CULTIVATING INNOVATION ECOSYSTEMS: A SYSTEMATIC LITERATURE REVIEW ON EDUCATIONAL AND RESEARCH TECHNOPRENEURSHIP IN HIGHER EDUCATION

M. ANBARASU, Principal and Associate Professor of Tamil, Arul Anandar College (Autonomous), Karumathur, Affiliated to Madurai Kamaraj University, Madurai, Tamil Nadu, India. E-mail: manbusj@gmail.com

S. JOHN KAVIARASU, Assistant Professor, School of Human Excellence, Loyola College (Autonomous), Affiliated to University of Madras, Chennai – 34. Tamil Nadu, India. E-mail: johnkavia@gmail.com

M. AROCKIA AMALI, Assistant Professor of Commerce, Auxilium College of Education, Regunathapuram, Pudukkottai, Tamil Nadu, India. E-mail: amalim739@gmail.com

Abstract

This systematic literature review explores the role of educational and research technopreneurship in higher education institutions (HEIs), focusing on its impact on fostering entrepreneurial mindsets and competencies among students. Drawing on 28 peer-reviewed articles from 2007 to 2023, sourced from databases such as ResearchGate, Scopus, and Google Scholar, the study synthesizes findings on theories, influencing factors, strategies, and gaps in technopreneurship education. The review employs a qualitative methodology, using thematic coding to analyze patterns in technopreneurial intention, guided by Ajzen's Theory of Planned Behavior, which highlights attitudes, subjective norms, and perceived behavioral control as key drivers. Individual factors, such as self-efficacy and digital literacy, are identified as significant predictors of technopreneurial intention, supported by 15 variables across studies. Educational strategies, including integrated curricula and business incubators, enhance competence by blending technical skills with entrepreneurial acumen, while industry collaborations and inclusive learning environments mitigate risks and expand networks. However, gaps persist in addressing subjective norms, government support, and the role of social media, with challenges like digital divides and curriculum misalignment hindering progress. The findings underscore the transformative potential of technopreneurship education in equipping students to navigate digital disruptions and contribute to economic vitality through tech-driven ventures. Business incubators and project-based learning are pivotal in fostering innovation ecosystems, yet

under-researched areas like normative influences and policy interventions require further exploration. The study advocates for adaptive frameworks and scalable interventions, such as innovation centers, to democratize access and measure long-term alumni success. Future research should empirically test interventions in underrepresented contexts, including social media's impact and government-backed programs, to strengthen global entrepreneurial ecosystems. By prioritizing refined curricula, enhanced collaborations, and targeted policies, HEIs can cultivate resilient technopreneurs capable of driving sustainable innovation. This review contributes to the discourse on academic entrepreneurship by providing a comprehensive synthesis and actionable recommendations for educators, policymakers, and researchers to foster robust technopreneurship ecosystems in higher education.

Keywords: technopreneurship education, entrepreneurial intention, higher education institutions, innovation ecosystems, Theory of Planned Behavior, business incubators, digital literacy, industry collaboration, subjective norms, government support

Introduction

Technopreneurship represents the convergence of technological innovation and entrepreneurial initiative, positioning itself as a pivotal force in driving economic progress and addressing societal challenges (Shane, 2009). Unlike traditional entrepreneurship, technopreneurship emphasizes leveraging cutting-edge technologies to create scalable ventures, often in digital or high-tech sectors. In higher education institutions (HEIs), it serves as a transformative approach to equip students with the skills to identify market opportunities, develop innovative solutions, and establish technology-driven startups (Audretsch, 2014). This paradigm has gained prominence as a mechanism to foster economic resilience, particularly in the context of global disruptions that demand adaptive, innovation-led economies.

The economic landscape, particularly in developing regions, underscores the urgency of technopreneurship education. Post-COVID-19, youth unemployment has surged, with countries like Malaysia and Indonesia reporting rates as high as 13-15% among graduates (International Labour Organization, 2021). Technopreneurship offers a viable pathway to self-employment, enabling young graduates to create jobs rather than seek them (Fayolle & Gailly, 2015). By embedding entrepreneurial training within academic curricula, HEIs can empower students to harness technologies like artificial intelligence and blockchain, addressing both local and global market needs while contributing to economic diversification (Zahra & Wright, 2016).

In educational settings, technopreneurship transcends traditional business education by integrating technical expertise with entrepreneurial competencies. This involves fostering skills such as coding, product development, and digital marketing alongside risk-taking and opportunity recognition (Gibb, 2011). Research highlights that HEIs adopting technopreneurship curricula produce graduates who are better equipped to navigate dynamic, technology-driven markets (Krueger et al., 2000). Such programs often incorporate practical components like hackathons and incubators, which bridge theoretical knowledge with real-world application, preparing students for the complexities of launching tech ventures (Neck & Greene, 2011).

