

# The Role of Digital Technologies and AI on the Development of Entrepreneurial Mindset in First-Year University Students

Cláudia Rodrigues<sup>1</sup>, Pedro Novo Melo<sup>1,2</sup>, Liliana Pereira<sup>1</sup>, Cristina Pereira<sup>1</sup> and Rúben Carvalho<sup>1</sup>

<sup>1</sup>Polytechnic University of Cávado and Ave, Portugal

<sup>2</sup>Applied Management Research Unit, Polytechnic University of Cávado and Ave, Portugal

[cmrodrigues@ipca.pt](mailto:cmrodrigues@ipca.pt)

[pmelo@ipca.pt](mailto:pmelo@ipca.pt)

[lpereira@ipca.pt](mailto:lpereira@ipca.pt)

[ccpereira@ipca.pt](mailto:ccpereira@ipca.pt)

[rscarvalho@ipca.pt](mailto:rscarvalho@ipca.pt)

**Abstract:** In the context of an increasingly digitalized world, entrepreneurship education must adapt to new technological paradigms to effectively prepare students for future challenges. Digital technologies and artificial intelligence (AI) are transforming the ways in which first-year university students engage with entrepreneurial learning, influencing their mindset, creativity, and problem-solving abilities. This study explores the extent to which AI-driven tools, digital platforms, and online collaborative environments contribute to the early development of an entrepreneurial mindset among first-year students in higher education. Through questionnaire surveys, this research investigates how students interact with digital learning resources, including AI-driven business simulations, virtual mentorship programs, and automated feedback systems. The study seeks to analyze whether these technologies enhance students' ability to identify opportunities, develop resilience, and think innovatively, key characteristics of successful entrepreneurs. Additionally, the research assesses potential barriers, such as gaps in digital literacy, resistance to AI adoption, and ethical concerns related to data privacy and bias in AI-generated recommendations. The results of this study will provide valuable insights into the role of AI and digitalization in the development of students' entrepreneurial skills, both in terms of pedagogical outcomes, such as the ability to deliver presentations, work in teams, or solve case studies, and in fostering creative and innovative ideas with the potential for business creation. Ultimately, this study contributes to the ongoing debate on the role of AI and digitalization in transforming entrepreneurship education. By understanding the impact of these technologies on first-year students, we can develop more effective learning strategies that not only enhance entrepreneurial thinking but also empower students to become problem solvers and innovators in an ever-changing global market.

**Keywords:** Entrepreneurship; AI; Higher Education; Entrepreneurial Mindset.

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## 1. Introduction

The development of an entrepreneurial mindset in first-year university students is increasingly influenced by the integration of digital technologies and artificial intelligence (AI) into educational environments. As higher education adapts to the demands of a digital economy, the role of these technologies in shaping entrepreneurial thinking, creativity, and opportunity recognition has become a central focus of academic inquiry.

Lynch and Corbett (2023) emphasize that the entrepreneurial mindset is not static but evolves through cycles of learning that involve both ideation and execution. They argue that digital tools can support this duality by offering iterative, feedback-rich environments that mirror real-world entrepreneurial challenges.

This aligns with the pedagogical shift toward experiential learning, where AI-driven simulations and virtual mentorship platforms provide students with opportunities to test ideas, fail safely, and refine their approaches.

Hasan et al. (2024) further highlight the importance of digital business literacy in fostering entrepreneurial readiness among Generation Z students. Their study shows that digital competencies, including familiarity with AI tools, significantly enhance students' ability to engage with entrepreneurial education. They argue that digital literacy acts as a mediator between educational content and entrepreneurial outcomes, reinforcing the need to embed these skills early in university curricula.

Moreover, the adoption of AI in educational settings is not without challenges. Ethical concerns, such as algorithmic bias and data privacy, are increasingly scrutinized. Pratschke (2024) warns that while AI can personalize learning and support creativity, it must be implemented with transparency and critical oversight to avoid reinforcing inequalities or limiting student agency.

