

Virtual Simulation Games in Entrepreneurship Education: Status Quo and Prospects

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Abstract: This study reviews the current status and future perspectives of virtual simulation games in entrepreneurship education in higher education institutions. Virtual simulation games act as digital twins to replicate real-world scenarios, which can be integrated as a part of online learning in entrepreneurship courses or digital learning resources in entrepreneurship education in higher education institutions. Virtual simulation game-based learning effectively enhances student engagement and entrepreneurial competencies in entrepreneurial learning to improve student learning outcomes in entrepreneurship education in higher education institutions. Virtual simulation games as digital tools for specific learning tasks or active teaching methods engage students with virtual simulation learning experiences to generate improved student learning in immersive and interactive environments through the use of extended reality (XR) including virtual reality (VR), augmented reality (AR), and mixed reality (MR) in a virtual or blended learning environment. This study indicates the promising development of AI and XR applications in virtual simulation games in entrepreneurship education. It provokes discussions on the technological, pedagogical, and content design of virtual simulation games and their integration into hybrid and online models of entrepreneurship education, which has significant implications for the digital transformation and innovation of entrepreneurship education in higher education institutions. It draws attention to digital well-being and digital inclusion in virtual simulation game-based learning in entrepreneurship education in higher education institutions.

Keywords: Virtual Simulation Games, Digital Game-based Learning, Serious Games, Entrepreneurship Education, Higher Education Institutions

1. Introduction

With the development of ICTs and the digitalization of higher education, digital game-based learning is increasingly used in teaching and learning in higher education institutions such as virtual simulation games in entrepreneurship education. Digital game-based learning, virtual simulation game-based learning, online gamification, and other gamification applications in entrepreneurship education have gained popularity with the development of online learning and technological advancement in teaching and learning in entrepreneurship education. Virtual simulation game learning in entrepreneurship education aims to engage students in online learning to improve their learning experience within the virtual environment including virtual teamwork experience and self-efficacy (Chen et al., 2021). Virtual simulation games in entrepreneurship education as interactive learning tools replicate real-world business scenarios in a risk-free virtual environment to allow students to engage in decision-making, problem-solving, and resource management, mirroring the experiences of actual entrepreneurs, which are designed to enhance students' entrepreneurial skills and engagement by providing practical, hands-on experiences to complement theoretical knowledge and bridge the gap between classroom learning and real-life business challenges for more effective entrepreneurship education (Yasin et al., 2022). Virtual simulation games function as digital twins, an integrated part of online learning, or digital learning resources in entrepreneurship education. Virtual simulation games can generate improved immersive and interactive experiences in students' entrepreneurial learning by using extended reality (XR) technologies including virtual reality (VR), augmented reality (AR), and mixed reality (MR) and virtual interactive environments to deliver engaging, simulated, and real-world learning experiences. In virtual simulation games, "students take the roles of business managers and make sequences of managerial decisions to understand the obstacles and consequences of running a company, and the interdependencies among the different areas of business" (Gawel et al., 2022, p. 5). Virtual simulation game learning in entrepreneurship education provides an innovative way of using immersive learning technologies to foster students' engagement and entrepreneurial skill development, which has significant implications for teachers to select and/or develop virtual simulation games to enhance students' engagement and learning outcomes (Yang et al., 2022, p. 1).

Three objectives of entrepreneurship education focus on education "about" entrepreneurship to increase awareness about entrepreneurship, "for" entrepreneurship to enhance students' intentions to be entrepreneurs, and "through" entrepreneurship to develop entrepreneurial competencies in new venture creation (Kyrö, 2005). Four programs suitable for entrepreneurship education include "entrepreneurship awareness education about the development of the know-how on the subject; education for individuals with background on the subject and the need for gaining a practical understanding of how to set up start-ups;

education for entrepreneurial dynamism programs can be delivered” (Liñán, 2004). Entrepreneurship education should transit business scenarios to deliver effective learning modules to support developing students’ entrepreneurial skills and mindset (Maaravi et al., 2020). Virtual simulation game-based learning fits these purposes to achieve the objectives of entrepreneurship education in blended or digital learning settings. This study aims to answer the following question: What are the current status and future perspectives of virtual simulation games in entrepreneurship education in higher education institutions?

