SILESIAN UNIVERSITY OF TECHNOLOGY PUBLISHING HOUSE

SCIENTIFIC PAPERS OF SILESIAN UNIVERSITY OF TECHNOLOGY 2025
ORGANIZATION AND MANAGEMENT SERIES NO. 235

STRATEGIC DECISION-MAKING UNDER UNCERTAINTY: BUILDING ENTREPRENEURIAL MINDSET THROUGH PROJECT-BASED LEARNING

Beata MALIK-KOZŁOWSKA[1*], Rafał KOZŁOWSKI[2]

[1] University of Economics in Katowice; beata.malik@ue.katowice.pl, ORCID: 0000-0002-8992-6074
[2] University of Economics in Katowice; rafal.kozlowski@ue.katowice.pl, ORCID: 0000-0002-9258-8248
* Correspondence author

Purpose: The purpose of this paper is to conceptually examine how entrepreneurial mindset development can be strategically embedded into higher education curricula to equip students with the competencies necessary for decision-making under uncertainty. In response to rapidly evolving labor market conditions characterized by volatility, complexity, and technological disruption, the paper introduces and analyzes a validated Project-Based Learning (PBL) model designed to foster entrepreneurial competencies aligned with these contemporary demands. While existing approaches to entrepreneurship education often emphasize startup outcomes or isolated skill acquisition, the field still lacks a pedagogically grounded and theoretically integrated model for cultivating the entrepreneurial mindset required for strategic decision-making in uncertain environments.
Design/methodology/approach: This conceptual paper draws on theoretical synthesis and pilot empirical evidence. It reinterprets a previously validated PBL model through the lens of entrepreneurial mindset theory. The approach includes literature integration across entrepreneurship, strategic management, and pedagogy to demonstrate alignment between the model's six learning dimensions and the cognitive, behavioral, and dispositional antecedents of entrepreneurial mindset.
Findings: The analysis reveals strong theoretical alignment between entrepreneurial mindset theory and the pedagogical mechanisms embedded in the PBL model. The model's six elements: Collaborative Learning, Supportive Learning Environment, Engagement, Reflection on Self-Efficacy, Autonomy, and Awareness of Influence and Iterative Environment, collectively simulate real-world uncertainty and foster metacognitive, adaptive, and opportunity-seeking behaviors. Empirical findings from a pilot study confirm the model's feasibility, with students reporting increased resilience, reflective learning, and self-efficacy.
Research limitations/implications: The findings are based on a single pilot study in a specific educational context, limiting generalizability. The scalability of the model across institutions and disciplines remains to be tested. Future research should employ longitudinal and mixed-method designs to explore causal mechanisms and evaluate impact across diverse environments. Further development could integrate competencies like ethical judgment and digital adaptability.
Practical implications: This research offers actionable insights for universities redesigning curricula toward competency-based, experiential learning. The PBL model provides

a structured framework for embedding entrepreneurial mindset development in higher education, addressing employers' increasing emphasis on adaptability, resilience, and opportunity creation. It supports institutional transformation in response to AI-driven and skills-based shifts in workforce strategy.
Social implications: The model equips students with competencies vital for navigating societal complexity, uncertainty, and labor market disruption. Embedding entrepreneurial learning in higher education can enhance social resilience by preparing graduates to contribute to innovation, sustainability, and inclusive economic growth. It also aligns with public policy efforts to mainstream entrepreneurial competencies as a public good.
Originality/value: The paper makes a novel contribution by linking a validated pedagogical model to the latest entrepreneurial mindset theory. It reframes project-based education as a strategic response to uncertainty and labor market transformation. The model provides a replicable template for institutions seeking to develop entrepreneurial graduates fit for the 21st-century workplace.
Keywords: entrepreneurial mindset, project-based learning, decision-making under uncertainty, entrepreneurial competencies, higher education.
Category of the paper: Conceptual paper.