The literature also suggests that AI can serve as a cognitive partner in the learning process. Bell and Bell (2023) propose that generative AI tools, when used responsibly, can stimulate entrepreneurial thinking by offering

diverse perspectives, automating routine tasks, and enabling rapid prototyping of business ideas.

These capabilities are particularly valuable for first-year students, who may lack confidence or experience in entrepreneurial contexts.

The integration of digital technologies and AI into entrepreneurship education is reshaping how first-year university students develop entrepreneurial mindsets. These tools not only enhance pedagogical outcomes—such as collaboration, presentation skills, and problem-solving—but also foster the resilience and creativity needed to navigate an uncertain global economy. However, successful implementation requires addressing digital literacy gaps and ethical concerns to ensure equitable and effective learning experiences.

By examining these concerns, the study provides a balanced view of AI's role in shaping entrepreneurial education while ensuring ethical considerations.

## **2. Methodology**

This study employed a quantitative research approach through a structured survey administered to first-year students enrolled in short-cycle professional higher education courses at Polytechnic University of Cávado and Ave, Portugal. These short-cycle programs last two years (3 academic semesters and 1 semester of practical training in a work context) and are designed to provide practical and vocational education aligned with labour market needs.

The questionnaire was developed through an internal collaborative process among faculty members involved in entrepreneurship education. Its design was also informed by relevant literature on digital literacy and entrepreneurial skills (e.g., Hasan et al., 2024; Lynch & Corbett, 2023). The survey aimed to explore students' experiences, behaviors, and perceptions regarding the use of artificial intelligence and digital technologies within the academic setting.

A pilot version of the survey was tested with a small group of students ( $n = 10$ ) to ensure clarity and relevance. Items were then refined based on feedback. The final version included both closed-ended and Likert-scale questions. Inclusion criteria for questions were based on their alignment with the study's objectives, clarity of language, and ability to yield actionable insights into entrepreneurial mindset development. Questions not directly related to these constructs or found ambiguous during the pilot were excluded.

This analysis focused on a sample of 124 higher education students, mostly from Management courses (56,6%), followed by Technology (11,5%), Design (8,2%) and other areas (23,8%). The respondents were 57% female and 43% male, ensuring a balanced gender representation.

The survey consisted of both closed-ended and Likert-scale questions, designed to explore students' experiences and perceptions regarding artificial intelligence and digital technologies in the context of entrepreneurship education.

The objective of the survey was to gather data on how students engage with AI and digital technologies in their academic journey and to assess the extent to which these tools contribute to the early development of entrepreneurial thinking and behavior. The results aim to inform people about the design of more effective and ethically aware entrepreneurship education practices in digitally enhanced learning environments.

## **3. Results**

The findings of the questionnaire reveal a mixed but insightful picture of the entrepreneurial mindset among first-year students enrolled in short-cycle professional higher education programs.

Although students recognize the value of digital tools and AI technologies in enhancing their personal and academic skills, a strong entrepreneurial intent is not yet widespread. In fact, with regard to entrepreneurial intentions, 20,3% of those surveyed said they wanted to set up their own business, and 47,2% said they would consider doing so in the future.

The frequency of use of digital tools and online platforms proved to be high, with 93% of students indicating daily or weekly use (Table 1). This intensity of use demonstrates a strong integration of these technologies into students' daily academic and personal lives.

**Table 1: Frequency of usage of digital tools**

Question: How frequently do you use digital tools or online platforms?	Answers	%
Daily	85	69%
Weekly	30	24%
Monthly	7	6%
Rarely/Never	2	2%

As for the purposes of use, Table 2 illustrates the primary purposes for which students use digital tools and online platforms in their academic and personal routines. The data reveal that the majority of respondents employ these tools for academic tasks, with 31% using them primarily for writing university assignments and 26% for collaborative teamwork with classmates. Additionally, 30% reported using digital tools for personal purposes, indicating a high level of digital engagement beyond academic contexts. However, only 9% of students reported using these tools for entrepreneurship-related activities, which suggests that this aspect, although present, is not yet central to students' digital practice.

