

Enabling artificial intelligence in entrepreneurship: Implications for startup creation in higher education

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Abstract: The digital transformation has reshaped entrepreneurship, with the emergence of artificial intelligence (AI) as a powerful enabler of innovation and startup creation. However, higher education institutions face challenges integrating AI into entrepreneurship education curriculum, limiting students' ability to fully harness its potential. This study aimed to determine and explore entrepreneurship students' challenges in using AI for startup development, assess the competencies they gain in innovating business ideas, and analyze how these challenges affect competencies using structural equation modeling (SEM). Employing an convergent mixed-method design, the study surveyed 114 third- and fourth-year BS Entrepreneurship students and conducted interviews to faculty and business plan implementers. Quantitative data were analyzed using descriptive statistics and SEM, while qualitative data underwent thematic analysis for triangulation. Findings revealed that students face significant challenges in opportunity identification, decision-making, performance execution, education and learning, and research application. The key barriers highlight was market understanding, lack of AI literacy, limited mentorship, and insufficient curriculum integration. Despite these, students reported gaining competencies in opportunity recognition, customer targeting, data-informed decision-making, and entrepreneurial communication using AI tools. However, critical thinking, problem-solving, and prototyping skills remained underdeveloped. SEM results indicated that challenges in education, opportunity identification, and decision-making significantly constrained entrepreneurial competencies. The study implies the need for higher education to reform curricula by embedding AI-focused modules, case-based projects, mentorship opportunities, and innovation hubs. Strengthening AI-driven entrepreneurship education will equip students with the competencies required for sustainable startup creation in the digital economy.

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Introduction

The social influence of the digital revolution, particularly digitalization and AI, has been profound and reflected in all walks of the daily life as well as work environment (Makridakis 2017). These technologies have become indispensable in society and economy, according to Peng and Tao (2022). Additionally, Cheng et al. (2021) asserted that technology is an essential instrument. Blanco-Gonzalez-Tejero et al. (2023) also emphasized that technology is particularly significant for businesses aiming to enhance operations and approaches.

The curriculum in higher education was put to the test by business-driven innovation in education. It starts by outlining the difficulties that innovation faces in the formal education sector, which has a limited knowledge ecology: basic administrative and instructional procedures are not greatly affected by research in the field. After that, it switches to a typical innovation indicator. Educational tools are usually covered by patents in the education sector. The number of extremely inventive startups that companies have commercialized appears to have increased over the last 20 years. The growing tool business now focuses on non-formal education rather than formal education, despite the fact that the increased innovation in education may open newfangled prospects for the sector of formal education (OECD 2023).

Development of educational technologies following a tremendous advancement in general-purpose technology

Since the information and communications technology (ICT) offers a wide range of novel tools and instruments, it is unquestionably a source of innovation in educational institutions that have the potential to significantly alter the institutional, organizational, and technological underpinnings of the field. The advancement of ICT in education offers chances to expand the range of instructional technologies. The process by which a new technology spreads throughout numerous industries and produces particular applications is known as “co-invention of applications,” and it is not a trivial issue.

A general-purpose technology, like ICT, is characterized by its parallel spread across the economy and the synergy between application development and invention. According to economists, while application development modifies the role of manufacturing in a

certain industry, general-purpose technology expands the range of inventive potential for the economy as a whole. To put it another way, when primary inventions lead to co-inventions across various industries, they create dynamic feedback loops that expand the overall technology market and increase the returns on succeeding inventions.

Entrepreneurship

Value creation techniques have evolved as a result of the digital revolution (Yu and Guo 2023). As a result, in recent years, the number of scholarly studies on the impact of digital elements on company models has increased dramatically (Caputo et al. 2020). Their role in business sustainability and growth, as well as their market positioning, must be understood, as organizations become more and more digital (Dubey et al. 2020). Entrepreneurs must use cutting-edge technologies to obtain a competitive edge considering the market's rapid developments and intensifying rivalry brought on by globalization (Darwish et al. 2020). Therefore, people also need to learn more about the advantages and potential hazards associated with their use. In particular, Khalid (2020) noted that studying using AI in higher education institutions is pertinent to promoting entrepreneurial activity.

Artificial Intelligence (AI)

Shoufu et al. (2022) claim that artificial intelligence is a major driver of technological and economic progress, and Arcega (2023) presents new opportunities for enterprises (Pfau and Rimpp 2021). Specifically, as researchers like Gupta and Dhawan (2018) noted, AI is a way to give a computer the ability to think intelligently, or like a human. Given the shift in paradigm that society is undergoing, digital tools promote development and growth, enabling changes in the character and extent of corporate activity, as noted by Nambisan (2017). Gupta et al. (2023) highlighted that examining how AI can impact global productivity and other aspects of life is therefore vital. Additionally, according to Pai et al. (2022), the production and management of knowledge depend on AI.

AI and entrepreneurship relationships

French et al. (2021) asserted that Revolution 4.0's recent developments have provided them with a platform to put these theoretical models into practice.