1. Introduction

Uncertainty has long been acknowledged as a defining feature of contemporary business environments (Milliken, 1987; Courtney et al., 1997), but the accelerated pace of technological, economic, and geopolitical disruption in recent years has amplified its scope and implications. In what is often described as a VUCA world, marked by volatility, uncertainty, complexity, and ambiguity (Bennett, Lemoine, 2014; Codreanu, 2016), strategic decision-making has become increasingly difficult not only for organizations but also for higher education institutions, students, and employers. While much of the management and entrepreneurship literature has focused on how firms navigate market turbulence, less attention has been paid to how educational systems might prepare future professionals to act decisively and entrepreneurially within these uncertain environments.

A growing body of research positions the entrepreneurial mindset as a critical individual-level capacity for coping with such conditions (Daspit et al., 2023; Kuratko et al., 2021). Defined as a constellation of cognitive, behavioral, and dispositional attributes that enable individuals to identify opportunities, mobilize resources, and take informed action under conditions of ambiguity (Daspit et al., 2023; Kuratko et al., 2021), the entrepreneurial mindset offers valuable competencies not only for prospective entrepreneurs but for all graduates entering increasingly unpredictable labor markets. This shift has strategic implications for universities, which are being called upon to reimagine their educational models and move beyond traditional knowledge transmission toward cultivating adaptive, opportunity-oriented, and competency-based forms of learning (World Economic Forum, 2025).

Despite growing consensus on the importance of entrepreneurial mindsets for navigating uncertainty, existing entrepreneurship education practices often fall short of translating theoretical constructs into pedagogical models that support mindset development. Specifically, there remains a lack of integrated, theory-informed approaches that align the cognitive, behavioral, and dispositional dimensions of entrepreneurial mindset with experiential learning environments. This gap is particularly pressing given the accelerating shift toward skills-based employment and the rising demand for graduates capable of adaptive, strategic decision-making. The present study addresses this gap by proposing and conceptually validating a Project-Based Learning (PBL) model designed to cultivate entrepreneurial competencies and mindsets through structured, iterative, and student-centered pedagogical experiences.

This study was developed as a conceptual contribution, integrating theoretical synthesis with model construction and pilot evaluation. An integrative review of literature from entrepreneurship, strategy, and educational theory was conducted to identify key antecedents of the entrepreneurial mindset. Based on this synthesis, a Project-Based Learning for Developing Entrepreneurial Competencies was constructed. The model was subsequently implemented in a pilot study within a business education program, providing preliminary empirical validation of its conceptual structure and pedagogical value.

This study builds on prior work by the authors, which demonstrated that project-based, competency-driven learning environments can meaningfully enhance entrepreneurial skills essential for navigating uncertainty, including creative problem-solving, opportunity recognition, and adaptability. These findings echo the conclusions of Morris et al. (2013), who underscored the pedagogical value of experience-based, competency-centered approaches in entrepreneurship education. Together, this evidence provides a strong rationale for examining how PBL fosters entrepreneurial mindsets for decision-making in unpredictable contexts.

This conceptual paper examines how higher education institutions might strategically respond to these demands by embedding entrepreneurial mindset development within their curricula. It draws on entrepreneurial mindset theory to reinterpret the theoretical foundations of a previously piloted Project-Based Learning (PBL) Model for Developing Entrepreneurial Competencies, framing it as an illustrative example of how educational practices can cultivate opportunity recognition, adaptive decision-making, and cognitive agility under uncertainty. In doing so, the paper highlights how experiential, competency-based approaches can operationalize mindset development in ways aligned with contemporary labor market and organizational demands.

To address this, the paper draws upon contemporary entrepreneurial mindset theory to explore how higher education institutions can cultivate students' adaptive, opportunity-oriented capacities. It synthesizes current conceptualizations and antecedents of the entrepreneurial mindset, connects them to the demands of decision-making under uncertainty, and proposes a Project-Based Learning (PBL) model explicitly designed to foster entrepreneurial

competencies. By integrating insights from both theory and pilot empirical evidence, the paper offers strategic recommendations for universities, students, and employers seeking to navigate the volatility of future labor markets through competency-based, mindset-oriented education.