The global pandemic has amplified the need for technopreneurship as a response to economic and social disruptions. With remote work and digital transformation accelerating, HEIs have a critical role in preparing students for a tech-centric future (Bacigalupo et al., 2016). Studies indicate that regions with robust technopreneurship ecosystems, such as Silicon Valley or Singapore, have demonstrated resilience against economic shocks, partly due to their emphasis on innovation-driven entrepreneurship (Isenberg, 2010). This underscores the necessity for HEIs to prioritize technopreneurship education to address unemployment and foster sustainable growth in a post-COVID world.

This literature review seeks to systematically explore the domain of educational and research technopreneurship by synthesizing secondary sources. Its objectives are threefold: first, to map the theoretical foundations, such as the Theory of Planned Behavior, that underpin technopreneurial intention (Ajzen, 1991); second, to identify effective strategies for implementing technopreneurship programs in HEIs; and third, to highlight research gaps and propose implications for future studies. By doing so, it aims to contribute to the academic discourse on fostering innovation ecosystems within educational institutions (Etzkowitz & Leydesdorff, 2000).

The focus on technopreneurship aligns with global calls for sustainable entrepreneurial education, as outlined in frameworks like the United Nations Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education) and SDG 8 (Decent Work and Economic Growth) (United Nations, 2015). HEIs are increasingly recognized as catalysts for innovation, with technopreneurship programs fostering interdisciplinary collaboration and societal impact (Secundo et al., 2020). This review draws on global case studies and theoretical insights to underscore how HEIs can build resilient ecosystems that empower students to address contemporary challenges through technology-driven entrepreneurship.

By synthesizing secondary sources from 2007 to 2023, this review provides a comprehensive analysis of technopreneurship in educational and research contexts. It addresses the interplay of individual, institutional, and external factors shaping technopreneurial outcomes, offering insights for educators, policymakers, and researchers (Fayolle et al., 2016). The findings aim to inform the design of curricula and support systems that enhance student readiness for tech-driven markets, contributing to the broader goal of sustainable economic development. This study is positioned for a special edition on innovation and entrepreneurship, emphasizing its relevance to global academic and policy discussions.

Literature Review

Technopreneurship, an advanced form of entrepreneurship, integrates technological innovation as a central mechanism for identifying and exploiting business opportunities, distinguishing itself from traditional entrepreneurship through its focus on technology-driven ventures. This field is pivotal in fostering economic growth by transforming research outputs into marketable solutions within higher education institutions (HEIs). Scholars argue that technopreneurship enhances competitiveness in knowledge-based economies, where universities serve as critical hubs for nurturing innovation and entrepreneurial ecosystems (Anubhav et al., 2024). The commercialization of research through technopreneurial initiatives strengthens the linkage between academia and industry, creating a dynamic environment for economic and technological advancement (Kashino, 2020).

Ajzen's Theory of Planned Behavior (TPB) provides a robust framework for understanding technopreneurial intentions, positing that intentions are shaped by three core components: attitudes toward the behavior, subjective norms, and perceived behavioral control. In the context of technopreneurship, attitudes reflect students' perceptions of technology ventures, subjective norms capture social influences from peers and family, and perceived behavioral control relates to self-efficacy in managing tech startups (Ajzen, 1991). Educational interventions in HEIs can enhance these components, fostering students' willingness to pursue technopreneurial ventures by building confidence and technical competence (Lihua, 2022).

Extensions of TPB have incorporated situational and contextual factors to better predict the transition from technopreneurial intention to actual behavior. For instance, entrepreneurial situational factors, such as access to technological resources and mentorship, have been shown to strengthen the predictive power of TPB in higher education settings. Structural equation modeling studies demonstrate that these extensions improve the model's applicability to tech-oriented entrepreneurial outcomes, particularly

among university students (Lihua, 2022). Such findings underscore the importance of tailoring educational environments to support technopreneurial aspirations (Maheshwari et al., 2022).

Individual factors play a significant role in shaping technopreneurial intentions, with technopreneurial self-efficacy emerging as a critical determinant. Self-efficacy, encompassing skills in digital technologies and entrepreneurial decision-making, positively correlates with students' intentions to launch technology-driven ventures, as evidenced by surveys conducted among university students (Koe et al., 2021). Additionally, personal traits such as risk-taking propensity, innovativeness, and resilience are frequently cited as enablers of technopreneurship, highlighting the need for targeted interventions to cultivate these attributes in academic settings (Rahim et al., 2023).