**Table 2: Purpose of the use of digital tools**

Options	Answers	%
Team work with university mates	80	26%
Paper works for university	95	31%
Personal subjects	90	30%
Entrepreneurship activities	26	9%
Other	13	4%

Ethical concerns regarding AI usage emerged as a significant issue. When asked whether they had ever avoided using AI tools due to ethical concerns (e.g., related to personal data use or bias), 55% of respondents answered "yes," indicating a cautious stance toward AI integration in academic contexts (Table 3).

**Table 3: Ethical concerns**

Question: Have you ever avoided using an AI tool due to ethical concerns (e.g., use of personal data)?		
Options	Answers	%
Yes	68	55%
No	56	45

Despite these concerns, students acknowledged that digital technologies positively contribute to the development of soft skills critical to an entrepreneurial mindset. As shown in Table 4, 93% of respondents stated that digital tools have improved their ability to work in teams remotely, 91% reported improvements in their capacity to present ideas clearly, and 96% affirmed that digital tools enhanced their ability to analyze complex case studies.

**Table 4: Impact of Digital Technologies on Key Soft skills**

Question	Yes	No	% Affirmative answers
Have digital technologies improved your ability to work in teams remotely?	115	8	93%
Have digital technologies improved your ability to present ideas clearly (e.g., in a pitch)?	112	11	91%
Have digital technologies improved your ability to analyze complex case studies?	117	5	96%

Students' perceptions of the impact of digital technologies and artificial intelligence (AI) on their skills are generally very positive (Table 5). The majority recognized improvements in remote teamwork skills (93,5%), in the presentation of ideas (91,1%) and in the analysis of complex case studies (95,9%). In addition, 79,7% said that digital or AI tools are used in their courses, and 60,2% have used AI to validate a business idea. Although participation in simulations of entrepreneurial challenges is more limited (36,9%), the data indicates a growing involvement with this type of tool.

**Table 5: Perception of AI impact on entrepreneurial skills**

Question	Affirmative answers
Have digital technologies improved the ability to work remotely?	93,50%
Have they improved the ability to present ideas?	91,10%
Improved ability to analyse complex cases?	95,90%
Are digital tools/IA used in the course?	79,70%
Did you take part in online simulated entrepreneurial activities?	36,90%
Used AI to validate a business idea?	60,20%

When asked if they felt better prepared to undertake business after using digital and AI tools during their first year at university, 62,6% answered yes, although only partially. Only 16,3% felt fully prepared, and a minority felt no effect at all (4,1%).

Perceptions of the impact of AI on soft skills were particularly positive with regard to generating innovative ideas (mean = 3,89) and solving problems (mean = 3,83) (Table 6). The perception that these tools help develop critical thinking, initiative and resilience, although positive, showed slightly lower average values.

When asked whether AI tools help them solve problems, the majority of students expressed agreement: 57% agreed and 14% totally agreed, while only 2% disagreed. Similarly, 52% agreed and 10% totally agreed that AI tools contribute to building resilience in the face of failure, although a significant portion (40%) responded neutrally, indicating room for deeper engagement in this area.

Students showed particularly strong support for the idea that AI tools help generate innovative ideas with 59% agreeing and 18% totally agreeing—making it the item with the highest positive response rate in this set. Responses to whether AI tools help develop initiative were more balanced: 43% agreed and 10% totally agreed, but 35% selected the neutral option, and 10% expressed disagreement, suggesting mixed perceptions about AI's role in fostering proactive behaviors.

Finally, in regard to critical thinking 40% agreed and 10% totally agreed that digital tools enhance this skill, while 33% remained neutral and 15% disagreed. These results suggest that while students generally recognize the value of AI and digital tools in supporting innovation and problem-solving, the perceived impact on resilience, initiative, and critical thinking is less definitive and may require targeted pedagogical strategies to strengthen.

