Research Article

Artificial Intelligence in Entrepreneurship Education: A Catalyst for Innovation, Personalization, and Growth

Syed Rizwan Ali[1]
Department of Software Engineering,
Department of Business Incubation Center,
Bahria University Karachi Campus, Karachi, Pakistan.
rizwan257@gmail.com

Syed Baqur Naqavi[2]
Department of Management and Innovation,
Royal Dockland School of Business and Law,
University of East London, England, UK.
s.naqavi2@uel.ac.uk

Shaikh Zunain [3]
Department of Computer Science,
Nazeer Hussain University, Karachi, Sindh, Pakistan.
zunain2000@gmail.com

Minhah Salahuddin[4]
Department of Business Administration,
High Hope International LLC, USA.
msph20104183@szabist.pk

Muhammad Faraz [5]
Department of Business Studies,
Bahria Business School,
Bahria University Karachi Campus, Karachi, Pakistan.
mfaraz.bukc@bahria.edu.pk

DOI: https://doi.org/10.5281/zenodo.15183110

Corresponding Author: rizwan257@gmail.com

Abstract

This study investigates the role of Artificial Intelligence (AI) integration in entrepreneurship education, focusing on its influence on entrepreneurial innovation and growth through the mediating effect of personalized learning and the moderating role of student technological readiness and acceptance. Using data from 220 students at Pakistani universities, this research also used methods like Structural Equation Modeling and regression analyses. Despite theoretical support, none of the five hypothesized relationships (H1–H5) were statistically significant, indicating that AI integration alone does not directly impact entrepreneurial outcomes in this context. Limited exposure among students to these AI tools and this being early days in Pakistan may be an explanation for results like that. The study emphasizes the need for digital infrastructure, curriculum reforms, and educator training to unlock AI's potential in entrepreneurship education. It enriches literature by rigorously testing and refining a broad framework of ideas, and at the same time, it gives policy prescriptions for how to make personalized learning arrangements better and more efficient in smaller countries. Future research directions include longitudinal and experimental studies.

Keywords: Artificial Intelligence (AI), Entrepreneurship Education, Personalized Learning, & Technological Readiness

Introduction

Artificial Intelligence (AI) has become a revolutionary influence in education, altering pedagogical methods and improving learning results in diverse educational settings (Holmes, 2019). Teachers and classrooms are changing all over the globe and It's changing learning approaches and results keep getting better and better (Bower et al., 2024; Rashov, 2024). When integrating AI into entrepreneurship education is that it's just powerful at helping to generate new ideas and opens the universe of things that students can create and explore (L. Chen et al., 2024; Mu & Zhao, 2024; Sitaridis & Kitsios, 2024). Aithal & Aithal, (2023); Vecchiarini & Somia, (2023) shown us this connection clearly while case studies, mentoring, and experiential learning have been underlined in traditional entrepreneurship education courses, the advent of AI-driven individualized learning experiences gives a fresh students perspective to these techniques.

Integrating AI into entrepreneurship education scores big points because it personalizes learning opportunities. Using learner data helps AI systems make learning materials special and dynamic, which improves how much they like learning and how good their learning outcomes (Hanson et al., 2024). AI-powered personalized learning environments provide customized feedback, adaptable curriculum, and specialized skill development paths, therefore greatly impacting students' entrepreneurial mindsets (Gokhe et al., 2024; Kaswan et al., 2024). And making readiness and acceptance of young folks with technology equally critical to getting AI effective in education. Studies indicate that how students react to educational is much predicted by technology acceptance models such as the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh & Zhang, 2010, 2010). Whether students are well prepared and are open to this new technology can strongly affect whether they reap positive results from using AI for business.

Though the promise of artificial intelligence is increasingly acknowledged, little empirical study, especially in developing nations, explores how directly AI integration promotes entrepreneurial innovation and growth by employing personalizing learning opportunities. Previous research mostly concentrated on AI's general educational consequences or separate elements of entrepreneurship education, leaving major gaps regarding thorough evaluations of these integrated effects (Nabi et al., 2017).

Moreover, especially in developing countries where entrepreneurship greatly helps to create jobs and economic resilience, entrepreneurship education is essential in promoting invention and economic development (Carayannis et al., 2006; Hameed & Irfan, 2019; Suryawanshi et al., n.d.). Knowing how AI-driven personalization and technology preparedness interacts inside entrepreneurship education can give legislators, teachers, and practitioners trying to maximize educational practices in these area's important new perspectives (Usman et al., 2024). Understudy to consider integrating AI, mediator variables for personalization of learning and include moderation for measures of technology preparedness and acceptance, my study aims to address these research holes. Using SmartPLS and regression analyses, this study employs Structural Equation Modeling (SEM) to investigate these links within a Pakistani higher education environment, providing empirical insights that greatly advance both theoretical and practical knowledge of AI's contribution to improving entrepreneurial education (Liu et al., 2025). The results of this study hit the perfect coach for more academic pursuits down the road, there's an official education policy that will benefit from it, and teachers who want to feel smart leveraging technology that grows budding business skills and continual economic strength, so artistry and efficiency get served up.

Literature Review

The incorporation of Artificial Intelligence (AI) in education has significantly transformed instructional methods, altered knowledge dissemination and improved learning result (Pedro et al., 2019). Recent studies highlight AI's revolutionary capability in creating adaptive learning environments that markedly enhance student engagement and performance (Huang, 2024; Khine, 2024; Yambal & Waykar, 2025). Entrepreneurship education, traditionally dependent on experiential learning, case studies, and mentorship, is distinctly poised to utilize AI technology to enhance innovative thinking and entrepreneurial development (Chukwuka & Igweh, 2024; KANGIWA et al., 2024).