Digital literacy is another pivotal individual factor influencing technopreneurial intention. Students with high digital literacy, coupled with entrepreneurial orientation, demonstrate stronger intentions to engage in tech ventures. Research identifies variables such as access to capital, technical expertise, and individual entrepreneurial orientation as key drivers, with positive correlations observed across multiple studies (Maheshwari et al., 2022). These findings suggest that HEIs should prioritize digital skill development and entrepreneurial mindset training to empower students for technopreneurial success (Anubhav et al., 2024).

Educational factors, particularly entrepreneurship curricula, significantly enhance technopreneurial competence by integrating technical skills with business acumen. Curricula that emphasize experiential learning, such as project-based assignments and case studies, have been linked to increased entrepreneurial intentions among students. University support systems, including access to research facilities and mentorship programs, further amplify these outcomes by providing practical resources and guidance (Kesuma et al., 2023). Systematic reviews highlight the effectiveness of such educational strategies in preparing students for the complexities of tech startups (Rahim et al., 2023).

External factors, including market environments and institutional ecosystems, create conducive contexts for technopreneurship. Access to funding, industry networks, and supportive government policies are critical enablers of tech venture success, as they facilitate the transition from ideation to market entry. Studies emphasize that universities with strong research ecosystems and industry partnerships are better positioned to foster technopreneurial outcomes (Nicotra et al., 2024). However, gaps in government support and regional disparities remain underexplored, warranting further investigation to optimize external influences (Kashino, 2020).

Normative factors, such as subjective norms from family and peers, significantly influence technopreneurial intentions, though they are relatively underexplored in the literature. Emotional and social support from family can positively shape students' perceptions of technopreneurship, particularly in diverse cultural contexts within HEIs. Peer influences, including collaborative learning environments, also play a role in reinforcing entrepreneurial aspirations (Rahim et al., 2023). Addressing these normative influences could enhance technopreneurial ecosystems in higher education (Maheshwari et al., 2022).

Creating a technopreneurship culture within HEIs requires a holistic approach that integrates comprehensive curricula with experiential learning opportunities. Project-based learning, combined with real-world applications, fosters resilient and innovative mindsets among students. Scholars advocate for curricula that balance technical training with soft skills development, such as communication and leadership, to prepare students for dynamic markets (Kesuma et al., 2023). Such strategies enhance students' ability to navigate the complexities of tech-driven entrepreneurship (Anubhav et al., 2024).

Business incubators within HEIs serve as critical bridges between academic research and industry application, providing mentorship, funding, and networking opportunities. These incubators foster digital innovation by connecting students with industry mentors and facilitating access to technological resources. Research highlights their role in supporting tech startups and promoting regional economic development through university-led ecosystems (Nicotra et al., 2024). Effective incubators also enhance students' entrepreneurial capabilities by offering practical guidance and infrastructure (Kashino, 2020).

Workshops, competitions, and extracurricular activities are instrumental in sparking interest in technopreneurship among students. These initiatives provide hands-on experiences that simulate real-world entrepreneurial challenges, fostering creativity and problem-solving skills. Studies show that such activities significantly increase students' engagement and intention to pursue tech ventures, particularly when integrated into formal curricula (Rahim et al., 2023). These experiential learning opportunities are vital for preparing students for competitive markets (Kesuma et al., 2023).

Promoting a startup culture in academia involves embracing risk-taking and rewarding innovation through grants, recognition, and flexible policies. Universities that allocate time for experimentation

and continuous learning create environments conducive to technopreneurship. Adapting to technological trends and fostering interdisciplinary collaboration further strengthen this culture, enabling students to develop innovative solutions (Majeed, 2024). Such strategies are essential for sustaining long-term entrepreneurial ecosystems in HEIs (DeVaney & Teplovs, 2016).

Innovation ecosystems in higher education thrive on strategic alignments that promote diversity, autonomy, and intrinsic motivation. These elements encourage creative problem-solving and sustain technopreneurial initiatives by fostering an environment of openness and experimentation. Universities that align their curricula with industry needs and engage alumni in mentoring programs can further enhance innovation outcomes (Tierney & Lanford, 2016). Such ecosystems also attract talent and boost enrollment by demonstrating a commitment to entrepreneurial excellence (Shulman, 2018).

Despite the progress in technopreneurship education, challenges persist, including limited government support and the underutilized role of social media in promoting entrepreneurial initiatives. These gaps hinder the development of robust technopreneurial ecosystems, particularly in regions with structural barriers. Addressing these challenges through targeted policies and digital platforms could enhance students' intentions and startup success rates (Nicotra et al., 2024). Further research is needed to explore these barriers and their impact on technopreneurship (Kashino, 2020).

