

EXPLORING THE ROLE OF ARTIFICIAL INTELLIGENCE IN DESIGN-DRIVEN STARTUP EDUCATION

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Abstract

The growing availability of Artificial Intelligence (AI) tools is reshaping entrepreneurship education, particularly within design-driven approaches to startup creation. While AI is increasingly used to support entrepreneurial activities, there is still limited understanding of how it influences the different phases of the startup creation process in higher education contexts. This paper investigates the role of AI within a design-driven startup education course, where students develop entrepreneurial ideas from opportunity identification to business model definition. The course integrates design methodologies with entrepreneurial and managerial tools, supporting students in navigating uncertainty, feasibility, and strategic decision-making. A structured survey was administered to students to assess the extent of AI usage and its perceived usefulness across key phases of the startup process, including opportunity identification, need analysis, concept development, market exploration, and business model definition. The results show that AI is perceived as particularly useful in early and analytical phases, where it supports information gathering, synthesis, and the exploration of alternative solutions. In these stages, AI functions as a cognitive amplifier, helping students navigate uncertainty and structure complex inputs. However, its perceived usefulness decreases in more strategic and decision-intensive phases, where human judgment, critical thinking, and responsibility become central. These findings highlight a tension between the exploratory potential of AI and its tendency toward risk-averse reasoning. From an educational perspective, this suggests framing AI as a cognitive sparring partner that stimulates thinking without replacing decision-making. The study contributes to the design of startup education models that leverage AI while preserving the uncertainty and risk that are fundamental to innovation-driven entrepreneurship.

Keywords: *Artificial Intelligence, startup education, design education, design-driven entrepreneurship, human-AI collaboration.*

1. Introduction and theoretical background

The growing diffusion of Artificial Intelligence (AI) is significantly transforming educational practices across multiple domains, including entrepreneurship education. Recent advances in generative AI systems have expanded students' access to information, analytical capabilities, and ideation processes, enabling new forms of interaction with knowledge and problem-solving (Luckin et al., 2016; Holmes et al., 2019). In particular, AI tools are increasingly used by students to support research activities, synthesize complex information, generate ideas, and structure arguments, thereby reshaping how learning processes are enacted and experienced.

In the context of entrepreneurship education, these transformations are particularly relevant. The startup creation process is characterized by high levels of uncertainty, ambiguity, and iterative learning, requiring students to navigate incomplete information, interpret emerging signals, and make decisions without full validation (Ries, 2011; Blank, 2020). Within this domain, design-driven approaches have gained increasing relevance, as they provide methodologies to address complexity through exploration, iteration, and user-centered inquiry (Brown, 2008; Martin, 2009).

Design-driven startup education integrates principles from Design Thinking, Design Sprint, and Lean Startup methodologies, combining creative exploration with analytical validation (Garbuio et al., 2018; Kremel & Wetter-Edman, 2019). These approaches emphasize a set of key competencies that are considered fundamental in entrepreneurial learning. First, they support the ability to identify and frame opportunities, enabling students to move beyond predefined problem spaces and actively construct

meaningful areas of intervention. This involves not only recognizing potential market gaps, but also interpreting weak signals and reframing initial ideas into more structured entrepreneurial directions.

Second, they foster the capacity to interpret user needs and contextual dynamics, which is central to developing solutions that are both relevant and viable. Through user-centered methods, students learn to engage with stakeholders, uncover latent needs, and situate their ideas within broader socio-economic and market contexts. Third, these approaches promote iterative experimentation and prototyping as a way to navigate uncertainty. Rather than pursuing linear planning, students are encouraged to test assumptions, develop early-stage concepts, and refine their ideas through continuous feedback loops. This iterative logic allows them to progressively reduce uncertainty while maintaining openness to change.

Finally, they develop the capability to make strategic decisions under conditions of incomplete information. In entrepreneurial contexts, decisions often need to be taken without full validation, requiring students to balance analytical reasoning with intuition and to assume responsibility for the risks associated with their choices. Importantly, entrepreneurship education is not only about developing viable business models, but also about fostering an entrepreneurial mindset characterized by adaptability, resilience, and a willingness to take risks (Sarooghi et al., 2019). In this sense, risk-taking is not a side effect of entrepreneurship, but a core component of innovation processes (Eisenmann, 2021).

This characteristic introduces a critical tension when Artificial Intelligence tools are integrated into the learning process. AI systems are typically designed to generate outputs based on patterns, probabilities, and existing data, often favoring plausible, coherent, and incremental solutions. While this makes them highly effective in supporting analysis, synthesis, and early-stage exploration, it may also lead to a bias toward risk-averse reasoning, potentially limiting the exploration of more radical or unconventional entrepreneurial directions.