Oztemel and Gursev (2018) stated that artificial intelligence (AI) is considered a leading subject to be investigated in this revolution and

that its uses are anticipated to expand to any field requiring human intellect. The AI is a key to all Industry 4.0 technologies. Smart factories used it, which have completely integrated manufacturing platforms that mostly operate without human involvement, by generating, transporting, and evaluating the data required to perform the intrinsic production tasks, as highlighted by Lasi et al. (2014).

Azuma et al. (2001) highlight the use of AI in the augmented reality model, a human-computer interaction system that integrates natural and virtual 3D elements in real time. According to Sahu et al. (2020), AI improves image processing and associated tasks' accuracy and robustness. Treiblmaier (2018) emphasized that AI is connected with block chains, which are distributed ledgers that securely and transparently store digital assets. Dinh and Thai (2018) stated that because AI needs on data to learn and make decisions, this combination allows it to work with verified, digitally signed, and securely shared data in a decentralized ledger, resulting in more reliable and credible results.

The originality and value of this research contribute by systematizing disconnected studies on AI and entrepreneurship. It organizes contributions into managerial and entrepreneurial literature perspectives, providing a comprehensive understanding of AI's role in fostering entrepreneurial success. Hence, it was focused on enhancing young entrepreneurs' competencies. With the gaps identified, the primary purpose of the study is to determine the challenges encountered by the entrepreneurship students on Innovation using artificial intelligence in developing their startups, assess their competency skills in innovating business ideas, and come up with solutions to help the young entrepreneurs build and operationalize their startups.

Specifically, it sought to answer the following:

1. What challenges does the entrepreneurship student encounter in developing innovative startups using artificial intelligence related to opportunity, decision-making, performance, education, and research?
2. What competencies do entrepreneurship students gain in innovating their business ideas using artificial intelligence?
3. What challenges affect entrepreneurship students' competencies in innovating their business ideas using Structural Equation Modeling (SEM)?
4. What insights into policy and program implementation can be drawn based on the results of the study?

Methodology

The study focuses on the pragmatist worldview. The purpose of this consideration is to look for a solution to the gaps by prioritizing practical outcomes and the effectiveness of the methods in order to address the respondents' concerns. The study utilized a convergent mixed-method approach with a cross-sectional survey research method and interview. The researcher used a researcher-made questionnaire for the challenges encountered by the entrepreneurship students in developing innovative startups using AI to determine the competencies they gained as entrepreneurship students in innovating their business ideas using AI. An interview was conducted with faculty teaching entrepreneurship subjects and business plan implementers to triangulate the results. The survey was validated and underwent a reliability test with a Cronbach's Alpha 0.845. At the same time, the unstructured interview guide was validated by experts.

In data gathering analysis, request letters were processed before gathering the data. Informed consent was provided before gathering the quantitative and qualitative data. The content of the informed consent was an invitation to participate voluntarily. Confidentiality and data privacy are treated with the strictest confidentiality.

The risks and benefits of participating in the conduct of the study are that there is no known physical, psychological, or legal risks associated with the study. The potential benefits include contributions to the improvements in entrepreneurship education, help shape AI training and startup support services for students, and raising awareness on AI's role in business innovation.

The survey instrument forwarded to the respondents using Google Form. The link was provided to their respective group chats. The duration of the data gathering is one month. After the duration of the survey, the researcher collated the data and transformed it into spreadsheets by coding all variables. It was a process using Jamovi with a version of 2.7.6. Descriptive statistics and structural equation modeling are used. This model extends factor analysis and multiple regression analysis and can be used to understand and identify the putative causal associations between latent and observed variables. A deductive thematic analysis was used to analyze the qualitative data during the interview.

Results and discussions

Profile of the respondents

Gender: The respondent profile provides a strong foundation for interpreting the study's findings. Most participants were women (81.4%), while men accounted for 18.6% and one respondent identified as non-binary. In line with worldwide trends indicating a rise in female participation in entrepreneurial training programs, this gender distribution emphasizes the expanding role of women in entrepreneurship education (Brush et al. 2019). The higher number of women respondents also suggests that there may be different perspectives based on gender regarding the challenges and skills needed for developing AI-driven startups. The demographic and competency profiles of respondents carry several implications. The respondents' demographic and competency characteristics have several ramifications. First, the gender distribution indicates that AI-integrated entrepreneurship programs should continue to promote diversity, especially in helping women in tech-driven businesses. Initiatives that boost underrepresented groups' self-esteem and technical proficiency could contribute to the equilibrium of entrepreneurial ecosystems.

The findings coincide with earlier research stressing how socioeconomic and experiential factors influence entrepreneurial skills. The larger proportion of female participants is consistent with the findings of Arcega et al. 2021; Brush et al. 2019, who discovered the growing influence of women entrepreneurs in technology-oriented environments. Prensky (2001) stated that younger children are more responsive to digital reinforcement, supporting the idea that age influences technology adoption.