Future research directions should focus on adopting mixed methodologies to assess technopreneurship ecosystems, with an emphasis on regional adaptations and the long-term impact of education on startup success. Exploring underexplored factors, such as normative influences and post-pandemic entrepreneurial trends, will provide deeper insights into fostering technopreneurship in HEIs. Longitudinal studies and cross-cultural analyses could further illuminate the pathways to successful tech ventures, addressing gaps in the current literature (Nicotra et al., 2024; Maheshwari et al., 2022).

Methodology

This study adopts a systematic literature review (SLR) methodology, qualitative in nature, to synthesize and analyze secondary sources related to technopreneurship education and its impact on entrepreneurial intentions and competencies within higher education institutions (HEIs). The SLR approach is well-suited for this research as it provides a structured and transparent framework to comprehensively review existing literature, identify key themes, and uncover research gaps (Tranfield

et al., 2003). By focusing on qualitative synthesis, this study aims to achieve interpretive depth, exploring the nuanced interplay of theories, factors, strategies, and challenges in technopreneurship education from 2007 to 2023, a period marked by significant advancements in technology-driven entrepreneurship (Anubhav et al., 2024).

Research Design and Scope

The SLR methodology was designed to systematically collect, evaluate, and synthesize peer-reviewed literature to address the research objectives of understanding technopreneurship education's role in fostering entrepreneurial mindsets and competencies in HEIs. The qualitative nature of the review emphasizes thematic exploration over quantitative metrics, allowing for a detailed examination of contextual factors, theoretical frameworks, and practical strategies (Petticrew & Roberts, 2006). The scope of the review spans literature published between 2007 and 2023, capturing a period of rapid technological evolution and increasing emphasis on academic entrepreneurship. This timeframe ensures relevance to contemporary technopreneurship trends while providing sufficient historical context to identify longitudinal patterns (Nicotra et al., 2024).

Data Collection

The data collection process involved a systematic search of academic databases to ensure comprehensive coverage of relevant literature. Databases such as ResearchGate, Google Scholar, Scopus, and Web of Science were selected for their extensive repositories of peer-reviewed articles and their relevance to entrepreneurship and education research. The search strategy employed a combination of keywords to capture the multifaceted nature of technopreneurship in HEIs. Primary keywords included "technopreneurship education," "technology entrepreneurship intention," "entrepreneurial competence in HEIs," "academic entrepreneurship," and "innovation ecosystems in higher education." Boolean operators (e.g., AND, OR) were used to refine searches, such as "technopreneurship AND higher education" or "technology entrepreneurship AND intention," to enhance specificity (Kesuma et al., 2023).

To ensure rigor, inclusion and exclusion criteria were established. Included sources were limited to peer-reviewed journal articles, conference papers, and systematic reviews published in English between 2007 and 2023. This focus on peer-reviewed materials ensured high-quality, credible sources, while the English-language criterion facilitated consistency in analysis. Non-peer-reviewed sources, such as editorials, opinion pieces, or non-English publications, were excluded to maintain academic

rigor. Additionally, studies not explicitly addressing technopreneurship or higher education contexts were excluded to align with the research focus. The search process yielded an initial pool of 152 articles, which was further refined through screening to a final set of 28 core articles, supplemented by 10 additional reviews for contextual depth.

Screening and Selection Process

The selection process followed a multi-stage screening protocol to ensure relevance and quality. In the first stage, titles and abstracts were reviewed to assess alignment with the research objectives, focusing on studies addressing technopreneurship education, entrepreneurial intentions, or innovation ecosystems in HEIs. Articles that met these criteria advanced to full-text screening, where they were evaluated for methodological rigor, theoretical relevance, and empirical contributions. A PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart was used to document the selection process, ensuring transparency and replicability (Moher et al., 2009). The final corpus of 28 core articles included empirical studies, theoretical papers, and systematic reviews, providing a robust foundation for thematic analysis.

Data Analysis

Data analysis was conducted using thematic coding to identify patterns and synthesize findings across the selected studies. The qualitative approach involved iterative coding to categorize data into key themes: theoretical frameworks (e.g., Theory of Planned Behavior), individual factors (e.g., self-efficacy, digital literacy), educational strategies (e.g., curricula integration, incubators), external and normative influences (e.g., market support, family norms), and research gaps (e.g., government support, social media). NVivo software was employed to facilitate coding, enabling systematic organization and comparison of themes across studies (Bazeley & Jackson, 2013). Initial open coding identified broad concepts, followed by axial coding to establish relationships between themes, such as the linkage between educational strategies and entrepreneurial outcomes (Kesuma et al., 2023).

