiar with Disruptive Innovation Theory are better equipped to anticipate industry shifts and position themselves as change agents [5]. This proactive approach is critical for teaching aspiring entrepreneurs how to anticipate and respond to changing circumstances.

4. Results and Discussion

Examining the relationship between "disruptive innovation" and "entrepreneurship education" provides critical insights into how education may foster an entrepreneurial mindset and help individuals recognize and capitalize on disruptive opportunities. According to research, entrepreneurship education fosters the development of the qualities necessary to engage in disruptive innovation, such as risk-taking, creativity, and adaptability [2, 4]. Furthermore, experts have emphasized the need to incorporate real-world disruptive business models and approaches into entrepreneurship programs so that students may engage in the actual implementation of disruptive innovation concepts [5]. This study shows how entrepreneurship education may help aspiring entrepreneurs and intrapreneurs navigate the changing corporate environment by finding and effectively using disruptive technologies. Table 4 summarize the finding of this study.

Table 4 clearly shows the relationship between "disruptive innovation" and "entrepreneurship education" and provides critical insights into how education may foster an entrepreneurial mindset and help individuals recognize and capitalize on disruptive opportunities.

5. Conclusion

Finally, the dynamic connection between 'disruptive innovation' and 'entrepreneurship education' underlines their symbiotic importance in shaping the future of entrepreneurship. Entrepreneurship education provides fertile ground for building the fundamental attitudes, talents, and procedures necessary to recognize, adapt, and use innovative innovations. According to Christensen [1], disruptive innovations are powerful forces reshaping industries, and entrepreneurship education assists individuals in harnessing and capitalizing on these transformative transitions. Literature highlights the need for

Table 4: The disruptive innovation current practices in entrepreneur education.

(i) Technology enabler creates virtual learning environments (VLEs)
The role of technology is vital in enabling effective distance learning experiences via virtual learning environments (VLEs)MOOCs are a prominent trend, influencing content and instructional dynamics in digital entrepreneurship education tools.Micro-credentials are gaining traction as a significant development in Entrepreneurship Education, offering targeted learning experiences aligned with practical entrepreneurship needs.
(ii) Distance Learning in Entrepreneurship Education
Disruptive information and communications technologies and innovative teaching methods are reshaping education through distance learning. The online distance learning concept is getting attention from many universities, including entrepreneurship education. Distance learning benefits entrepreneurship education, including accessibility to diverse resources and expert insights from anywhere, anytime worldwide. Strategies must be made to foster student collaboration and networking in a virtual learning environment.
(iii) Digitalization in Entrepreneurship Education
Integration of digital tools, platforms, and resources into entrepreneurship education is emerging and vital. More exploration of innovative digital teaching methods should be increased, such as gamification, simulations, and virtual reality.
(iv) Business Model Innovation: Competency-based education (CBE)
Features of CBE should be underlined, including flexible learning paths, mastery-based progression, and competency assessment.Benefits of CBE for entrepreneurship students, such as tailored learning experiences and skill development.
(v) Experience Entrepreneurial Education: Entrepreneurship-based learning
Experiential learning activities, such as business simulations, internships, and startup projects.Develop diverse skills for a sustainable future.Self-Regulated Entrepreneurial Learning (SREL) processes to enhance entrepreneurial expertise.Integrating disruptive innovation principles into entrepreneurship courses enhances practical relevance and equips students to foresee industry shifts, preparing them to drive change.

Source: Author's own work

creative pedagogies to effectively incorporate disruptive innovation concepts into educational curricula [5]. This synergy is expected to give prospective entrepreneurs the tools they need to thrive in an era of rapid technological advancement and market disruption, hence driving the growth of innovative enterprises and the extension of industries.

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