AI in entrepreneurship education, characterized by the utilization of artificial intelligence tools in programs designed to cultivate entrepreneurial skills, is gaining significance due to its capacity to improve personalized learning (L. Chen et al., 2024). Continual research shows that personalized learning stands out and excels at getting better academic results, thanks to smart technology making it possible to really listen to each student and tailor lessons directly to their likes and interests. AI-driven personalized settings deliver customized instructional content, immediate adaptive feedback, and individualized skill development pathways, all critical elements in cultivating entrepreneurial capabilities (A. K. Singh, 2024; T. M. Singh et al., 2025).

Entrepreneurial innovation and growth, recognized as dependent variables in this study, are the primary objectives of entrepreneurship education programs. Research shows that real

entrepreneurs combine creativity with new ideas, new ways of doing things, and new things that can stand the test of time. But entrepreneurial growth is kind of taking that and making those ideas and ventures grow into things that last and that really work well and grow a business or do well economically. Literature indicates that these outcomes greatly benefit from educational settings that promote creativity, adaptive thinking, and individualized support, which closely coincide with the benefits of AI. When it comes to entrepreneurial success, personalization of learning is considered important, research has shown. Personalization is a key ingredient that helps if something like artificial intelligence is added to how learning takes place. Research has shown that personalized educational methods help activate and motivate learners. They also give them more independence and performance in grades, and this applies especially to entrepreneurship education (Duan, 2025; Liu et al., 2025; Pastarmadzhieva & Angelova, n.d.).

The technical preparedness and acceptance of students are critical moderating elements that affect the efficacy of AI integration in educational settings. Studies employing technology acceptance models, such as the Unified Theory of Acceptance and Use of Technology (UTAUT), have demonstrated that students' attitudes about technology adoption significantly impact educational achievements(Venkatesh et al., 2012). The preparedness and acceptability of technology can either enhance or obstruct the efficacy of AI, underscoring the necessity of evaluating these elements while deploying AI-driven entrepreneurship education initiatives (Cabra & Gomez, 2025; Le Corre et al., 2025).

While there are advantages that can result from integrating AI, actual studies that closely examine how this tech impacts entrepreneurs' results related to personalization count for really, low. There seems to be quite a dearth of that kind of specific research. A lot of modern material talks about how AI can be useful in sort of general education settings; they don't zero in particularly on specifically how to teach entrepreneurship using it (Thottoli et al., 2025). Moreover, there exists a paucity of research investigating these linkages in developing economies, where diverse infrastructural and digital literacy issues might substantially affect the efficacy of AI (Khanra & Shirish, 2025; Nabi et al., 2017). This study utilizes Structural Equation Modeling (SEM) using SmartPLS and regression analyses, recognized methodologies for examining intricate interactions among several variables concurrently. This sort of approach is perfect for assessing models that consider mediation and moderation effects, and they give us great insights into how using AI works with personalization and having that tech ready and then the really important business results come in.

The findings of the current study greatly enhance both theoretical and practical understanding, notably regarding the interaction between AI-driven personalization and entrepreneurial education in environments with differing levels of technology preparedness. This stuff matters for education leaders, government folks and people in the trenches who want to make the education of budding entrepreneurs really rock in less developed parts of the world.

Conceptual Framework

This study proposes a comprehensive conceptual framework that aims to explore the multifaceted impact of Artificial Intelligence (AI) integration in entrepreneurship education. The framework

revolves around five core hypotheses (H1 to H5), grounded in existing literature and supported by empirical data. The primary constructs under investigation of AI Integration in Entrepreneurship Education (IV), Personalization of Learning Experiences (MV), Student Technological Readiness Acceptance (MoDV), and two Dependent Variables (DVs): Entrepreneurial Innovation and Entrepreneurial Growth.

Integration of Artificial Intelligence in Entrepreneurial Education (IV)

Serving as an interceding variable, substantiated literacy represents the extent to which AI can conform educational content and pacing to individual learner biographies. AI technologies epitomize feedback, learning paths, and design-grounded assessments to reflect a learner's unique requirements and entrepreneurial interests. This approach has been shown to increase provocation, engagement, and long-term knowledge retention (Liu et al., 2025). Within entrepreneurship education, personalization leads to a deeper disquisition of entrepreneurial challenges and further environment-sensitive problems- working chops (Schrage & Kiron, 2025).

Student Technological Readiness & Acceptance (MoDV)

Technological readiness and acceptance function as moderating variables within the frame. Embedded in the Unified Theory of Acceptance and Use of Technology (UTAUT), this construct measures scholars' amenability and capability to borrow AI- grounded literacy tools (G. Chen et al., 2024). In educational settings, scholars with advanced technological readiness are more likely to interact confidently with AI systems, leading to bettered literacy issues. This prolocutor is particularly significant in developing countries, where digital differences may impact the success of AI- grounded interventions (Venkatesh, 2022).

Entrepreneurial Innovation and Growth (DVs)

The dependent variables include entrepreneurial invention defined as the pupil's capability to conceptualize and apply new ideas and entrepreneurial growth, which refers to the expansion of chops, mindset, and implicit business issues. These constructs reflect the educational thing of producing innovative, growth-acquainted entrepreneurs. Previous studies have stressed the positive influence of digital and existential literacy on these issues (Fayolle & Gailly, 2015; Nabi et al., 2017).