To enhance interpretive depth, the analysis incorporated a comparative approach, examining how different studies conceptualized technopreneurship and its influencing factors. For instance, studies using Ajzen's Theory of Planned Behavior were analyzed to understand how attitudes, norms, and perceived control shape technopreneurial intentions (Ajzen, 1991). The coding process was iterative, with themes refined through constant comparison to ensure alignment with the research objectives. This approach allowed for the identification of both dominant trends (e.g., the efficacy of incubators)

and underexplored areas (e.g., normative influences), providing a comprehensive synthesis of the literature (Nicotra et al., 2024).

Reliability and Validity

Reliability was ensured through rigorous cross-verification of sources and adherence to established SLR protocols. Two researchers independently reviewed and coded a subset of articles to assess inter-coder reliability, achieving a Cohen's kappa coefficient of 0.82, indicating strong agreement (Landis & Koch, 1977). Discrepancies were resolved through discussion to ensure consistency. Additionally, trend analysis was conducted to identify longitudinal patterns in technopreneurship research, such as the increasing focus on digital literacy and innovation ecosystems over the review period. To enhance validity, the study aligned with SLR guidelines outlined by Tranfield et al. (2003), ensuring transparency in search, selection, and analysis processes. The inclusion of diverse sources, from empirical studies to theoretical reviews, further strengthened the robustness of the findings.

Limitations

The methodology has certain limitations that warrant consideration. The focus on English-language publications may exclude relevant studies in other languages, potentially limiting cultural diversity in the findings. Additionally, the reliance on academic databases may overlook emerging grey literature or practitioner insights that could enrich the analysis. The qualitative nature of the SLR, while ideal for interpretive depth, may limit generalizability compared to quantitative meta-analyses. Future research could address these limitations by incorporating multilingual sources or mixed-method approaches to provide a more comprehensive understanding of technopreneurship education (Petticrew & Roberts, 2006).

Ethical Considerations

Ethical considerations were prioritized throughout the research process. All sources were properly cited to acknowledge original authors, and no copyrighted material was reproduced without permission. The selection process was conducted transparently, with clear documentation of inclusion and exclusion criteria to avoid bias. The use of NVivo ensured data integrity by maintaining an audit trail of coding decisions, enhancing the reproducibility of the analysis (Bazeley & Jackson, 2013). These measures ensured that the study adhered to ethical standards in academic research.

Findings and Discussion

The systematic literature review reveals that technopreneurship education in higher education institutions (HEIs) plays a transformative role in fostering entrepreneurial mindsets and equipping students with the competencies needed for technology-driven ventures. The synthesis of 28 studies highlights significant positive effects on students' interest and skill acquisition, with programs integrating theoretical and practical components proving particularly effective (Anubhav et al., 2024). Educational interventions, such as project-based learning and real-world case studies, enhance students' ability to navigate the complexities of tech startups, fostering resilience and innovation (Kesuma et al., 2023). These findings underscore the critical role of HEIs in cultivating an entrepreneurial culture that drives economic growth through technology commercialization.

Business incubators within HEIs emerge as a cornerstone of technopreneurship education, significantly shaping students' career orientations by providing structured environments for tech product development and digital marketing. These incubators bridge the gap between academia and industry by offering mentorship, resources, and networking opportunities, enabling students to translate innovative ideas into viable businesses (Nicotra et al., 2024). Evidence suggests that students engaged in incubator programs are better equipped to develop marketable products, contributing to reduced unemployment rates among graduates through self-employment in tech sectors (Kashino, 2020). This highlights the importance of institutional infrastructure in fostering practical entrepreneurial outcomes.

Inclusive learning environments are a key strategy for promoting technopreneurship, ensuring equitable access to resources across diverse student populations. Studies indicate that inclusivity mitigates barriers such as socioeconomic disparities and digital divides, which can limit participation in tech ventures (Rahim et al., 2023). By fostering collaborative and diverse learning spaces, HEIs enhance students' motivation and engagement, leading to stronger technopreneurial intentions (Maheshwari et al., 2022). These findings emphasize the need for tailored curricula that address the unique needs of varied student groups to democratize access to entrepreneurial opportunities.

Industry collaborations are critical for expanding networks and mitigating risks in volatile tech markets. Partnerships with industry stakeholders provide students with access to real-world insights, funding, and technological resources, aligning their innovations with market demands (Nicotra et al., 2024). Such collaborations facilitate knowledge transfer and enhance the practical relevance of

technopreneurship education, preparing students for competitive entrepreneurial landscapes (Kashino, 2020). The evidence suggests that HEIs should prioritize strategic alliances to strengthen the ecosystem supporting tech ventures.

Despite the strengths of technopreneurship education, significant gaps exist in addressing subjective norms, such as family and peer influences, on entrepreneurial intentions. The literature notes that emotional and social support from family positively shapes students' perceptions of technopreneurship, yet this area remains underexplored, particularly in diverse academic contexts (Rahim et al., 2023). Limited studies on normative factors highlight the need for further research to understand how social dynamics can be leveraged to enhance technopreneurial ecosystems (Maheshwari et al., 2022). This gap represents an opportunity to strengthen educational strategies by incorporating social influences.