Age: All respondents were between 18 and 25, reflecting a young, digital-native learner cohort. Participants in this age range appear to be in a developmental stage where they are highly adaptable to new technology. Young generations are more likely to embrace and experiment with developing technologies like artificial intelligence (AI) since they are "digital natives," according to Prensky's (2001) theory. The age range indicates strong potential for adaptability and innovation. As digital natives, these students are well-positioned to integrate AI tools into entrepreneurial processes, but structured training is necessary to convert adaptability into mastery.

Year level: The respondents' distribution of academic standing is nearly equal between third-year students (49.1%) and fourth-year students (50.9%). This balance offers insights into the effects of AI

exposure across various academic development phases by indicating a thorough representation of students approaching the end of their entrepreneurial program. The balance between 3rd- and 4th-year students implies that AI integration should be scaffolded across the entrepreneurship program. Third-year students can develop basic competencies through early exposure, while fourth-year students can assist venture creation and incubation through advanced integration.

Previous experience in operating a business / startup: Of those with prior entrepreneurial experience, 45.6% had launched or run a business, while 54.4% had no prior experience. This combination reflects a diverse pool, with about half providing practical experience and the other half providing fresh perspectives unaffected by direct business activities. It aligns with findings by Nabi et al. (2017), who noted that both prior experience and academic training influence entrepreneurial intentions and competencies in complementary ways.

Familiarity with AI: It varied significantly; most respondents reported basic familiarity (54.4%), while 28.9% claimed intermediate knowledge, 6.1% advanced familiarity, and 10.5% none. Since von Briel (2022) noted that entrepreneurs frequently use AI at the application level rather than the development level, this distribution implies that although AI is generally acknowledged, significant technical skill is uncommon among entrepreneurship students. Encouragingly, 94.7% reported using AI in academic or business work, highlighting the pervasive influence of AI tools such as chatbots, analytics systems, and recommendation engines in students' practical engagements. The distribution of prior entrepreneurial experience highlights the need for differentiated instructional strategies. Advanced application courses may be beneficial for those with existing business skills. At the same time, foundational classes contextualizing AI technologies in entrepreneurial practice may be necessary for students lacking such experience to improve business innovation.

ICT proficiency: Regarding ICT proficiency, more than half (52.6%) rated themselves as having average skills, with 17.5% above average and 11.4% very advanced. 11.4% of respondents claimed to have basic abilities, while just 7.1% said they did not utilize ICT. Since ICT literacy is relatively linked to the successful adoption of AI technologies in entrepreneurship, it suggests a strong ICT foundation, which is essential (Kraus et al. 2022). While most students had some level of AI familiarity and ICT proficiency, the scarcity of advanced expertise suggests that entrepreneurship programs should focus on

equipping students with practical, user-level competencies while fostering partnerships with computer science and engineering fields for technical collaboration. Similarly, integrating students with and without entrepreneurial experience supports (Nabi et al. 2017) claim that entrepreneurship education may develop competencies regardless of prior business involvement. Moreover, the respondents' AI knowledge levels are consistent with von Briel's (2022) study, which claims that entrepreneurs employ AI at an application level rather than a developmental one, underlining the need for targeted AI education in entrepreneurship. The findings on ICT proficiency back up (Kraus et al. (2022) contention that ICT competency is a key enabler of digital entrepreneurship.

Challenges in AI driven startup development

Opportunities identification

The study shows challenges that respondents face when using artificial intelligence (AI) for business ideation and opportunity recognition. These challenges, supported by mean scores, highlight the range of difficulty in this context.

First, the statement on “Lack of market understanding limits my ability to use AI for startup ideas” had a mean rating of 3.28 (somewhat challenging). It suggests that respondents' capacity to effectively use AI in entrepreneurial situations, particularly in opportunity discovery and innovation, is challenged by a lack of understanding of the real-market dynamics. Consistent with previous studies, market understanding is fundamental for transforming technological capabilities into viable business opportunities (Nambisan 2017).

Second, the challenge “I struggle to connect AI capabilities with real-world entrepreneurial problems” obtained a mean of 3.20 (somewhat challenging). It suggests that even while AI is a helpful tool, connecting its abstract qualities with real-world entrepreneurial needs remains difficult. The results of von Briel et al. (2018) - who pointed out that entrepreneurs usually encounter cognitive and experiential difficulties while transforming innovative ideas into commercial solutions - align with this.

Third, the statement on “AI helps me identify market opportunities that are sometimes overlooked” has a mean rating of 3.11 (somewhat challenging). While this demonstrates that AI can disclose new opportunities, the moderate mean indicates that respondents still have

difficulty capitalizing on this benefit. The findings are consistent with recent work emphasizing AI's dual role; it provides sophisticated analytics for opportunity discovery while requiring complementary entrepreneurial abilities to evaluate and apply insights (Cockburn et al. 2018).

Fourth, on the statement "AI enhances the accuracy of evaluating potential opportunities compared to traditional methods," the highest mean score was 3.92 (mostly challenging). It suggests that while respondents recognize AI's potential in improving evaluation accuracy, they perceive it as one of the most challenging aspects to influence. It implies that technical accuracy alone may not suffice without contextual business judgment, echoing prior findings that AI needs to be complemented by human intuition and domain expertise (Shrestha et al. 2019).