The increasing adoption of AI in educational settings is beginning to intersect with these dynamics. Emerging studies suggest that AI tools can enhance learning by supporting information processing, accelerating ideation, and providing immediate feedback to students (Holmes et al., 2019; Zawacki-Richter et al., 2019). In entrepreneurship education, preliminary evidence indicates that AI can be particularly useful in early phases of the entrepreneurial process, such as opportunity exploration, market analysis, and idea generation, where access to diverse information and rapid synthesis can support students in expanding their understanding of potential directions.

At the same time, recent discussions highlight potential limitations and risks associated with the use of AI in entrepreneurial contexts. Because AI systems generate outputs based on patterns and probabilities derived from existing data, they tend to produce solutions that are coherent and aligned with dominant logics. While this can be beneficial for structuring knowledge and supporting analysis, it may also lead to more conservative and incremental outcomes, potentially constraining the exploration of innovative and high-risk entrepreneurial opportunities.

Despite these emerging insights, there is still limited empirical understanding of how AI is actually used by students within entrepreneurship education, and how its perceived usefulness varies across different phases of the startup creation process. In particular, there is a lack of research that explicitly connects the use of AI with the specific cognitive and decision-making dynamics of design-driven startup education, where exploration, iteration, and risk-taking are central.

This paper addresses this gap by investigating the role and perceived usefulness of AI within a design-driven startup education course. By analyzing how students use AI across the different phases of the startup creation process, the study aims to contribute to the understanding of how AI can support entrepreneurial learning while preserving the critical role of human judgment, responsibility, and risk-taking in innovation-driven contexts.

2. Educational context and methodology

The study is based on a didactic experimentation conducted within a design-driven startup education course offered at the School of Design of Politecnico di Milano. The course is designed to bridge design methodologies and entrepreneurial thinking, providing students with a hybrid framework to develop innovative startup ideas.

The educational model builds upon previous research on the integration of design and entrepreneurship, which highlights the importance of combining creative exploration with business-oriented validation (Carella et al., 2025; Garbuio et al., 2018). The course structure reflects this integration by combining:

- Design Thinking for opportunity exploration and problem framing,
- Design Sprint for rapid ideation and prototyping,
- Lean Startup for testing assumptions and validating business models.

Students work in teams to develop an entrepreneurial idea, progressing through key phases of the startup creation process: opportunity identification, need analysis, concept development, market and competitor analysis, business model definition, and basic economic evaluation. The course also includes lectures, guest talks from entrepreneurs, and project-based activities, allowing students to connect theoretical knowledge with real-world applications.

Within this context, students were allowed to use AI tools autonomously during the development of their projects. This choice reflects a realistic learning environment in which AI is available but not prescribed, enabling the observation of natural usage patterns.

To investigate the role of AI, a structured survey was administered at the end of the course. The questionnaire explored how AI was used and perceived across the different phases of the startup creation process, asking students to evaluate both its usefulness and the relevance of human contribution in each phase.

The data were analyzed using descriptive statistics and qualitative interpretation, with the aim of identifying patterns in AI usage and understanding how its perceived value changes across the entrepreneurial process.

3. Results and discussion

The results highlight a differentiated and non-uniform role of AI across the phases of the startup creation process. Students reported a higher perceived usefulness of AI in early and analytical phases, such as opportunity identification, need analysis, and market and competitor exploration. In these stages, AI was primarily used to support information gathering, synthesis, and the generation of alternative perspectives.

For instance, in the opportunity identification phase, students reported using AI tools to explore emerging trends, identify potential market gaps, and generate initial ideas. Similarly, during market and competitor analysis, AI was used to quickly synthesize large amounts of information, compare positioning strategies, and identify patterns that would otherwise require significant time and effort. In these contexts, AI functioned as a cognitive amplifier, enabling faster access to structured knowledge and supporting divergent thinking.

These findings are consistent with existing research on AI in education, which highlights its potential to enhance information processing, ideation, and exploratory learning (Holmes et al., 2019; Zawacki-Richter et al., 2019). In particular, AI appears to be especially effective in supporting phases characterized by high cognitive load and the need to process multiple sources of information, allowing students to expand their exploration space and engage with a broader range of possibilities.

However, as the process moved toward more strategic and decision-intensive phases—such as opportunity selection, value proposition definition, and business model development—the perceived usefulness of AI decreased significantly. Students emphasized that, while AI could suggest possible configurations or provide structured outputs, it was less effective in supporting decisions that required prioritization, trade-offs, and commitment to a specific entrepreneurial direction.

For example, in the definition of the business model, AI could support the structuring of revenue streams or cost components, but students reported difficulties in using AI outputs to make final strategic choices. Similarly, in the selection of a target market or the prioritization of a value proposition, students highlighted the need to rely on their own judgment, intuition, and interpretation of contextual factors. These findings align with previous research suggesting that AI systems are less effective in supporting tasks that require contextual interpretation, judgment, and responsibility (Luckin et al., 2016).