2. Literature Review

Studies have discussed overlapped concepts of gamification, serious games, simulation games, virtual simulation games, online games, virtual games, digital games, and business simulation games in entrepreneurship education. “Game-based learning effectively enhances students’ entrepreneurial competence, e.g., generating ideas, managing resources and taking action, and boosting self-efficacy but didn’t significantly impact entrepreneurial intentions” (Daniel et al., 2024). Gamification as a learning process can enhance learners’ motivation and engagement in entrepreneurial learning. Content and structural gamification can create a more engaging and effective learning experience (Kapp et al., 2013). Online games as mutual interactive learning are useful tools to enhance learning outcomes (Takemoto & Oe, 2021). Serious games and simulations often overlap with similar features. Simulations feature students’ active interaction with real-life complex situations (Thavikulwat, 2004). Serious games as computer-based learning simulations engage players in realistic activities to increase knowledge; improve skills; and enable positive learning outcomes (Prensky, 2001; Fox et al., 2018, p. 63). The main difference between virtual simulation games and traditional simulation games lies in the level of immersion and the technology used. “Mobile business simulation games improve entrepreneurial attitudes and self-efficacy, but cannot change entrepreneurial intentions” (Chen et al., 2023). Simulation games positively influence students’ entrepreneurial intentions (Bhullar & Aggarwal, 2022) and foster experiential learning (Fox et al., 2018). Business simulation games positively enhance students’ skills, attitudes, and practical knowledge, ultimately impacting their intention to become entrepreneurs (Shabbir et al., 2024). “Simulations, serious games, and virtual worlds provide immersive three-dimensional spaces to embed major learning principles” (Marques & Martins, 2013, p. 29). Educators can use serious games, mobile business simulation games, and virtual simulations to create a holistic learning experience in blended or digital learning environments and incorporate game-based learning into teaching and learning in entrepreneurship education (Chen et al., 2023).

Methods used in entrepreneurship education include “action learning, new venture role plays, serious games, the development of actual ventures, skills-based courses, video role plays, experiential learning, and mentoring” (Fox et al., 2018, p. 63). Game-based learning in entrepreneurship education focuses on experiential learning via serious games. Game-based learning activities help students gain the necessary skills to tackle everyday obstacles on their entrepreneurial pathways (Grivokostopoulou et al., 2019, p. 1). Simulation-based learning uses immersive learning simulation technologies to foster realism for effective learning (Yasin et al., 2022, p. 26) through learners’ observation to learn or understand the simulation being an illustration of the contents or through experiential learning induced by direct interactions with the simulation (Frasson & Blanchard, 2012, p. 2). “Simulation games represent players with simulations of a mimicking real-life scenario for educational purposes to facilitate ‘learning’ (e.g., acquiring or enhancing knowledge and skills) and ‘simulation’ (e.g., facilitating learning primarily or supporting learning indirectly)” (Frasson & Blanchard, 2012, p. 2). Business simulation games involve humans and learning practices for (teams of) students to act as if they were in charge of a real business (Frasson & Blanchard, 2012, p. 2). Several features of simulations (e.g., realization, fidelity, interactivity, immersiveness, and intelligence) influence simulation-based learning opportunities (Frasson & Blanchard, 2012, pp. 3-4). Interactive games with different scenarios keep students motivated and immersed in the learning process during online teaching to enhance the learning effectiveness of entrepreneurship education (Takemoto & Oe, 2021, p. 28).