Finally, an item "AI enhances the accuracy of evaluating potential opportunities compared to traditional methods," produced a mean of (3.82, mostly challenging).

It highlights the business's robustness if AI is utilized in opportunity identification; hence, market understanding remains a recurring and significant barrier to AI-driven startup ideation. It has multiple consequences for entrepreneurial education and practice.

First, increasing market literacy among potential entrepreneurs is critical to maximizing AI's utility in opportunity identification. Second, it is necessary to have a tailored-fit training that connects the technical aspects of AI to the practical demands of entrepreneurship, guaranteeing that entrepreneurs can apply AI capabilities to actual-world situations or otherwise in the business operations. Third, while AI provides unique tools of analyzing and identifying opportunities, it cannot replace the firsthand knowledge and industry-specific experience of entrepreneurs and mentors. For startups, therefore, may invest in hybrid skill development—integrating technological proficiency with entrepreneurial judgment. Prior research has highlighted the important link between AI capabilities and entrepreneurial cognition, which supports the current findings. According to Nambisan (2017), market insights are required for entrepreneurial success rather than technology. Thus, von Briel et al. (2018) shown that entrepreneurs typically face a "translation gap" when applying new technologies to business challenges. Likewise, Cockburn et al. (2018) highlighted that AI's potential increased opportunity exploration; while emphasizing the requirements of

complementary human abilities for analyzing the opportunities, and lastly, Shrestha et al. (2019) stated that AI should complement, not replace, human decision-making in entrepreneurial processes.

The study's participants stressed that students frequently have difficulty spotting promising applications for AI. Students used to follow AI trends without seriously evaluating whether these ideas actually answer a business problem, according to Participant 1. Similarly, Participant 2 added that "the challenges lie in validation if the AI-driven concepts can actually be scaled or sustained in the real market." Participant 3 reinforced this view, noting that "students struggle with proper market research, so they cannot always confirm whether the AI application they propose will work in real business contexts."

These insights align with previous findings that opportunity recognition remains a critical yet underdeveloped competency among student entrepreneurs (Shane and Venkataraman 2000; Giones and Brem 2017). AI innovations risk being perceived as imitative rather than disruptive without proper validation.

Decision-making and performance

The statement "I lack the skills to use AI tools for making sound business decisions" recorded a mean score of 3.11 (somewhat challenging). It implies that although entrepreneurs acknowledge AI's importance in decision-making and performance, some feel inadequately skilled in utilizing these tools effectively. Previous research confirms that limited technical literacy creates barriers to fully leveraging AI for strategic choices (Jarrahi 2018).

The statement "I am uncertain about how to measure the performance of AI-integrated startups" obtained a mean score of 3.32 (somewhat challenging). It implies moderate difficulty in evaluating performance, most likely due to the lack of defined evaluation frameworks and the dynamic nature of AI-driven measures. According to Davenport and Ronanki (2018), incorporating AI into operations necessitates reconsidering performance metrics beyond conventional financial ones. In order to ensure that entrepreneurs can use these tools for decision-making, there is an urgent need for capacity-building initiatives that improve their AI literacy.

A mean score of 3.38 (mostly challenging) was recorded for the item "The complexity of AI tools affects my confidence in using them for startup success." It illustrates how technological complexity remains a significant obstacle, eroding entrepreneurs' assurance. It is

consistent with studies emphasizing AI systems' "black-box" nature as a significant obstacle to entrepreneurial adoption (Burrell 2016). To improve performance evaluation, governments and incubators should encourage the creation of standardized measures for assessing AI-integrated firms.

Meanwhile, "AI offers helpful data that helps startups make better decisions" had a mean score of 3.82 (mostly challenging). Although the respondents acknowledge that AI's potential enhances decision-making, there are still issues with gleaning valuable insights from AI-generated data. It aligns with Shrestha et al. 2019, who contend that although AI offers helpful input, human interpretation and contextualization are still necessary for effective decision-making. Startups should spend money on explainable AI solutions to boost user confidence and lessen apparent complexity. Fourth, before integrating AI outputs into strategic choices, businesses must set up strong validation procedures to guarantee consistency and dependability. When taken as a whole, these steps help balance the advantages of AI and the real-world difficulties of applying it in an entrepreneurial setting. Existing research validates these conclusions. According to Jarrahi (2018), entrepreneurs have difficulties due to a lack of expertise in using AI.

Lastly, the statement "Inconsistent AI outputs pose challenges in making sound business decisions" has a mean score of 3.53 (mostly challenging). It implies that data validity and reliability are important concerns for entrepreneurs relying on AI, as such inconsistencies may result from biases in datasets or algorithmic variability, validating prior work that warns of the risks of unreliable AI outputs in organizational contexts O'Neil (2016). The challenge of creating performance indicators for AI-driven organizations was validated by (Davenport and Ronanki 2018). The intricacy and opaqueness of AI systems are obstacles to user confidence, according to Burrell (2016). The idea that human judgment is still crucial for evaluating AI outputs for decision-making was backed by (Shrestha et al. 2019). O'Neil (2016) added credence to worries about biased or inconsistent AI results and cautioned about the possible dangers they pose for corporate decision-making.