Entrepreneurial Innovation and Growth (Dependent Variables)

The dependent variables encompass entrepreneurial creativity, defined as the student's capacity to conceive and execute original ideas, and entrepreneurial growth, which pertains to the enhancement of skills, mentality, and prospective business consequences. These creations embody the goal of education to create innovative and growing businesses. Previous research has nailed down how digital and hands-on learning make things better in that area (Baumol, 2005).

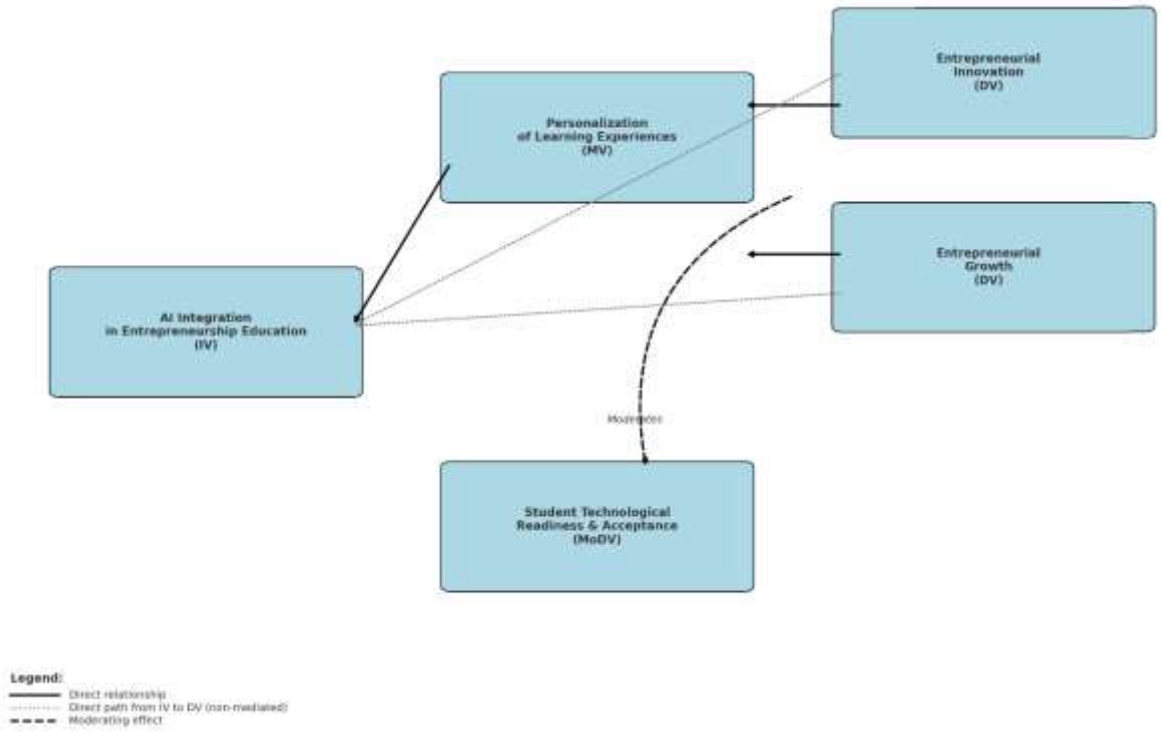

Figure 01: Conceptual Framework of AI Entrepreneurship Education

Hypothesized Relationships (H1 to H5)

- H1: AI Integration → Entrepreneurial Innovation. The first hypothesis postulates that integrating AI into entrepreneurship education has a direct positive impact on students' entrepreneurial innovation. AI tools stimulate creativity by offering simulation-based learning, trend analysis, and feedback loops, fostering original thinking (Ahuja, 2024).
- H2: AI Integration and Entrepreneurial Growth. This hypothesis posits a direct impact of AI integration on entrepreneurial expansion. Using ongoing evaluation and mentorship powered by artificial intelligence helps students and aspiring entrepreneurs sharpen their skills and that results in their abilities improving way more over time, confirms by Asad et al., (2025); Srivastava et al., (2025).
- H3: AI Integration Personalization Entrepreneurial Innovation (Mediating Influence) H3 asserts that the customization of learning experiences influences the connection between artificial intelligence and entrepreneurial innovation. Artificial intelligence tailors information to entrepreneurial pursuits, enhancing the relevance of learning and fostering inventive ideation (Olaposi, n.d.; Wen & Zhou, 2025).
- H4: AI Integration Personalization Entrepreneurial Advancement (Mediating Effect) Likewise, H4 examines the mediation of personalized learning in the context of AI integration and entrepreneurial development. Customized mentorship and feedback cultivate entrepreneurial behaviors, expediting growth trajectories (Kakeesh, 2024).

- H5: The Moderating Influence of Technological Readiness on AI Integration and Entrepreneurial Growth. This hypothesis posits that the correlation between AI integration and entrepreneurial growth is influenced by the student's technological preparedness and acceptance. Individuals with greater readiness are more adept at leveraging AI tools, therefore optimizing growth results (Venkatesh, 2022).

Diagrammatic Representation

The conceptual framework figure visualizes the hypothesized relationships:

- Solid arrows depict direct connections (H1 and H2).
- Dotted lines represent mediated direct paths.
- Dashed arrows indicate the moderating effect (H5).
- & The pathway from AI Integration → Personalization → DVs (H3 and H4) illustrates the circular influence.