Digital game-based learning, coined by Prensky (2001), is the fusion of knowledge dissemination and gameplay from computer and video games, aiming to leverage digital games’ learning and motivational potential to acquire real-world knowledge to support players to engage with educational content while enjoying the game. Digital game-based learning as an effective learning medium is “a competitive activity in which students are set educational goals intended to promote knowledge acquisition” (Erhel & Jamet, 2013). Digital simulations are computer-based versions of high-fidelity simulations. Virtual simulation game-based learning integrates educational content into game formats to enhance learning. “The ideal game can capture critical aspects of the entrepreneurial process, but sufficiently simple to minimize the danger of confounding factors” (Low et al., 1994, p. 384), which highlights the importance of entrepreneurship simulations to assist learners in avoiding some of

the most painful life lessons one might encounter in a real company (Fox et al., 2018, p. 64). Fox et al. (2018) conducted an in-depth assessment of the impact of simulation games in enterprise education, considering “the level of fidelity (i.e., the amount of realism), verification (the quality of the game’s technical design), and validation (the game’s adherence with the tasks that are being attempted to be simulated)” (Fox et al., 2018; Yasin et al., 2022, p. 31).

A broader definition of virtual reality as a three-dimensional interactive computer-generated environment incorporates a first-person perspective including immersive and non-immersive (screen-based) forms of VR (Brey, 2008, p. 2). “Augmented reality (AR) as a special type of VR in simulated virtual worlds is blended with the real world experienced through normal vision or a video link, usually through transparent glasses on which computer graphics or data are overlaid” (Brey, 2008, p. 3). Four essential elements in virtual reality include a virtual world, immersion, sensory feedback, and interactivity (Sherman & Craig, 2003). “The 3D virtual reality educational environment utilizes pedagogical approaches based on gamification principles for students’ immersive game-based learning activities on real challenges in business environments” (Grivokostopoulou et al., 2019, p. 1). VR applications in education increase student engagement; provide authentic experiences to impact student identity; allow for new perspective-taking and empathy; and support creativity and the ability to visualize difficult models (Hu-Au & Lee, 2017, p. 222). Digital game-based learning focuses on integrating game elements into the learning process, while virtual simulation game learning provides realistic practice scenarios in a virtual environment. Both approaches enhance engagement and skill development but differ in formats and emphasis. Many studies have discussed adopting serious games and game simulation in entrepreneurship education. However, it is vital to integrate virtual simulation games into entrepreneurship courses for educational innovation rather than adoption and application.

“Studies on the effect of virtual simulation game courses on students’ entrepreneurial learning are generally based on the planned behavior theory, the technology acceptance model, and flow theory” (Yang et al., 2022). Yang et al. (2022) explored the influence mechanism of virtual simulation game learning experience on students’ engagement and entrepreneurial skill development including game design, teamwork, and self-efficacy based on Biggs’ (1993) 3P model (presage-process-product). “Virtual simulation games based on the experiential learning theory (Kolb, 1983), combined with the organization theory and the game theory to design rules and algorithms are widely used in business education” (Yang et al., 2022, p. 3). Constructivist learning theory focuses on the active role of learners in constructing new knowledge, inferring meaning to concepts through experience, active learning, and social interaction as a factor in the knowledge construction process (Kayii & Akpomi, 2022, p. 33). Based on these theories, this study views the status quo and prospects of virtual simulation games in entrepreneurship education.

3. Methods

This study conducts a status quo and prospects analysis of virtual simulation games in entrepreneurship education. It uses online website search through Google and Google Scholar search engines with key phrases for the search engines including “digital simulation games”, “online simulation games”, “virtual simulation games”, “simulation games”, “business simulation games”, “(virtual) simulation game-based learning”, “(virtual) simulation game learning”, “serious games”, and “(virtual) simulation games in entrepreneurship education”. The samples of (virtual) simulation games are presented in Table 1.

4. Current Status of Virtual Simulation Games in Entrepreneurship Education

Virtual simulation games have emerged as an effective teaching method for entrepreneurship education, which can be integrated as a key part of online learning into entrepreneurship courses or digital learning resources. Virtual simulation games in entrepreneurship education aim to engage students in online learning to improve their learning experience and entrepreneurial skills development, self-efficacy, and virtual teamwork experience within the virtual environment. Virtual simulation games as an effective teaching method for online entrepreneurship education directly or indirectly affect entrepreneurial skills development through students’ learning engagement to improve students’ participation, learning outcomes, teamwork experience, and general self-efficacy (Yang et al., 2022, p. 1), while students’ general self-efficacy affects entrepreneurial skills development and students’ engagement (Yang et al., 2022, p. 9). Virtual simulation games have been used to generate improved interactive student learning experiences and create immersive environments where players interact with digital elements. Virtual simulation games play an important role in supporting learners’ entrepreneurial learning in a virtual and risk-free environment to develop students’ professional and decision-