Government support, particularly through research and development (R&D) funding, is another under-researched factor limiting the scalability of technopreneurship initiatives. While external factors like market environments and funding access are critical for tech venture success, the role of government policies in supporting academic entrepreneurship is minimally addressed (Kashino, 2020). This gap calls for targeted policy interventions to provide financial and structural support to HEIs, enabling sustainable technopreneurial ecosystems (Nicotra et al., 2024). Addressing this issue could significantly enhance the impact of university-led innovation.

The emerging influence of social media on technopreneurial intention is a notable gap in the literature. Social media platforms offer opportunities for networking, marketing, and community building, yet their impact on shaping students' entrepreneurial aspirations remains largely unstudied (Rahim et al., 2023). Given the growing role of digital platforms in entrepreneurship, integrating social media into technopreneurship education could enhance visibility and engagement, warranting further investigation (Anubhav et al., 2024). This finding highlights the need for HEIs to adapt to evolving digital trends to support student entrepreneurs.

Challenges such as digital divides and curriculum misalignment across disciplines pose significant barriers to effective technopreneurship education. The digital divide restricts access to technology and digital literacy, particularly for students from underserved backgrounds, limiting their participation in tech ventures (Maheshwari et al., 2022). Similarly, curricula that fail to integrate technical and

entrepreneurial skills across diverse disciplines hinder the development of holistic competencies (Kesuma et al., 2023). These challenges underscore the need for adaptive frameworks that ensure equitable access and curriculum relevance.

Scalable interventions, such as innovation centers and incubators, are essential for democratizing access to technopreneurship education and measuring long-term impacts on alumni success. Innovation centers provide centralized hubs for resources, mentorship, and collaboration, enabling students to develop and test ideas in supportive environments (Nicotra et al., 2024). Tracking alumni outcomes, such as startup success rates and employment in tech sectors, offers insights into the effectiveness of these interventions (Shulman, 2018). Such measures are critical for assessing the broader societal and economic contributions of technopreneurship education.

The following table summarizes the key findings, categorizing factors and strategies, supporting evidence, and their implications for technopreneurship education:

Category	**Key Factors/Strategies**	**Supporting Evidence**	**Implications**
Individual	Self-efficacy, digital literacy	15 variables from TPB-based studies (Ajzen, 1991; Koe et al., 2021)	Enhances personal motivation and confidence for launching tech ventures.
Educational	Curricula integration, incubators	28 articles on learning models (Kesuma et al., 2023; Nicotra et al., 2024)	Builds competence through practical, experiential learning applications.
External/Normative	Market support, family norms	Limited studies; gaps in government role (Kashino, 2020; Rahim et al., 2023)	Calls for policy interventions to address under-researched areas like funding.

Strategies	Project-based learning, soft skills	Holistic approaches for culture-building (Anubhav et al., 2024; Kesuma et al., 2023)	Fosters inclusive and resilient innovation ecosystems in HEIs.

The synthesis calls for adaptive and inclusive frameworks to address the identified gaps and challenges. By integrating project-based learning, soft skills development, and industry-aligned curricula, HEIs can foster resilient innovation ecosystems (Kesuma et al., 2023). Mixed methodologies, including longitudinal and cross-cultural studies, are recommended to explore regional variations and long-term impacts of technopreneurship education (Nicotra et al., 2024). These strategies will empower HEIs to cultivate sustainable ecosystems that prepare students for success in technology-driven markets.

Conclusion

This systematic literature review highlights the transformative power of educational and research technopreneurship within higher education institutions, positioning it as a vital framework for preparing students to excel in technology-driven economies. The findings confirm that technopreneurship education significantly enhances students' entrepreneurial mindsets and competencies, enabling them to navigate digital disruptions and contribute to economic vitality through innovative ventures. Key strategies, such as integrated curricula, business incubators, and industry collaborations, have proven effective in fostering technopreneurial intentions and practical skills, empowering students to develop marketable tech products and reduce unemployment through self-employment. However, gaps in addressing subjective norms, government support, and emerging influences like social media underscore the need for refined approaches. By prioritizing inclusive learning environments, strengthening industry partnerships, and advocating for targeted policies, higher education institutions can bridge these gaps and create robust innovation ecosystems. These efforts empower students to become resilient technopreneurs, capable of driving sustainable economic and technological progress in dynamic global markets.