This shift across phases reveals a critical tension between the exploratory potential of AI and its tendency toward risk-averse reasoning. AI systems are trained on existing data and patterns, which often leads them to generate solutions that are plausible, coherent, and aligned with dominant market logics. While this characteristic is valuable in analytical phases, it may limit the generation of more radical or unconventional ideas.

In entrepreneurial contexts, however, innovation often emerges from the ability to take risks and pursue directions that cannot be fully justified through available data (Martin, 2009; Eisenmann, 2021). Startups frequently succeed by challenging existing assumptions and exploring uncertain opportunities, rather than optimizing them within known frameworks. In this sense, the tendency of AI to favor incremental solutions may conflict with the fundamental dynamics of entrepreneurial innovation.

From an educational perspective, this raises important questions about the role of AI in shaping students' cognitive processes. If students rely excessively on AI-generated outputs, there is a risk that they may adopt more conservative and risk-averse approaches, potentially limiting their ability to engage in creative and entrepreneurial thinking. This concern echoes broader discussions in the literature about the impact of AI on higher-order cognitive skills, including critical thinking and decision-making (Holmes et al., 2019).

At the same time, the results suggest that AI does not replace human reasoning, but rather reshapes how it is exercised. Students appear to renegotiate the role of AI across different phases, using it as a support tool when dealing with complexity and uncertainty, but reverting to human judgment when faced with decisions that require commitment and responsibility. This dynamic reflects a hybrid form of cognition, in which human and artificial intelligence interact in complementary ways.

In this context, framing AI as a cognitive sparring partner provides a useful interpretative lens. Rather than acting as a decision-making authority, AI can be seen as a tool that challenges assumptions, generates alternatives, and stimulates reflection. This perspective aligns with recent studies that emphasize the role of AI as an augmentative rather than substitutive technology in education (Luckin et al., 2016), and highlights its potential to support learning processes without undermining human agency.

4. Conclusions and educational implications

This study contributes to the understanding of how AI influences design-driven startup education by providing empirical insights into its role across different phases of the entrepreneurial process. The findings highlight that AI is particularly effective in supporting exploratory and analytical activities, such as opportunity identification, market analysis, and idea generation, where it enhances students' ability to process information and explore alternative solutions. At the same time, the study shows that its perceived usefulness decreases in phases that require strategic decision-making, prioritization, and commitment to a specific entrepreneurial direction, where human judgment, critical thinking, and responsibility remain central.

From an educational perspective, these results suggest that the integration of AI in entrepreneurship education should be carefully designed. Rather than focusing solely on how to use AI tools, educators should explicitly address when and how AI should be used across the different phases of the startup creation process. This implies recognizing that AI does not play a uniform role throughout the process, but rather supports different types of cognitive activities depending on the phase.

In particular, the findings point toward a phase-based approach to AI integration. AI can be effectively leveraged in early stages of the entrepreneurial process, where exploration, analysis, and synthesis are required, helping students expand their understanding of opportunities and structure complex information. However, its use should be more critically framed in later stages, where decisions involve prioritization, trade-offs, and risk-taking. In these moments, over-reliance on AI may lead to more conservative and incremental solutions, potentially limiting the development of innovative entrepreneurial directions.

A second key implication concerns the development of critical AI literacy. Students should not only learn how to use AI tools, but also how to evaluate their outputs, recognize their limitations, and understand the biases embedded in data-driven systems. This is particularly relevant in entrepreneurial contexts, where decisions often require moving beyond what is already known and embracing uncertainty. Developing the ability to critically engage with AI outputs becomes therefore a fundamental competence for future entrepreneurs.

A third implication relates to the design of reflective learning environments. The integration of AI should be accompanied by pedagogical strategies that encourage students to reflect on how AI influences their thinking and decision-making processes. This may include structured moments of reflection in which students assess when AI was helpful, when it was limiting, and how it affected their approach to risk and uncertainty. Such practices can foster metacognitive awareness and support students in developing a more conscious and intentional use of AI.

Within this perspective, positioning AI as a cognitive sparring partner represents a particularly valuable pedagogical approach. Rather than acting as a decision-making authority, AI can be used to challenge assumptions, generate alternatives, and stimulate reflection, while leaving responsibility for strategic choices to the student. This framing allows educators to leverage the strengths of AI in supporting exploration and analysis, without undermining the central role of human agency in decision-making.

Overall, the study suggests that AI should not be introduced as a tool to optimize or simplify the startup creation process, but rather as a resource to support learning while preserving the uncertainty and risk that are fundamental to innovation-driven entrepreneurship. By explicitly scaffolding its use and fostering critical engagement, educators can design learning experiences that integrate AI without compromising the development of entrepreneurial thinking.

Future research could further explore how different instructional strategies, levels of AI integration, and pedagogical approaches influence students' ability to balance AI support with human judgment. In particular, longitudinal studies could provide insights into how the use of AI affects the development of entrepreneurial competencies, including creativity, decision-making, and risk-taking, over time.

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