making skills to cope with unexpected market changes in a multifaceted environment, which overcome the constraints of conventional teaching methods and techniques in teaching entrepreneurship education through lectures and case studies and the lack of real-world experiences and practices. “Learning entrepreneurial skills through real-life simulations can prevent and reduce potential risks, harms, the costs of acquiring entrepreneurial skills and abilities” (Chen et al., 2021, p. 213). “In a simulation game course, students’ general skills (e.g., decision-making, communication, teamwork, information processing ability, entrepreneurial ability, and new application skills) have positive impacts on learning outcomes” (Hernández-Lara et al., 2019).

An e-learning model using virtual simulation games is designed to build a virtual learning space to foster learners’ entrepreneurial mindsets and entrepreneurship through virtual experiential learning. An e-learning framework in entrepreneurship integrates three main components identifying business opportunities, developing business scenarios, and risk analysis (Bodea et al., 2015). “In business simulation game courses, students’ generic skills (e.g., decision-making, communication, teamwork, information processing ability, entrepreneurial ability, and new technology application ability) could have a significant positive impact on learning outcomes” (Hernández-Lara et al., 2019).

Business simulation games simulate real-life business scenarios to support learners in acquiring entrepreneurial skills and competencies while avoiding real-life risks and damages and reducing cost and uncertainty (Chen et al., 2021, p. 213); allow learners to run virtual companies including making financial decisions and competing in markets; and make the learning process attractive and fun (Chen et al., 2021, p. 219). “Business simulation games are a practical way of learning about business challenges and how to overcome those challenges in a risk-free environment to enhance critical experimental thinking and learning, time management, teamwork, and collaborative learning and significantly increase students’ investment and acceptance of entrepreneurship courses to improve students’ entrepreneurial intention and learning performance” (Zulfiqar et al., 2021, p. 3). Business simulation games integrate business concepts into realistic business scenarios for users to practice business concepts in lifelike scenarios and make decisions based on visualized data diagrams, tables, and charts such as Harvard Business Simulations (Chu et al., 2023). Startup simulation allows students to create and manage a virtual startup including scaling and making decisions on product development, pricing, and market entry. Simulation games for startups can significantly improve students’ business management knowledge and business planning skills (Kriz & Auchter, 2016). Marketplace simulation simulates a competitive market where students run their businesses and compete against each other. Supply chain simulation explores supply chain dynamics, inventory management, and logistics. Serious games (e.g., SimVenture) offer student experiments in a virtual environment and simulate real-world entrepreneurial challenges without risks.

Good game design has the following features: “a clear overall vision, a constant focus on players’ experience, strong character and structures, useful interfaces, and dynamic range; the ability to store development, progress, exploration, and discovery; highly adaptive and interactive; easy to learn but hard to master; staying within the ‘flow state’; and providing mutual assistance and frequent rewards instead of punishments” (Prensky, 2001, p. 23). The good user-centered game design of virtual simulation games should have clear learning objectives and goals, diverse authentic scenarios, feedback mechanisms, balanced complexity, intensive interactivity, high replayability, and storytelling with a compelling narrative around the simulation. Active learning game design should support “students’ learning journey with a cyclic approach in deepening students’ critical thinking and application of theories in entrepreneurship learning” (Takemoto & Oe, 2021, p. 31).

The integration and innovation of virtual simulation games in the hybrid and online model of entrepreneurship education in higher education institutions should consider the compatibility of virtual simulation in entrepreneurship courses: “whether they meet the teaching objectives, whether the game establishes clear performance evaluation standards and provides rich and clear learning materials, and whether it can provide clear feedback to students” (Yang et al., 2022, p. 8). Educators must ensure that the adoption of virtual simulation games fits the curricula of entrepreneurship courses including the technological, pedagogical, and content design of virtual simulation games and their compatibility and deep integration in alignment with the course goals to fit the purposes of entrepreneurship courses to improve student learning and entrepreneurial skills. Virtual simulation games should integrate their technological, pedagogical, and content design into the teaching practice compatible with deep learning and game-based learning in teaching and learning in entrepreneurship education in higher education institutions. Meanwhile, virtual simulation game-based learning needs to draw attention to digital well-being and digital inclusion in virtual simulation game learning in entrepreneurship education in higher education institutions.