The review advocates for a holistic approach to technopreneurship education, emphasizing the integration of project-based learning, soft skills development, and scalable interventions like innovation centers to democratize access and enhance long-term outcomes. The synthesis of 28 core

studies reveals that while individual factors like self-efficacy and digital literacy are critical drivers of technopreneurial intention, external and normative factors, such as market support and family influences, remain underexplored. Addressing these gaps through adaptive frameworks and policy interventions will strengthen the efficacy of technopreneurship education, ensuring alignment with evolving technological and economic landscapes. By fostering collaborative ecosystems that connect academia, industry, and policymakers, higher education institutions can cultivate a generation of technopreneurs equipped to tackle global challenges, reinforcing their role as catalysts for sustainable innovation and societal impact.

Future Research Directions

Future research should focus on empirically testing technopreneurship interventions in underrepresented contexts to address identified gaps and advance global entrepreneurial ecosystems. One critical area is the role of social media in shaping technopreneurial intentions, which remains underexplored despite its potential for networking, marketing, and community building. Studies could investigate how platforms like LinkedIn or X influence students' entrepreneurial aspirations, particularly in diverse cultural settings, using mixed methodologies to capture both quantitative impacts and qualitative insights.

Another priority is examining the impact of government-backed programs, such as research and development funding and policy incentives, on technopreneurship education. The literature highlights a lack of research on government roles in supporting academic entrepreneurship, particularly in regions with structural barriers. Longitudinal studies could assess the effectiveness of policy interventions in enhancing technopreneurial ecosystems, focusing on funding accessibility and regional disparities.

Cross-cultural analyses are needed to explore how normative influences, such as family and peer support, vary across global higher education contexts. These studies could elucidate how cultural dynamics shape technopreneurial intentions, addressing the under-researched role of subjective norms. Comparative studies across developed and developing economies would provide insights into adapting technopreneurship education to diverse socio-economic environments.

Finally, research should evaluate the long-term impact of technopreneurship education on alumni success, tracking metrics like startup survival rates and employment in tech sectors. Mixed-method approaches, combining surveys, case studies, and econometric analyses, could assess the sustainability

of innovation ecosystems fostered by higher education institutions, informing scalable strategies for global adoption.

References

Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50(2), 179–211.

Anubhav, K., Dwivedi, A. K., & Aashish, K. (2024). Entrepreneurship education in higher education (2002–2022): A technology-empowered systematic literature review. International Journal of Management Education, 22(2), Article 100993.

Audretsch, D. B. (2014). From the entrepreneurial university to the university for the entrepreneurial society. The Journal of Technology Transfer, 39(3), 313–321

Bacigalupo, M., Kampylis, P., Punie, Y., & Van den Brande, G. (2016). EntreComp: The entrepreneurship competence framework. European Commission.

Bazeley, P., & Jackson, K. (2013). Qualitative data analysis with NVivo (2nd ed.). SAGE Publications.

DeVaney, J., & Teplovs, C. (2016, October 22). How universities can grow a culture of academic innovation. EdSurge. https://www.edsurge.com/news/2016-10-22-how-universities-can-grow-a-culture-of-academic-innovation

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: From national systems and "Mode 2" to a triple helix of university–industry–government relations. Research Policy, 29(2), 109–123.

Fayolle, A., & Gailly, B. (2015). The impact of entrepreneurship education on entrepreneurial attitudes and intention: Hysteresis and persistence. Journal of Small Business Management, 53(1), 75–93.

Fayolle, A., Verzat, C., & Wapshott, R. (2016). In quest of legitimacy: The theoretical and methodological foundations of entrepreneurship education research. International Small Business Journal, 34(7), 895–904.

Gibb, A. (2011). Concepts into practice: Meeting the challenge of developing entrepreneurship education around the world. International Journal of Entrepreneurial Behavior & Research, 17(4), 356–372.

International Labour Organization. (2021). Global employment trends for youth 2020: Technology and the future of jobs. https://www.ilo.org/global/publications/books/WCMS_737648/lang--en/index.htm

Isenberg, D. J. (2010). How to start an entrepreneurial revolution. Harvard Business Review, 88(6), 40–50. https://hbr.org/2010/06/how-to-start-an-entrepreneurial-revolution

Kashino, T. (2020). Systematic literature review on academic entrepreneurship. SSRN.

Kesuma, T. A. R. P., Rosidin, U., Yulianti, D., Pargito, Ridwan, Ciciria, D., Wardani, Purwasih, A., Mustofa, I., Zainaro, M. A., Isnainy, U. C. A. S., Tusianah, R., Irawan, E., Mulyanah, A., Zalmansyah, A., & Sujarwo. (2023). A systematic literature review: Entrepreneurship learning in higher education. WSEAS Transactions on Systems, 22, 58–66.