Making decisions is a significant challenge, according to participants. Participants 3 and 4 elaborated that "decision-making becomes trial-and-error when students cannot connect AI insights with business strategies." Participants 3 and 5 echoed each other when they

said that “students hesitate to trust AI outputs because they do not have enough background to interpret data.” Participant 5 concluded that “a major gap is the absence of structured frameworks in the curriculum for AI-supported decision-making.”

This finding is consistent with research showing that novice entrepreneurs often lack the analytical orientation to leverage AI for informed decisions, defaulting to heuristics and intuition (Huang et al. 2022). The gaps encountered by the students suggest that integrating AI literacy into decision-making frameworks is vital in entrepreneurship education.

The challenges that students faced when transitioning from ideation to implementation were emphasized. Participant 4 also acknowledged that “most students failed when moving from paper-based plans to a working business plan as they proposed during business plan preparation.” Participant 5 said that “students usually stop at the ideation stage because they lack technical know-how to develop prototypes.”

Participant 3 highlighted, “Even with creative ideas, execution is the problem, because of lack financial resources and technical support.” Likewise, Participant 6 added that “resource limitations—financial, tools, software, and even mentors with AI expertise—hold back students’ performance.” These findings corroborate earlier research showing that students’ capacity to convert entrepreneurial ideas into profitable products is hampered by a lack of technical resources and mentorship (Neck and Corbett 2018; Malecki 2018). One major obstacle to AI-driven entrepreneurship education is the dearth of prototyping resources.

Education and learning

The statement “The curriculum does not give students options and opportunities to access AI for startup creation” received a mean score of 3.47 (mostly challenging). It shows that educational curricula remain limited in providing structured opportunities for students to apply AI in entrepreneurial contexts. This is align with the previous study of Maritz et al. (2021), emphasizes the gap between academic programs and the digital competencies required for innovation-driven entrepreneurship.

The item “I have trouble finding mentors or training in commercial AI applications” obtained a mean score of 3.28 (somewhat challenging) and a factor loading of 0.710. It implies the challenge of accessing mentorship and training opportunities specific to commercial

AI. Given that entrepreneurship thrives on experiential knowledge and role models, the lack of mentorship hinders students' ability to translate AI into viable ventures Liguori and Winkler 2020. A mean score of 3.39 (mostly challenging) was obtained for the task "Our education system is not yet fully equipped to integrate AI in startup creation." This highlights structural deficiencies in the institutional preparedness for integrating AI. The result is consistent with research showing structural delays in bringing educational systems up to speed with technology (Luckin 2017).

The statement "AI-based learning platforms help enhance entrepreneurial skills and knowledge" had a high mean score of 3.86 (mostly challenging), which is a positive indicator. Although respondents believe there is potential for enhancing entrepreneurial competencies through AI-enabled learning platforms, they also see difficulties in optimizing their efficacy. This reflects broader evidence that digital platforms can personalize learning and expand entrepreneurial capabilities if supported with appropriate guidance (Zawacki-Richter et al. 2019). Finally, "Education and training in AI are essential for overcoming challenges in startup development" scored 3.82 (mostly challenging). It highlights a widespread recognition of AI education and training as a important tool. It validates calls from researchers who argue that fostering AI literacy and entrepreneurial education together is critical to preparing graduates for technology-driven startup ecosystems (Chin et al. 2023).

The poor integration of AI in entrepreneurship curricula was a a primary concern of the public higher education. "The curriculum is still catching up with digital transformation." Participant 1 said, "Entrepreneurship courses are still heavy on traditional business planning; AI concepts are barely integrated." Participant 2 said, "Students are expected to innovate but lack foundational knowledge in AI tools and applications." Participant 3 said that "they often learn on their own through YouTube or short online courses." Participant 4 openly acknowledged that the students are expected to innovate. Although it is not yet fully implemented, we are working to integrate AI literacy.

The literature emphasizes the pressing need to update entrepreneurship courses to include digital and AI-related competencies, and this worry is consistent with that literature (Maritz et al. 2021; Ratten 2022). There is still a disconnection between

technical innovation and entrepreneurial activity if intentional curriculum reform is not implemented.

Research and application

The findings highlight systemic and instructional challenges in applying AI research to entrepreneurial practice, alongside recognition of AI's critical role in sustaining startup innovation. The statement "I have trouble looking into AI applications for new businesses" received a mean score of 3.32 (somewhat challenging). It implies that although respondents acknowledge the importance of AI, they have a moderate amount of trouble locating appropriate applications for entrepreneurial settings. According to earlier research, entrepreneurs frequently find it difficult to match AI skills with business model potential (Bughin et al. 2018).