2. Decision-Making Under Uncertainty

The concept of uncertainty has long occupied a central place in strategic management, particularly as it relates to how individuals and organizations make decisions in ambiguous, evolving environments. Drawing on Milliken (1987), uncertainty can be understood as an individual's perceived inability to predict the external environment with confidence. It refers to environments where outcomes are not only unknown but often unknowable, reflecting a deeper level of indeterminacy than risk, which involves known probabilities. Develaki (2024) clarifies this by distinguishing risk (quantifiable) from uncertainty (inherent unpredictability), noting that strategic decision-making increasingly occurs in contexts where neither outcome probabilities nor their bounds are established. Similarly, Gleißner (2023) emphasizes that uncertainty challenges traditional risk models and requires resilient strategic approaches designed for environments beyond probabilistic forecasting. Strategic actors must thus operate under conditions where critical information is incomplete, emergent, or fundamentally indeterminate (Courtney et al., 1997).

Courtney et al. (1997) offer a seminal typology of strategic uncertainty, distinguishing four levels: from "a clear-enough future," in which one forecast dominates, to "true ambiguity", where causal forces and outcomes remain unknowable even after extensive analysis (see Table 1). In high-uncertainty contexts, decision-makers cannot rely on deterministic logic or linear planning. Instead, they must embrace iterative, inductive, and action-oriented strategies that treat ambiguity not as a constraint but as a condition for opportunity creation.

Table 1.
Levels of Strategic Uncertainty

Level of Uncertainty	Description	Decision-Making Implications	Example Contexts
1. Clear-Enough Future	The environment is sufficiently predictable to develop a single forecast.	Traditional planning and forecasting are reliable.	Stable consumer markets; regulated industries with slow change.
2. Alternate Futures	A few discrete, well-defined outcomes are possible.	Scenario analysis and strategic hedging are needed.	Pending regulatory changes; competitor entry scenarios.
3. A Range of Futures	A broad range of possible outcomes exists, but no natural scenarios emerge.	Strategy must be robust and adaptive across multiple outcomes.	Entering emerging markets; launching new technologies.

Cont. table 1.

4. True Ambiguity	Key variables and their interactions are entirely unknown or unknowable.	Focus on learning, experimentation, and preserving flexibility.	AI disruption in creative sectors; geopolitical realignment.

Source: Adapted from Courtney, Kirkland, Viguerie, 1997, pp. 66-79.

Today's strategic environment is increasingly defined by volatility, uncertainty, complexity, and ambiguity, collectively known as VUCA (Bennett, Lemoine, 2014; Codreanu, 2016). These conditions are exacerbated by transformative technologies, most notably artificial intelligence (AI), which introduce both disruption and possibility. According to the World Economic Forum (2023), 44% of workers' core skills are expected to change by 2027, and 23% of current jobs may be reconfigured or displaced. Simultaneously, entirely new roles, such as AI specialists, sustainability analysts, or machine learning ethicists, are emerging in response to these technological shifts. The career landscape, once relatively stable and predictable, is now characterized by dynamism and fluidity. Organizations are responding by dismantling fixed job roles and instead adopting skills-based operating models (Deloitte, 2024). These models prioritize the identification and deployment of transferable competencies, such as critical thinking, resilience, creativity, and strategic adaptability, over fixed credentials or narrowly defined job tasks. The implications for business education are profound. As employers increasingly consider recruiting for competencies rather than degrees, business schools must rethink their curricula, pedagogies, and learning outcomes. Content mastery alone no longer ensures employability in an environment where both jobs and required skills are rapidly evolving (Deloitte, 2025).

Within this context, strategic decision-making is no longer merely an exercise in choosing between known alternatives. Instead, it becomes an entrepreneurial process, adaptive, emergent, and opportunity-creating. Alvarez and Barney (2007) argue that under conditions of high uncertainty, opportunities are not discovered but created through iterative experimentation and action. This creation view contrasts with the traditional discovery model, which assumes that opportunities exist objectively and can be identified through analysis. In highly uncertain environments, entrepreneurs and strategic decision-makers favor flexible, resource-driven decision-making strategies, an approach consistent with effectuation logic (Sarasvathy, 2001), that prioritize adaptability, incremental experimentation, and the effective use of available means (Alvarez, Barney, 2007). These behaviors exemplify an entrepreneurial mindset in action, the one that transforms uncertainty into opportunity through intentional experimentation, learning, and adaptation. Translating this logic to the domain of business education, particularly within higher education institutions, requires a fundamental pedagogical reorientation. Universities must no longer prepare students solely for static roles within established industries. Rather, they must cultivate learners who can navigate, and indeed thrive within, uncertain, ambiguous, and constantly evolving conditions. Entrepreneurial

competencies defined by Morris et al. (2013) offer a robust, future-proof foundation for such preparation.