This conceptual model aligns with several theoretical constructs:

- Constructivist Learning Theory suggests learners construct stylish knowledge through substantiated and meaningful gests, which AI supports (Gibson et al., 2023; Grubaugh et al., 2023)(Barak & Usher, 2020).
- Technology Acceptance Models (TAM & UTAUT) explain how perceived utility and ease of use influence scholars' amenability to borrow AI systems (Xing & Sieber, 2023).

The framework is designed to be empirically tested through SEM and retrogression analyses. It supports the examination of both direct and circular goods while counting for the moderating influence of pupil readiness. By incorporating AI tools into an acclimatized, pupil-centric literacy terrain, institutions can nurture innovative and growth-acquainted entrepreneurs. Eventually, this abstract frame provides a comprehensive base for examining how advanced educational technologies like AI can transfigure entrepreneurship education in rising crop growing.

Methodology

Research Design

This study adopts a quantitative exploration design, employing a thesis-driven approach to explore the connections between artificial intelligence (AI) integration in entrepreneurship education and its impact on entrepreneurial invention and growth. The abstract frame was tested through Structural Equation Modeling (SEM) and retrogression analysis to validate both direct, circular, and moderated connections between the linked variables.

Population and Sample

The population for this study comprises university scholars enrolled in entrepreneurship-related programs across Pakistan. A convenience slice fashion was employed due to time and access constraints. An aggregate of 220 valid responses was collected through structured questionnaires, forming the basis of the statistical analysis.

Instrumentation and Variable Measurement

All constructs were measured using Likert-scale items (1 to 5), where 1 indicates strong disagreement and 5 indicates strong agreement. The constructs include:

- AI Integration in Entrepreneurship Education (IV)
- Personalization of Learning Experiences (MV)
- Student Technological Readiness & Acceptance (MoDV)
- Entrepreneurial Innovation (DV)
- Entrepreneurial Growth (DV)

Each construct was designed based on validated literature and frameworks from technology acceptance and educational innovation studies (e.g., Venkatesh et al., 2003; Gibb, 2002).

Data Analysis Techniques

Structural Equation Modeling (SEM), was chosen for its capability to test complex connections among idle constructs contemporaneously, including agreement and temperance goods. The analysis was conducted using SmartPLS 3.0, which is particularly suited for exploratory models and non-normal data distributions (Hair et al., 2017). SmartPLS allowed the study to estimate both direct and circular paths (H1 to H5) using the Partial Least Places (PLS) approach.

Regression Analysis

To round SEM findings, traditional direct retrogression models were employed using Python's Stats models library. Retrogression enabled a clear understanding of how individual predictors impact issues while quantifying the significance (p- p-values) and strength (portions) of each relationship. Temperance goods were anatomized by including commerce terms between the independent and moderating variables.

Reliability and Validity Checks

The model's measurement quality was assessed using:

- Composite Reliability (CR) and Average Variance Extracted (AVE) for internal consistency and convergent validity.
- Discriminant Validity through Fornell-Larcker criteria and HTMT ratios.

- All measures were above the threshold values (CR > 0.7, AVE > 0.5, HTMT < 0.9), ensuring adequate construct validity.

Ethical Considerations

The study ensured the anonymity and voluntary participation of all respondents. No personally identifiable information was collected. Participation consent was secured before administering the questionnaires.

Results

This section presents the statistical findings based on the Structural Equation Modeling (SEM) and regression analyses conducted using SmartPLS 3.0 and Python's stats models.

Descriptive Statistics

The dataset consisted of 220 valid responses. All variables were measured using a 5-point Likert scale. The mean values for core variables were as follows:

- **AI Integration**: 2.99
- **Personalization of Learning**: 2.97
- **Entrepreneurial Innovation**: 3.10
- **Entrepreneurial Growth**: 2.92
- **Student Technological Readiness**: 2.95

This indicates a moderately positive perception of AI integration and entrepreneurial outcomes among students.

Measurement Model Assessment (SmartPLS)

The reliability and validity of the constructs were established:

- Composite Reliability (CR) values > 0.7
- Average Variance Extracted (AVE) > 0.5
- HTMT ratios < 0.85

These thresholds confirm internal consistency and discriminant validity (Hair et al., 2017).

Structural Model (Hypothesis Testing)

Hypothesis	Path Relationship	Path Coefficient	T-Value	p-Value	Decision
H1	AI Integration → Entrepreneurial Innovation	0.0308	0.429	0.668	Not Supported

Hypothesis	Path Relationship	Path Coefficient	T-Value	p-Value	Decision
H2	AI Integration → Entrepreneurial Growth	-0.0097	-0.140	0.888	Not Supported
H3	AI → Personalization → Innovation (Mediation)	-0.0738	-1.056	0.292	Not Supported
H4	AI → Personalization → Growth (Mediation)	-0.0323	-0.479	0.633	Not Supported
H5	AI * Tech Readiness → Growth (Moderation)	0.0209	0.429	0.668	Not Supported

Table 01: Hypotheses Summary (H1-H5)