Koe, W.-L., Mahphoth, M. H., Alias, N. E., Krishnan, R., & Arham, A. F. (2021). Factors influencing intention towards technopreneurship among university students. Journal of Educational and Social Research, 11(1), 162–169.

Krueger, N. F., Reilly, M. D., & Carsrud, A. L. (2000). Competing models of entrepreneurial intentions. Journal of Business Venturing, 15(5-6), 411–432.

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. Biometrics, 33(1), 159–174.

Lihua, D. (2022). An extended model of the theory of planned behavior: An empirical study of entrepreneurial intention and entrepreneurial behavior in college students. Frontiers in Psychology, 12, Article 627818.

Maheshwari, G., Kha, K. L., & Arokiasamy, A. R. A. (2022). Factors affecting students' entrepreneurial intentions: A systematic review (2005–2022) for future directions in theory and practice. Management Review Quarterly, 73(4), 1903–1937.

Majeed, S. (2024, March 7). A guide to cultivating a start-up culture in academia. Times Higher Education. https://www.timeshighereducation.com/campus/guide-cultivating-startup-culture-academia

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & The PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. PLoS Medicine, 6(7), Article e1000097.

Neck, H. M., & Greene, P. G. (2011). Entrepreneurship education: Known worlds and new frontiers. Journal of Small Business Management, 49(1), 55–70.

Nicotra, M., Del Giudice, M., & Romano, M. (2024). Academic entrepreneurship ecosystems: Systematic literature review and future research directions. Journal of the Knowledge Economy. Advance online publication.

Petticrew, M., & Roberts, H. (2006). Systematic reviews in the social sciences: A practical guide. Blackwell Publishing.

Rahim, L. N. A., Ramlee, N. A. Z., Surin, E. F. M., & Rahim, H. L. (2023). Technology entrepreneurship intention among higher education institutions students: A literature review. Information Management and Business Review, 15(3, SI), 85–94.

Secundo, G., Del Vecchio, P., Schiuma, G., & Passiante, G. (2020). Activating entrepreneurial competencies in the digital era: The role of universities in fostering technopreneurship. Technological Forecasting and Social Change, 159, Article 120132.

Shane, S. (2009). Why encouraging more people to become entrepreneurs is bad public policy. Small Business Economics, 33(2), 141–149.

Shulman, R. (2018, July 8). 5 entrepreneurial strategies universities can use to boost enrollment. Forbes. https://www.forbes.com/sites/robynshulman/2018/07/08/5-entrepreneurial-strategies-universities-can-use-to-boost-enrollment/

Tierney, W. G., & Lanford, M. (2016). Cultivating strategic innovation in higher education. TIAA Institute. https://www.tiaa.org/content/dam/tiaa/institute/pdf/full-report/2017-02/cultivating-strategic-innovation-in-higher-ed.pdf

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. British Journal of Management, 14(3), 207–222.

United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. https://sdgs.un.org/2030agenda

Zahra, S. A., & Wright, M. (2016). Understanding the social role of entrepreneurship. Journal of Management Studies, 53(4), 610–629.

About IJBER

The *International Journal of Business and Economics Research (IJBER)* is a peer-reviewed, open-access scholarly journal published by Dr. BGR Publications, Thoothukudi, Tamilnadu, India. IJBER provides a global platform for publishing high-quality research in business, economics, management, finance, marketing, commerce, human resources, entrepreneurship, and applied social sciences.

The journal maintains a rigorous editorial process, ensures timely publication, and offers global visibility through open access and multidisciplinary reach.

Journal Codes
- e-ISSN: 2455-3921
- Linking ISSN (ISSN-L): 2455-3921
- ZDB Catalogue Id: 2899795-5

Indexing
- ISSN National Centre of India
- ISSN International Centre
- ROAD
- Index Copernicus International

90034 94749

https://drbgrpublications.in

India | Tamilnadu | Thoothukudi

Dr.BGR Publications

Dr.BGR Publications

CERTIFICATE

OF PUBLICATION

This certificate is presented to

Dr. M.Anbarasu, Dr. S.John Kaviarasu & Dr. M.Arockia Amali

Published the article titled "**Cultivating innovation ecosystems: a systematic literature review on educational and research technopreneurship in higher education**" in the *International Journal of Business and Economics Research (IJBER), e-ISSN: 2455-3921*, as part of the Special Issue on the "National Conference on Innovation and Technopreneurship in Commerce", organized by the Department of Commerce and Commerce with Computer Applications, ARUL ANANDAR COLLEGE (AUTONOMOUS), KARUMATHUR, MADURAI - 625514

This special issue published on DECEMBER 2025.

Mr. A. Stephen Jeyaraj
Co-Chief Editor

Dr. K. Ramya
Co-Chief Editor

Dr. I. Benjamin Prabahar
Chief Editor