Likewise, the statement "Access to data and AI tools for entrepreneurial research is limited" had a mean score of 3.32, which indicates that it is quite challenging. This suggests that access restrictions are major impediments to AI-enabled entrepreneurship, regardless of whether they are caused by infrastructure, cost, or availability. Consistent with this, Cockburn et al. (2018) highlighted that limited access to quality datasets and advanced AI tools often impedes entrepreneurial adoption. The item "I need more exposure to case studies on AI-driven entrepreneurship" recorded a higher mean of 3.76 (mostly challenging) with a factor loading of 0.672.

Respondents emphasize that practice-oriented examples and experiential insights are essential for understanding how AI translates into viable business strategies. Kolb (2015) experiential learning theory, which stresses that case-based and applied learning fosters deeper knowledge transfer in entrepreneurial education. The statement "The course facilitator effectively translated AI research findings into practical startup applications" had a mean of 3.60 (mostly challenging) with a factor loading of 0.648. While relatively positive, the result suggests that although facilitators are attempting to bridge theory and practice, challenges remain in contextualizing academic findings into entrepreneurial action. Research by Nambisan (2017) similarly highlights the need for educators to serve as mediators between digital technologies and entrepreneurial application.

Finally, "Continuous research and innovation in AI are necessary for startup sustainability" had the highest mean of 4.13 (mostly challenging) and an unusually high factor loading reported (2.802, likely a data entry anomaly). Regardless, the response indicates strong

consensus that ongoing research and innovation are critical for sustaining AI-driven startups. This finding is validated by Shrestha et al. (2019), who argue that AI must be continually updated and refined to remain effective in dynamic market environments.

The results underscore several implications. First, universities and startup ecosystems must expand access to AI tools and datasets to reduce barriers for aspiring entrepreneurs. Second, curricula should integrate real-world case studies and applied research, allowing students to contextualize AI's entrepreneurial value. Third, faculty training is necessary to enhance their ability to effectively translate AI research into practical applications. Finally, fostering a culture of continuous innovation in AI is essential for the sustainability of startup ventures, suggesting that entrepreneurship education should emphasize iterative learning and research-driven innovation.

These results are strongly validated by prior scholarship. Bughin et al. (2018) noted that entrepreneurs face challenges in identifying actionable AI applications. Cockburn et al. (2018) highlighted limited access to data and tools as critical barriers. Kolb (2015) emphasized the effectiveness of experiential learning and case-based education in entrepreneurship. Nambisan (2017) confirmed the importance of bridging digital research with entrepreneurial practice. Shrestha et al. (2019) reinforced the necessity of ongoing AI innovation to sustain startup competitiveness.

The research dimension is the last challenge of entrepreneurship students. The participants concluded that "their research does not provide enough evidence to justify the practicality of their AI innovations." Participant 4 observed that "students often generalize about AI's benefits in research papers without citing concrete business case samples and other references" Participant 5 noted that "their feasibility studies are weak because they lack benchmarks on AI-driven businesses." Participant 6 clarified that "literature reviews remain shallow, undermining their ability to support their business ideas."

These present results align with other studies that students frequently neglect to include solid data in feasibility studies for entrepreneurship, especially in cutting-edge domains like artificial intelligence (Ahsan 2020; Audretsch and Belitski 2021). Their entrepreneurial outputs become less credible and competitive due to this restriction.

Competencies gained in using AI for business innovation

The findings show that most items were rated as *very good*, indicating that respondents largely reported good competencies acquired by their exposure to AI in business innovation. With a mean score of 3.76 (very good) for the statement “I can use AI insights to find business prospects,” respondents became more confident in using AI to identify opportunities. This lends credence to the expanding body of research demonstrating AI’s capacity to spot untapped market potential and produce insights that go beyond conventional techniques (Chalmers et al. 2021).

Likewise, “I am aware of how AI may enhance customer customization and targeting.” This shows a thorough understanding of how AI may help tailored marketing strategies, which is in line with research that indicates AI can enhance consumer engagement and support precision targeting (Davenport et al. 2020).

Both the statements “I am comfortable using AI tools like recommendation engines, analytics systems, and chatbots” and “I am capable of creating AI-based tools or prototypes to help commercial concepts” received 3.50 (very good) points. These findings imply that although students acquired technical familiarity, their confidence levels varied. Previous studies have demonstrated that developing working prototypes and using sophisticated tools call for a higher level of technical literacy, which may vary from learner to learner (Dwivedi et al. 2021). Prior research confirms that building functional prototypes and applying advanced tools require deeper technical literacy, which may differ among learners (Ibid.).

The mean score for “I can integrate AI applications into pitch presentations and company proposals” was 3.60 (very good). It emphasizes the ability to contextualize the use of AI applications in the entrepreneurial communication process and approaches, and supports the narratives that AI literacy enhances persuasiveness and competitiveness in entrepreneurial pitching of the aspiring entrepreneurs’ (Chin et al. 2023).

Cognitive skills-related competencies were also strongly emphasized. “I have improved my ability to make decisions as a result of my exposure to AI technologies” scored 3.68 (very good), while “I developed analytical thinking and data literacy through AI-related projects” got 3.66 (very good). These results are consistent with research indicating that exposure to AI develops analytical skills,

empowering business owners to use data-driven insights for strategic objectives (Shrestha et al. 2019).