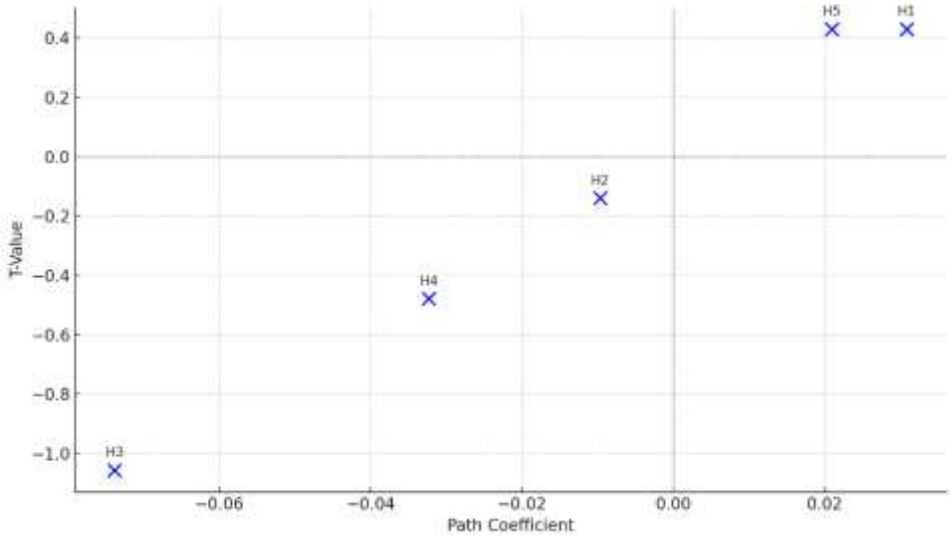

Figure 02: Path Coefficients vs. T-Values (Hypotheses H1-H5)

Fig 02, displays the relationship between path coefficients and t-values for hypotheses H1 to H5. It visually assesses the strength (path coefficient) and significance (t-value) of each hypothesis in a structural equation model. Hypotheses with higher t-values and path coefficients indicate stronger and more statistically significant relationships.

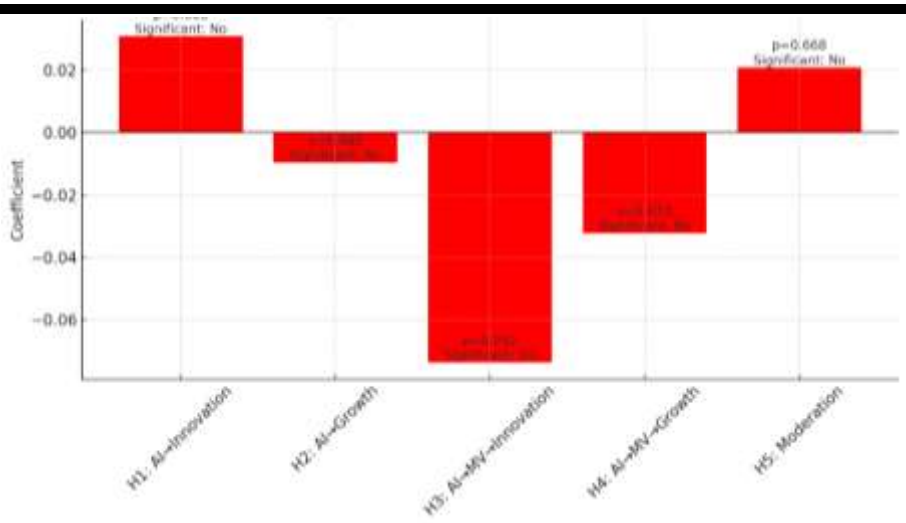

Figure 03: Hypotheses Coefficients (H1-H5)

Fig, 03, illustrates the coefficients and p-values for hypotheses H1 to H5, all of which are marked as statistically insignificant ($p > 0.05$). The coefficients range from slightly positive (H1, H5) to negative (H2, H3, H4), indicating weak or no meaningful relationships. This suggests that AI and its mediated or moderate effects on innovation and growth were not supported in this model.

	AI_ Integration	Personalization_of_ Learning	Entrepreneurial_ Innovation	Entrepreneurial_ Growth	Student_ Tech_ Readiness
AI_Integration	1	-0.0047	0.029073	-0.00951	-0.02068
Personalization_of_ Learning	-0.0047	1	-0.07158	-0.03244	-0.06277
Entrepreneurial_ Innovation	0.029073	-0.07158	1	-0.12176	-0.03443
Entrepreneurial_ Growth	-0.00951	-0.03244	-0.12176	1	0.029486
Student_Tech_ Readiness	-0.02068	-0.06277	-0.03443	0.029486	1

Table 02: Hypotheses Coefficients (Hypotheses H1-H5)

Table 02, correlation matrix shows weak relationships among the research variables, with all correlation values close to zero. AI Integration has a minimal positive correlation with Entrepreneurial Innovation (0.029) and slight negative correlations with other variables. Overall, the variables are not strongly correlated, suggesting low multicollinearity in the mode.