A 5-point Likert scale was used specifically in Table 6 to assess students' subjective perceptions of how AI and digital tools contribute to soft skill development—such as resilience, critical thinking, and initiative. These constructs are inherently personal and attitudinal, and therefore more suitably captured through scaled responses rather than binary yes/no options.

In addition to mean values and standard deviations, percentage breakdowns of responses (e.g., percentage of students who agreed or strongly agreed) are provided to enhance interpretability and support comparison across skill areas.

**Table 6: Perceptions of the impact of AI on soft skills**

Question	Mean	Std. Deviation
AI helps solve problems	3,83	0,712
AI helps develop resilience in the face of failure	3,56	0,793
AI helps generate innovative ideas	3,89	0,780

Question	Mean	Std. Deviation
AI helps develop initiative	3,51	0,911
The use of digital tools enhances critical thinking	3,42	0,969

The statistical analysis yielded compelling evidence of significant associations between key variables. Notably, the frequency of digital tool usage was positively correlated with students' perceptions of their ability to work remotely ( $p = 0,030$ ) and to analyse complex cases ( $p = 0,001$ ), indicating that more frequent use aligns with more favourable self-assessments in these domains. Furthermore, students enrolled in courses that incorporate AI tools reported significantly higher levels of agreement with the notion that such tools foster the development of initiative ( $p = 0,009$ ), underscoring the perceived educational value of AI integration.

Participation in online activities that simulate real entrepreneurial challenges is significantly related to remote working capacity ( $p=0,026$ ), with participation being associated with greater working capacity. On the other hand, those who have taken part in these types of challenges believe that they contribute significantly to increasing their critical thinking skills ( $p=0,012$ ) and that they help generate innovative ideas ( $p=0,032$ ).

#### 4. Discussion

The findings of this study offer important insights into the role of artificial intelligence (AI) and digital technologies in entrepreneurship education, particularly among first-year students in short-cycle higher education programs. The results confirm that while these students are deeply engaged with digital tools in their academic and personal routines, the direct connection between such tools and the cultivation of an entrepreneurial mindset remains underdeveloped.

The high frequency of digital tool usage (with 93% of students reporting daily or weekly engagement) indicates a strong baseline of digital integration. However, this engagement appears to be primarily task-oriented—focused on academic assignments and collaborative teamwork—rather than explicitly entrepreneurial. Only 9% of students reported using digital platforms for entrepreneurship-related activities. This disconnect suggests that while digital fluency is widespread, entrepreneurial application of these tools is not yet systematically adopted in the educational experience of first-year students.

Nevertheless, students perceive clear benefits of AI and digital technologies in developing key soft skills essential to entrepreneurship. A significant majority acknowledged improvements in teamwork, presentation, and analytical skills, with percentages exceeding 90% in each category. These findings reinforce previous literature (e.g., Lynch & Corbett, 2023; Bell & Bell, 2023), which state that AI can function as a cognitive and collaborative partner, enabling students to refine complex skills through real-time feedback and simulation-based learning.

In line with Hasan et al. (2024), the results also support the notion that digital and AI tools act as enablers of entrepreneurial readiness by bridging content knowledge with applicable competencies. The use of AI to validate business ideas (reported by 60,2% of respondents) and participation in entrepreneurial simulations (36,9%) highlight the potential of such tools in experiential learning. Moreover, statistical analyses revealed meaningful associations between digital engagement and self-perceived capacities in remote work, case analysis, initiative development, and innovative thinking—skills central to entrepreneurship.

Despite these positive trends, the development of more complex attributes—such as resilience, initiative, and critical thinking—appears less robust. Students' responses regarding the impact of AI on these dimensions were more nuanced and, in some cases, ambivalent. For instance, while a majority agreed that AI helps in generating innovative ideas (mean = 3,89), fewer were confident in its role in fostering initiative (mean = 3,51) or critical thinking (mean = 3,42). These findings indicate that, although AI demonstrates considerable potential in enhancing the cognitive and collaborative facets of learning, its impact on the affective and metacognitive components of entrepreneurial mindset development may necessitate more deliberate and pedagogically grounded instructional strategies.