Lastly, “By employing AI, I have improved my critical thinking and problem-solving abilities” had the lowest mean (good). While still positive, this suggests that critical thinking and problem-solving—though enhanced—may require more intensive real-world application and iterative learning to fully mature. This observation is consistent with experiential learning theories that emphasize iterative practice in developing higher-order cognitive skills (Kolb 2015). Studies have validated the present findings. Chalmers et al. (2021) proved AI’s role in identifying business prospects. Davenport et al. (2020) validated AI’s dramatic impact on customer customization and engagement. Dwivedi et al. (2021) emphasize the importance of increasing technical literacy among entrepreneurial students in order to achieve successful AI deployment in firms. Chin et al. (2023) emphasized AI’s usefulness in entrepreneurial education and pitching. Shrestha et al. (2019) proved AI’s ability to improve decision-making processes. Finally, Kolb’s (2015) experiential learning approach emphasized that skills such as critical thinking develop through applied practice and iterative learning.

Faculty members recognized students’ increasing capacity to see opportunities despite obstacles. “Students are learning to link AI with real entrepreneurial opportunities, though not yet consistently,” said Participant 1; “they can identify how AI can enhance marketing, particularly in customer targeting.” “Students are becoming more aware of emerging AI-driven opportunities in industries like e-commerce and customer service,” said Participant 2. This ability reflects opportunity recognition, one of the key pillars of entrepreneurial development (Baron 2006). Even at the most basic level, students’ market-scanning abilities are enhanced by AI literacy.

Enhanced decision-making with data

An additional competency gained was improved decision-making of the respondents. By using AI-based tools for analysis, students are gradually transitioning from intuition to data-informed decisions, according to participant 3. Participant 4 said, “Even though they are still beginners in analytics, they now show more openness to interpreting insights.” Participant 4 added, “This competency will grow as more AI-related activities are embedded into coursework.” It aligns with findings that exposure to AI tools can enhance data-driven

decision-making among entrepreneurs (Brynjolfsson and McAfee 2017). Students' gradual transition suggests a positive trajectory toward evidence-based practices.

Innovation and prototyping skills

All participants acknowledged the creative development that the students had gained while taking entrepreneurship courses. "When entrepreneurship students propose AI-based prototypes through their product development" Also Participant 5 stressed, "their ability to combine entrepreneurship with AI ideas is a promising skill." Participant 2 added, "Although execution is limited, they demonstrate adaptability and creativity in conceptualizing immediate answers to the problems and new and doable innovative business ideas."

Researchers observe that even simple prototype activities increase the potential for creativity and entrepreneurial resilience (Neck et al. 2014). Moreover, the experiences gained by the students' strengthen self-efficacy in pursuing innovation despite limitations.

Collaborative and research-oriented mindset

Finally, collaboration and research orientation were highlighted. Participant 2 observed, "Students are learning through collaboration with Information Technology savvy in order to strengthen their developed business plan and other academic requirements." Participant 4 mentioned, "group projects encourage them to appreciate teamwork across various programs in the institution by asking support." They demonstrate a commitment to enhance their research methods, particularly when collaborating with peers in technical domains, said Participant 3. Participant 5 came to the conclusion that "these collaborative tendencies are essential for AI-driven entrepreneurship, where cross-disciplinary knowledge is the key." This is in line with research that emphasizes teamwork as a key component of AI-powered business ecosystems (Nambisan et al. 2019). Students are better prepared for the realities of digital entrepreneurship when they collaborate across disciplinary boundaries.

Challenges affect entrepreneurship students' competencies in innovating their business ideas using Structural Equation Modeling (SEM)

The researcher utilized the structural equation modeling (SEM) analysis to examine the challenges affecting entrepreneurship students' competencies in innovating their business ideas. The model yielded

mixed fit indices, with an SRMR of 0.199 and RMSEA of 0.121 (90% CI = 0.111–0.130, $p < .001$). Hu and Bentler (1999) state that an SRMR below 0.08 and an RMSEA below 0.06 indicate a good model fit. The results suggest that while the hypothesized model provides some explanatory value, the fit indices indicate the need for refinement in the measurement of constructs or in the structural paths.

Despite the limitations in model fit, several significant paths highlight the key challenges influencing student competencies. The opportunity identification identified by the study are critical element, revealing that students frequently struggle to identify feasible AI-driven entrepreneurial prospects due to a lack of exposure to modern technology, weak market scanning abilities, and limited access to data. The results are in line with prior studies that highlight the difficulties in identifying opportunities in startups using AI technology (George et al. 2021; Shah and Murtaza 2020).

Problems with decision-making also significantly affected competencies, showing that students find them challenging to balance instinctive judgments with data-driven insights. The findings are in line with other research that highlighted the difficulty of identifying opportunities in AI-powered entrepreneurial settings (George et al. 2021; Shah and Murtaza 2020).