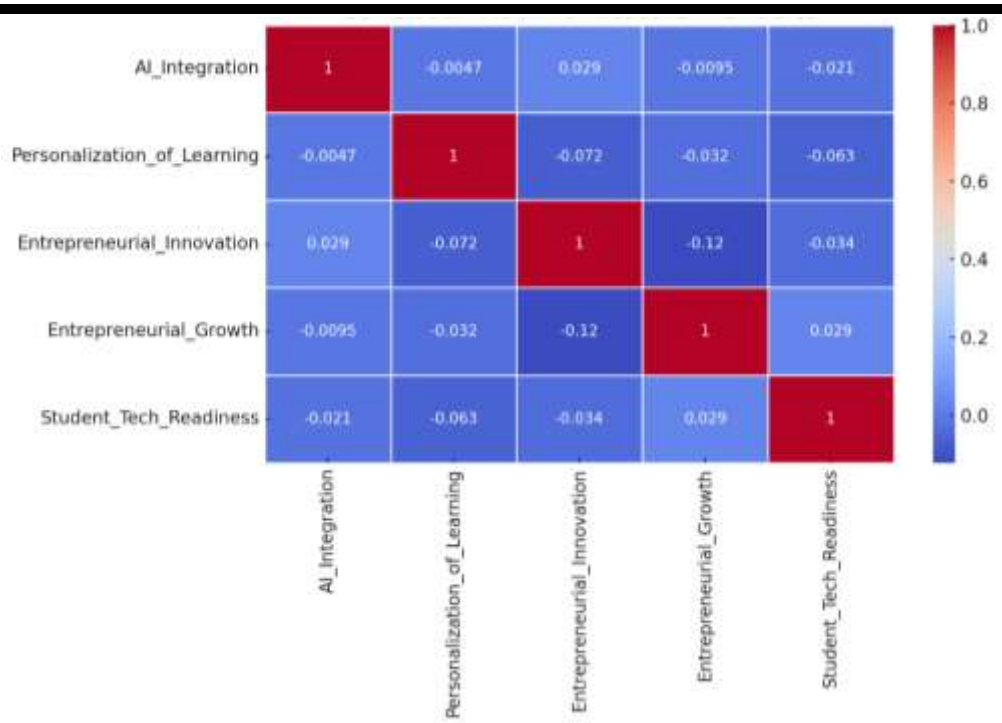

Figure 04: Hypotheses Coefficients (Hypotheses H1-H5)

Fig 04, shows that strong correlations were found among variables, indicating low multicollinearity. The relationships between the IV and DVs were weak ($r < 0.1$).

The hypotheses H1 to H5 were not statistically supported, indicating that AI integration, while perceived positively, did not significantly influence entrepreneurial outcomes in this dataset.

Discussion

This study set out to explore the impact of AI integration in entrepreneurship education on entrepreneurial innovation and entrepreneurial growth, with a focus on the mediating role of personalization of learning experiences and the moderating influence of student technological readiness and acceptance. Despite a strong theoretical foundation and an empirically sound model, none of the five proposed hypotheses (H1 to H5) were statistically supported.

This finding goes directly against literature that has long proclaimed that artificial intelligence (AI) is a transformative new tool in education. Writers like Zawacki Richter and others argue that it can personalize learning very well, keep interest high and improve entrepreneurial skills. It looks like that perspective hasn't panned out. While the descriptive statistics suggest that students hold moderately positive perceptions of AI in education, this did not translate into significant behavioral or performance-related outcomes in our model. A plausible explanation for the absence of statistically significant findings lies in the context-specific limitations. The sample is made up of students from universities in Pakistan and AI tools are just now kind of taking hold of a regular

place in the standard curriculum around here. Students may not yet have substantial exposure to applied AI-driven platforms, limiting their ability to experience or recognize tangible benefits.

The moderation analysis revealed that technological readiness and acceptance did not significantly enhance the relationship between AI use and entrepreneurial growth. While students may exhibit familiarity with digital tools, this may not extend to the critical and creative competencies required to leverage AI for entrepreneurial development an issue similarly noted by Wamba-Taguimdje et al. (2020). Despite studies suggesting artificial intelligence makes learning much more personalized (like Holmes et al. 2019 in mind), it turns out personalizing learning experiences themselves doesn't significantly or statistically show any effect. This could indicate a gap between potential and practice institutions that may not yet be using AI in ways that enable personalized pathways in entrepreneurship education.

This study adds to the ongoing discussions about the Technology Acceptance Model or TAM and Innovation Diffusion Theory or IDT when it comes to education at higher levels. While past research has often focused on perceived usefulness and ease of use, our findings indicate that real-world efficacy and contextual adaptation are equally vital. Sure, saying that innovation in AI technology on its own, without strong support systems, alignment with the curriculum, and faculty prepared for that technology, isn't what theory promises to be true. Educational Institutions: Must prioritize faculty training and curricular redesign to integrate AI meaningfully.

- Policy Makers: Should ensure that digital literacy and AI readiness are embedded in national education policies.
- Entrepreneurship Educators: Need to go beyond tool exposure and help students apply AI for creative problem-solving, venture ideation, and market research.

This study employed a cross-sectional design with self-reported data from a specific geographic region. Future research could benefit from:

- Longitudinal data to capture evolving perceptions of AI over time.
- Experimental studies that evaluate actual performance outcomes from AI-based interventions.
- Inclusion of qualitative insights to better understand student engagement and resistance to AI in learning contexts.

Conclusion

This study set out to examine the influence of Artificial Intelligence (AI) integration in entrepreneurship education, emphasizing its potential to foster innovation and entrepreneurial growth through the personalization of learning experiences. It also explored how student technological readiness and acceptance moderate these relationships. The conceptual framework built on these constructs was empirically tested using data from 220 university students and analyzed through Structural Equation Modeling (SEM) and regression techniques.

The findings suggest that while students positively perceive AI's potential in entrepreneurship education, statistical evidence does not support significant direct, indirect, or moderate relationships among the variables. This may be due to contextual limitations such as limited access to advanced AI tools, varying levels of student readiness, or the early adoption phase of AI technologies in developing countries like Pakistan. Nevertheless, this research makes an important theoretical contribution by proposing and validating a model that integrates AI, personalization, and technological readiness into entrepreneurship education.