Simulation games advertise them with their special characters (See Table 1): “GoVenture World is the most authentic business management and entrepreneur training experience ever created” (<https://goventureworld.com>); “The most advanced business game online about company management and economics” (<https://virtonomics.com>); and “The most realistic small business startup and operations simulation in the world” (<https://www.goventure.net/products>). “The Startup Game, GoVenture: Entrepreneur, GoVenture World, Hipster CEO, Innovative Dutch, Interpretive solutions: Entrepreneur, SimVenture, Venture blocks, Venture Strategy, and VSL simulations have been used in teaching related to the area of entrepreneurship in higher education” (Yasin et al., 2022, p. 32). However, whether simulation games fit the curricula of entrepreneurship education and the ongoing courses still need evidence-based studies. The case of Aarhus University provides evidence of the successful integration of game-based learning into entrepreneurship education.

“Gamification plays a special role in entrepreneurship teaching at Aarhus University and in the EIT Food Master’s program in Food Systems. An entrepreneurship professor from Aarhus University has been using physical and digital games for targeted purposes in several courses. Three games played an important role in online teaching during the COVID-19 pandemic: LeapInTime (<https://leapintime.grendelqames.com>) is a patent game developed specifically during the pandemic to tackle online team learning about intellectual property. Savvygoat (www.savvygoat.com) requires teams to fulfill tasks for climbing a mountain, training students in collaboration, and internal team and project management. ESHIP: NavigatingUncertainty (<https://biosymfonix.com/Biosymfonix/Eship.html>) is a multiplayer cooperative board game that teaches student teams to decide cooperatively under uncertainty. Available evidence indicates a positive effect on students. Serious games tend to enhance their technical understanding related to entrepreneurial processes such as intellectual property protection and acting under market uncertainty. However, the effect of digital games on improving teamwork skills was found to be limited.” (HEI Innovate, 2023)

Table 1: Samples of (virtual) simulation games in entrepreneurship education

Games	Websites	Descriptions on the Websites
Conscious Capitalism-Bikes	https://www.marketplace-simulation.com/compare-our-business-simulations/conscious-capitalism-bikes/	Conscious Entrepreneurship explores the costs and benefits of corporate social responsibility within a startup.
ENTRExplorer	www.entrexplorer.com/projecto.php	ENTRExplorer “Serious Game for Immersive Entrepreneurs” aims to develop an online serious game related to entrepreneurship themes where learners have access to learning content to acquire entrepreneurial skills necessary to manage their businesses in the future.
GoVenture Entrepreneur	https://www.goventure.net/en	GoVenture Entrepreneur, the most realistic small business startup and operations simulation in the world, offers the fastest and most experiential way to teach and learn business with the most realistic small business startup and operations simulation ever created.
GoVenture World	https://goventureworld.com	Players run virtual businesses while competing and collaborating with players (virtual entrepreneurs) in a global massively multiplayer online role-playing game (MMORPG).
Harvard Business Simulations	https://hbsp.harvard.edu/simulations/?ab=browse%7Csimulations	Marketplace Simulations: Conscious Capitalism - Bikes (Play against classmates); Entrepreneurship Simulation: The Startup Game, etc.
Interpretive simulations: Entrepreneur	https://www.interpretive.com/business-simulations/retail-entrepreneur-simulation/	Retail entrepreneurship simulation provides students hands-on experience running a clothing shop and making key decisions on inventory, pricing, and staffing.
SimVenture	www.simventure.com	SimVenture business simulations and online entrepreneurship learning tools with advanced business learning software support educators to provide learners with meaningful and authentic business experiences in a safe digital learning environment, ranging from a Windows-based small business simulation to an advanced online business simulation and an online startup ideas platform.
Startup Wars	www.startupwars.com	It brings education to life with immersive tailored simulations for students to explore business & entrepreneurship to enhance student engagement with immersive business simulations and bridge the theoretical learning and practical application gap.