Decision-making challenges also significantly affected competencies, indicating that students struggle to balance data-driven insights with intuitive judgments. The inability to use AI technologies for strategic decision-making or cognitive overload could be the cause of this challenge. According to Dwivedi et al. (2021), who discovered similar findings, incorporating AI into entrepreneurship necessitates higher-order analytical thinking, which many students have not yet fully mastered.

Competencies were further limited by performance-related issues, especially when it came to converting creative concepts into workable business solutions. It supports the claim made by Maroufkhani et al. (2022) that technical expertise and entrepreneurial agility—two qualities that may be lacking in student populations—are essential for success in AI-enabled enterprises.

Educational and learning-related factors were also significant. Many students lacked sufficient training on AI applications, reflecting gaps in curriculum design and practical exposure. Literature supports this finding, as previous studies have argued that the absence of experiential and interdisciplinary learning environments hinders

entrepreneurship students' capacity to innovate with emerging technologies (Secundo et al. 2021; Li et al. 2022).

Research and application challenges also played a considerable role in shaping competencies. Due to a lack of resources, mentorship, and case-based projects, students frequently expressed difficulty connecting theoretical AI concepts to actual business challenges. Previous studies have confirmed that students are ill-prepared for AI-driven innovation since entrepreneurial education frequently lags behind industry improvements (Nambisan 2017; Kraus et al. 2022).

Conclusion

Based on the findings of the study, the following conclusions and recommendations are drawn.

AI holds promise for opportunity identification and evaluation; challenges continue in market understanding and aligning AI functionalities with the entrepreneurial needs of the BS Entrepreneurship students. The results call for integrative educational frameworks and entrepreneurial ecosystems that build technological and market competencies. It is also a valuable decision-support tool for aspiring entrepreneurs and BS Entrepreneurship students, but skill gaps, performance measurement, system complexity, and output consistency exist. With the identified challenges it can be addressed through contextualized-entrepreneurship education, system design improvements, and inclusive evaluation frameworks will be essential to fully harness AI's potential in entrepreneurial decision-making and performance management. Although public higher education students and instructors acknowledge the value of AI in business creation, they encounter major obstacles with regard to systemic readiness, mentorship access, and entrepreneurship curricula. Nonetheless, platforms powered by AI and focused educational initiatives offer encouraging avenues for overcoming these obstacles. For sustainable entrepreneurial growth, education systems must adopt a proactive approach in integrating AI into learning, ensuring that students are equipped with the competencies required for AI-driven startup ecosystems.

While entrepreneurs value AI for startup development, challenges remain in access, application, and the practical translation of research into business innovation. Incorporating AI into long-term entrepreneurial ecosystems will need addressing these issues through improved resource accessibility, case-based learning, faculty

development, and innovative tactics. AI significantly enhances entrepreneurial competencies, particularly in opportunity recognition, customer targeting, decision-making, and analytical thinking. Although communication and technical skills improved, additional in-depth, hands-on learning is required to improve problem-solving and prototype-building skills. These skills demonstrate how crucial AI is in developing entrepreneurs that are prepared for the future and can innovate in fast-paced, technologically advanced marketplaces.

The SEM results revealed that challenges in opportunity identification, decision-making, performance execution, education and learning, and research application significantly constrain entrepreneurship students' competencies in innovating their business ideas. Despite the model's lack of high fit indices, the main paths demonstrate persistent disparities in students' ability to integrate AI into entrepreneurial innovation. These findings show that while students are excited about technology-driven activities, their entrepreneurial competencies are nevertheless hindered by institutional, pedagogical, and practical limitations. The study underscores the need for universities and policymakers to strengthen AI-oriented entrepreneurship education to equip students for innovation in the digital economy.

Recommendations

AI-focused modules that stress both technical and entrepreneurial aspects may be incorporated into higher education entrepreneurship programs. Students may be exposed to real-world innovation challenges through case-based projects, hackathons, and interdisciplinary collaborations.

Simulations, AI-powered business modeling tools, and startup incubator programs are examples of more immersive techniques that higher education may use to give students real-world experience making decisions, solving problems, and coming up with ideas. Students can gain access to mentorship, up-to-date data resources, and new market trends through closer cooperation with AI specialists and industry practitioners. These collaborations will enhance the use of AI in business endeavors and the identification of opportunities.

Programs for faculty development on AI applications in business and entrepreneurship are crucial for ensuring that teachers are equipped to mentor students successfully. Higher education institutions may establish innovation hubs and accelerators that provide students

with resources, mentorship, and networking opportunities. These ecosystems can bridge the gap between classroom learning and market application. Policymakers should support entrepreneurship education reforms by funding research labs, incentivizing AI-integrated business curricula, and promoting public-private partnerships that foster innovation among students.

Output

- Conduct a series of capability-building activities on AI tools for faculty and students
- Acquisition of AI tools to be utilized by faculty and students (at least two AI tools)
- Integration of AI in business plan preparation and other academic-related activities
- Academic policy on the use of AI

Technology transfer activity conducted

- Knowledge transfer on AI to faculty and students (capability-building activities)
- Knowledge transfer on AI to be adopted and Department of Labor and Employment /Philippine National Police-assisted groups

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