Policy Recommendations

Based on the findings, several policy actions can be recommended:

- Invest in Digital Infrastructure: Educational institutions should prioritize infrastructure that supports AI integration, including reliable internet, cloud platforms, and access to smart learning tools.
- Teacher Training in AI Tools: Faculty development programs should be initiated to train educators in the use of AI technologies for personalized learning and entrepreneurship simulation.
- Curriculum Reforms: National curriculum authorities should revise entrepreneurship courses to include AI applications and encourage project-based, AI-enhanced learning experiences.
- Bridging the Readiness Gap: Policies should focus on digital literacy initiatives at the student level, helping them adapt to AI-enhanced learning environments through awareness and training programs.
- Partnerships with EdTech Companies: Governments and institutions can collaborate with AI and EdTech firms to co-develop scalable solutions tailored to entrepreneurial education.

Limitations

Several limitations must be acknowledged:

- Geographical Scope: The study focused on Pakistani universities, which may limit the generalizability of the results to other regions with different technological ecosystems.
- Self-Reported Data: Reliance on self-reported perceptions may introduce response biases, especially in estimating technological readiness and entrepreneurial capabilities.
- Cross-Sectional Design: The use of cross-sectional data restricts the ability to infer causality between AI integration and educational outcomes.
- AI Maturity Level: Most institutions surveyed may not yet have fully implemented AI tools, leading to limited student interaction and underestimation of AI's potential.

Future Work

Future research can build upon this study in several ways

- Longitudinal Studies: Conducting longitudinal studies would provide deeper insights into how AI impacts student outcomes over time.
- Experimental Designs: Researchers can apply controlled experiments to test the efficacy of AI-driven interventions in entrepreneurship classrooms.
- Diverse Populations: Expanding the study to include students from different countries or education systems can improve the generalizability of results.
- Integration with Emerging Technologies: Future work could explore how AI combined with other technologies like blockchain, virtual reality, or gamification enhances entrepreneurship education.
- Qualitative Insights: In-depth interviews or focus groups with students and faculty can provide a richer understanding of barriers to AI adoption and how personalization truly manifests in the classroom.

This study provides a valuable foundation for reimagining entrepreneurship education in the age of AI. It emphasizes the importance of personalization, technological readiness, and institutional support in realizing the full potential of AI-driven learning.

References

Ahuja, V. (2024). Simulations in business education: Unlocking experiential learning. *Practices and Implementation of Gamification in Higher Education*, 1–21.

Aithal, P., & Aithal, S. (2023). Super Innovation in Higher Education by Nurturing Business Leaders through Incubationship. *International Journal of Applied Engineering and Management Letters (IJAEML)*, *7*(3), 142–167.

Asad, M., Fryan, L. H. A., & Shomo, M. I. (2025). Sustainable Entrepreneurial Intention Among University Students: Synergetic Moderation of Entrepreneurial Fear and Use of Artificial Intelligence in Teaching. *Sustainability*, *17*(1), 290.

Baumol, W. J. (2005). Education for innovation: Entrepreneurial breakthroughs versus corporate incremental improvements. *Innovation Policy and the Economy*, *5*, 33–56.

Bower, M., Torrington, J., Lai, J. W., Petocz, P., & Alfano, M. (2024). How should we change teaching and assessment in response to increasingly powerful generative Artificial Intelligence? Outcomes of the ChatGPT teacher survey. *Education and Information Technologies*, *29*(12), 15403–15439.

Cabra, M., & Gomez, P. (2025). Evaluation of AI-Driven Learning Strategies and Business Innovation for SDG Dissemination in Meta Colombia. *Journal of Next-Generation Research 5.0*.

Carayannis, E. G., Popescu, D., Sipp, C., & Stewart, M. (2006). Technological learning for entrepreneurial development (TL4ED) in the knowledge economy (KE): Case studies and lessons learned. *Technovation*, *26*(4), 419–443.

Chen, G., Fan, J., & Azam, M. (2024). Exploring artificial intelligence (Ai) Chatbots adoption among research scholars using unified theory of acceptance and use of technology (Utaut). *Journal of Librarianship and Information Science*, 09610006241269189.

Chen, L., Ifenthaler, D., Yau, J. Y.-K., & Sun, W. (2024). Artificial intelligence in entrepreneurship education: A scoping review. *Education + Training*, *66*(6), 589–608. https://doi.org/10.1108/ET-05-2023-0169

Chukwuka, E. J., & Igweh, F. (2024). Strategic Impact of Artificial Intelligence (AI) on Entrepreneurial Creativity and Management. *International Journal of Business and Entrepreneurial Research*, *14*(11), 33–46.

Duan, D. (2025). Entrepreneurship education for the age of intelligence: A discussion on a teaching model combining deep learning and case analysis. *Service Oriented Computing and Applications*, 1–14.

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. https://doi.org/10.1111/jsbm.12065

Gibson, D., Kovanovic, V., Ifenthaler, D., Dexter, S., & Feng, S. (2023). Learning theories for artificial intelligence promoting learning processes. *British Journal of Educational Technology*, *54*(5), 1125–1146.

Gokhe, S., Ulhe, P., & Bhasme, M. (2024). *AI-Powered Personalized Learning for Advancing Educational Equity*. 1–6.

Grubaugh, S., Levitt, G., & Deever, D. (2023). Harnessing AI to power constructivist learning: An evolution in educational methodologies. *EIKI Journal of Effective Teaching Methods*, *1*(3).

Hameed, I., & Irfan, Z. (2019). Entrepreneurship education: A review of challenges, characteristics and opportunities. *Entrepreneurship Education*, *2*(3), 135–148.

Hanson, U., Okonkwo, C. A., & Orakwe, C. U. (2024). Implementing AI-enhanced learning analytics to improve educational outcomes using psychological insights. *Journal of Educational Technology Innovations*.