Additionally, ethical concerns emerged as a salient theme. Over half of the respondents (55%) indicated having avoided AI tools due to data privacy or bias concerns. This finding underscores the importance of critical digital literacy and ethical education in preparing students for responsible AI engagement. As Pratschke (2024) notes, the implementation of AI must be accompanied by transparent, inclusive, and ethically grounded frameworks to ensure equitable learning environments and prevent the marginalization of certain student groups.

Finally, the study's findings also point to an opportunity for early-stage entrepreneurship education to leverage AI not just as a support tool, but as a co-creator in the learning process.

This discussion reveals both the promise and the challenges of using AI and digital technologies to foster entrepreneurial mindsets among first-year students. While students are receptive to digital tools and recognize their academic utility, a strategic reorientation is necessary to leverage these technologies for entrepreneurial development. Future research and practice should prioritize bridging the gap between digital engagement and entrepreneurial application through ethically grounded, experiential, and integrated teaching strategies.

## **5. Conclusion**

This study contributes to a growing body of research on the transformative role of artificial intelligence (AI) and digital technologies in entrepreneurship education. By focusing on first-year students enrolled in short-cycle higher education programs, the research has offered valuable insights into how digital tools influence the early development of entrepreneurial skills and mindset.

The results confirm that AI and digital platforms play a supportive role in enhancing pedagogical outcomes, such as improving students' ability to deliver presentations, collaborate in teams, and analyze complex case studies. Moreover, students perceive AI tools as facilitators of creativity and innovation—two fundamental dimensions of entrepreneurial capacity. A majority recognized that digital technologies help them solve problems and generate new ideas, which are essential for business ideation and opportunity recognition.

However, despite high levels of digital engagement, the specific application of these tools to entrepreneurship remains relatively underdeveloped. For instance, while most students use AI and digital resources regularly in academic contexts, only a small proportion reported using them directly for entrepreneurial initiatives. Additionally, ethical concerns about data privacy and AI bias emerged as significant barriers to more extensive use, suggesting the need for more transparent and responsible implementation.

These findings reinforce the necessity of designing entrepreneurship education that does not merely introduce AI tools, but integrates them meaningfully into learning processes that encourage initiative, resilience, critical thinking, and business creation. As highlighted in the literature (Lynch & Corbett, 2023; Bell & Bell, 2023; Hasan et al., 2024), AI can act as a cognitive partner in entrepreneurial learning, enabling feedback loops, rapid prototyping, and reflective experimentation. However, realizing this potential requires pedagogical strategies that are intentional, inclusive, and ethically grounded.

Overall, the results indicate that while first-year students are digitally engaged and recognize the usefulness of AI in skill development, a stronger connection between these tools and entrepreneurial practice is needed. There is significant potential for educational strategies to more explicitly bridge digital tool usage with entrepreneurial activities, thus fostering a more proactive entrepreneurial mindset early in higher education.

## **Ethics Declaration**

This research adhered to all ethical standards required for studies involving human participants. Prior to the administration of the questionnaire, ethical clearance was sought and obtained from the relevant institutional ethics committee. Participants were fully informed about the nature and purpose of the study and provided their consent to participate voluntarily. Anonymity and confidentiality were ensured throughout the data collection and analysis process.

A formal reference to the ethical approval granted for this study is included as attached to this paper.

## **AI Declaration**

Artificial Intelligence (AI) tools were used in the development of this paper to support language refinement and structural editing. Specifically, ChatGPT by OpenAI was employed to assist with the rephrasing of academic text, grammar correction, and improving the clarity and coherence of certain sections, such as the discussion and conclusion.

All substantive academic content, including research design, data analysis, interpretation of findings, and critical arguments, was developed by the authors. The outputs generated by the AI tool were carefully reviewed, edited, and integrated into the manuscript with full academic oversight to ensure accuracy, originality, and scholarly integrity.

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