Games	Websites	Descriptions on the Websites
The Startup Company	https://www.startupcompanygame.com	A business simulation sandbox game where the player is the CEO of a new company to build a website and compete against the largest tech giants.
The Startup Game	https://interactive.wharton.upenn.edu/academic/the-startup-game/	Each player takes on the role of either a founder, an investor, or a key early employee to secure the right combination of funding and talent to make their startup a success. Players actively move around the room, competing and cooperating to fund, join, and grow startups. The game introduces students to the latest academic findings that support real-world lessons about key startup concepts such as hiring, equity, salary, and funding considerations.
Venture blocks	https://ventureblocks.com/	Simulation + AI teaches students to interview customers and identify needs.
Venture Strategy	https://www.marketplace-simulation.com/compare-our-business-simulations/venture-strategy-bikes/	The Venture Strategy simulation provides students with a safe virtual environment to experience being an entrepreneur as they start up a new business.
Virtonomics	https://virtonomics.com	Business games and company management simulation games encourage entrepreneurship through realistic models of markets, industries, and businesses.

5. Future Perspectives of Virtual Simulation Games in Entrepreneurship Education

Serious games and virtual simulation games offer dynamic ways of teaching entrepreneurship that combine entertainment, learning, and practical applications, contributing to effective entrepreneurship education for different learning needs and preferences. Serious games are powerful tools to facilitate deeper learning through entertainment (Martins et al., 2023). Serious games often incorporate virtual simulation elements for educational purposes to eliminate the fear of failure and enable students to learn by doing. Integrating serious games into entrepreneurship education is important “to nurture key entrepreneurial competencies essential for students’ career development” (Daniel et al., 2024). Virtual serious games combine the principles of serious games with VR or AR in immersive environments to enhance the learning experience by allowing users to interact with digital content. Serious games combine learning with entertainment on broader educational content while virtual simulation games specifically target skill development and decision-making in entrepreneurship, providing practical experiences in a safe environment. Combining a digital twin with game-based learning in entrepreneurship education can create an innovative and engaging approach for students. Digital twin provides business processes’ visual representations and tangible abstract concepts and simulates entrepreneurial scenarios (e.g., market dynamics, supply chains, and financial management, allowing students to explore business concepts, decision-making, and problem-solving) (Sepasgozar, 2020, p. 1). Augmented reality (AR) and virtual reality (VR) allow students to model and interact with digital twins and immersive learning experiences. “AI can improve entrepreneurial attitude in business simulation games in various ways such as simulating competitors, providing targeted feedback for failures, and improving game experience” (Sepasgozar, 2020, p. 1). AI is increasingly used to improve virtual simulation games in entrepreneurship education. AI and XR applications in virtual simulation games in entrepreneurship education are promising.

6. Conclusion

Virtual simulation games as an effective approach to entrepreneurship education can enhance students’ immersive and interactive entrepreneurial learning experience to inspire them with positive intentions toward entrepreneurial learning. Virtual simulation game-based learning can increase student engagement to mitigate the challenges of lacking student engagement in traditional teaching methods in entrepreneurship education, allowing students to construct knowledge from meaningful experiences to explore solutions and collaborations. Virtual simulation games as an effective teaching method can affect students’ learning engagement, entrepreneurial learning experiences, and learning outcomes, which can be integrated as digital twins, online entrepreneurship courses, or digital learning resources of entrepreneurship education in higher education institutions. Virtual simulation games need proper technological, pedagogical, and content design to fit the specific teaching goals of entrepreneurship courses and integrate into entrepreneurship curricula to innovate entrepreneurship education in higher education institutions. The technological, pedagogical, and content design of virtual simulation games and their integration of hybrid and online entrepreneurship education has significant implications for promoting digital innovation of entrepreneurship education by using virtual simulation games

to enhance student learning outcomes and entrepreneurial competencies as well as the effectiveness and the quality of entrepreneurship education in higher education institutions.

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