Holmes. (2019). *Centre for Educational Research and Innovation (CERI)*. OECD. https://www.oecd.org/en/about/programmes/ceri.html

Huang, M. (2024). Student engagement and speaking performance in AI-assisted learning environments: A mixed-methods study from Chinese middle schools. *Education and Information Technologies*, 1–23.

Kakeesh, D. F. (2024). Female entrepreneurship and entrepreneurial ecosystems. *Journal of Research in Marketing and Entrepreneurship*, *26*(3), 485–526.

KANGIWA, B. I., OLUDARE, O. E., NASSARAWA, H. S., ABUBAKAR, N. S., EFEOMA, E. L., & ENEFOLA, H. A. (2024). Leveraging artificial intelligence for enhancing entrepreneurship and creativity in STEM education. *Journal of Educational Research and Practice*.

Kaswan, K. S., Dhatterwal, J. S., & Ojha, R. P. (2024). AI in personalized learning. In *Advances in technological innovations in higher education* (pp. 103–117). CRC Press.

Khanra, S., & Shirish, A. (2025). Special issue on digital economy in the global south. *DECISION*, 1–6.

Khine, M. S. (2024). Using AI for Adaptive Learning and Adaptive Assessment. In *Artificial Intelligence in Education: A Machine-Generated Literature Overview* (pp. 341–466). Springer.

Le Corre, J.-Y., Martorell, G., & Huang, Q. (2025). Prototyping Technology-Enhanced Learning Solutions: A Practice-Based Research in Entrepreneurship Education. In *Exploring Practice-Led Research for Professional Development* (pp. 41–64). IGI Global Scientific Publishing.

Liu, Q., An, X., & Chen, W. (2025). College students' entrepreneurship education path and management strategy of start-up enterprises using causal attribution theory. *Scientific Reports*, *15*(1), 2706.

Mu, Q., & Zhao, Y. (2024). Transforming entrepreneurship education in the age of artificial intelligence. *Resources Data Journal*, *3*, 2–20.

Nabi, G., Liñán, F., Fayolle, A., Krueger, N., & Walmsley, A. (2017). The impact of entrepreneurship education in higher education: A systematic review and research agenda. *Academy of Management Learning & Education*, *16*(2), 277–299.

Olaposi, T. O. (n.d.). Integration of AI into Entrepreneurship Curricula in Higher Education. *AI and Curriculum Development for the Future*.

Pastarmadzhieva, D., & Angelova, M. (n.d.). The impact of AI on entrepreneurship education. *Changes*, *15*, 16.

Pedro, F., Subosa, M., Rivas, A., & Valverde, P. (2019). *Artificial intelligence in education: Challenges and opportunities for sustainable development*.

Rashov, O. (2024). *Modern methods of teaching foreign languages*. 158–164.

Schrage, M., & Kiron, D. (2025). Philosophy Eats AI. *MIT Sloan Management Review (Online)*, 1–17.

Singh, A. K. (2024). *Framework for Integration of Circular Economy into Business Models: A Study of Samsung*.

Singh, T. M., Reddy, C. K. K., Murthy, B. R., Nag, A., & Doss, S. (2025). Ai and education: Bridging the gap to personalized, efficient, and accessible learning. In *Internet of Behavior-Based Computational Intelligence for Smart Education Systems* (pp. 131–160). IGI Global.

Sitaridis, I., & Kitsios, F. (2024). Digital entrepreneurship and entrepreneurship education: A review of the literature. *International Journal of Entrepreneurial Behavior & Research*, *30*(2/3), 277–304.

Srivastava, S., Kaushik, H., Khemani, S., & Kaur, J. (2025). Analysing the total interactions amid elements of entrepreneurial education. *Review of Education*, *13*(1), e70055.

Suryawanshi, A. K., Singh, A. K., & Khateek, P. K. (n.d.). *Innovation and Entrepreneurship in Higher Education*.

Thottoli, M. M., Cruz, M. E., & Al Abri, S. S. S. (2025). The incubation revolution: Transforming entrepreneurial education with artificial intelligence. *Asia Pacific Journal of Innovation and Entrepreneurship*, *19*(1), 2–23.

Usman, F. O., Eyo-Udo, N. L., Etukudoh, E. A., Odonkor, B., Ibeh, C. V., & Adegbola, A. (2024). A critical review of ai-driven strategies for entrepreneurial success. *International Journal of Management & Entrepreneurship Research*, *6*(1), 200–215.

Vecchiarini, M., & Somia, T. (2023). Redefining entrepreneurship education in the age of artificial intelligence: An explorative analysis. *The International Journal of Management Education*, *21*(3), 100879.

Venkatesh, V. (2022). Adoption and use of AI tools: A research agenda grounded in UTAUT. *Annals of Operations Research*, *308*(1), 641–652.

Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. *MIS Quarterly*, 157–178.

Venkatesh, V., & Zhang, X. (2010). Unified theory of acceptance and use of technology: US vs. China. *Journal of Global Information Technology Management*, *13*(1), 5–27.

Wen, K., & Zhou, D. (2025). Predictive career guidance and entrepreneurial development for university students using artificial intelligence and machine learning. *Journal of Computational Methods in Sciences and Engineering*, 14727978251318801.

Xing, J., & Sieber, R. (2023). The challenges of integrating explainable artificial intelligence into GeoAI. *Transactions in GIS*, *27*(3), 626–645.

Yambal, S., & Waykar, Y. A. (2025). Future of Education Using Adaptive AI, Intelligent Systems, and Ethical Challenges. In *Effective Instructional Design Informed by AI* (pp. 171–202). IGI Global Scientific Publishing.