Following prior research on entrepreneurial cognition and metacognitive adaptability (Haynie et al., 2010; Mitchell et al., 2002), this paper views decision-making under uncertainty as a capacity that can be developed rather than a fixed, innate trait. Experiential learning theories (Kolb, 1984) and related pedagogical models suggest that decision agility, tolerance for ambiguity, and effectual reasoning can be cultivated through active engagement in complex, real-world problem contexts. Project-Based Learning (PBL) offers one such model, enabling students to work through open-ended projects in collaborative settings. When thoughtfully implemented, PBL simulates the decision-making challenges students are likely to encounter in entrepreneurial or strategic roles, providing structured opportunities to develop the metacognitive, behavioral, and emotional capabilities necessary for uncertain environments.

Moreover, as decision-making authority increasingly shifts from hierarchical managers to agile teams and frontline actors, especially in digitally transformed organizations, the strategic value of entrepreneurial competencies only grows. Employees who can exercise judgment, adapt in real time, and make autonomous decisions become essential contributors to organizational resilience. In this light, preparing students to make decisions under uncertainty is not only a matter of individual career readiness but also of institutional strategy for innovation and adaptability.

In sum, decision-making under uncertainty is no longer the exceptional challenge, it is the new normal. As AI, platform economies, and geopolitical instability redraw the contours of business and employment, equipping students with the entrepreneurial mindset to navigate this landscape becomes an urgent educational priority. Business schools that embrace this imperative will not only remain relevant, they will become essential actors in preparing future leaders for the unknown.

3. Entrepreneurial Mindsets and Competencies

In an increasingly volatile and technology-disrupted global economy, the entrepreneurial mindset (EM) has gained prominence as a meta-capability essential for navigating uncertainty, recognizing emerging opportunities, and initiating strategic action. Long regarded as a defining feature of entrepreneurial behavior, EM has recently been reconceptualized by Daspit et al. (2023) as a broader cognitive and behavioral capacity relevant not only to founders but also to professionals, managers, and leaders across organizational contexts. Daspit et al. (2023) offer a widely accepted integrative definition, synthesizing insights from 61 publications: “Entrepreneurial mindset is defined as a cognitive perspective that enables an individual to create value by recognizing and acting on opportunities, making decisions with limited

information, and remaining adaptable and resilient in conditions that are often uncertain and complex" (p. 8).

This definition highlights the contextual relevance of EM to the unpredictable, fast-changing environments that characterize contemporary labor markets. Additionally, Kuratko et al. (2021) emphasize three interwoven components of the entrepreneurial mindset: the cognitive aspect, describing how individuals perceive and interpret uncertainty and opportunity; the behavioral aspect, concerning how they act strategically in uncertain environments; and the emotional aspect, reflecting psychological capacities such as resilience, optimism, and tolerance for ambiguity that sustain entrepreneurial action. These elements interact dynamically, producing a mindset oriented toward sensemaking, experimentation, opportunity recognition, and resourceful decision-making under pressure. As such, EM offers a valuable theoretical construct for understanding how individuals mobilize internal and external resources in response to ambiguity and change, conditions increasingly common in both entrepreneurial ventures and established organizational careers.

4. Entrepreneurial Competencies

The entrepreneurial mindset gives rise to, and is reinforced by, a set of entrepreneurial competencies, transferrable, learnable capabilities that support adaptive behavior under uncertainty. Morris et al. (2013) identify 13 core entrepreneurial competencies Opportunity Recognition, Opportunity Assessment, Risk Management/Mitigation, Conveying a Compelling Vision, Tenacity/Perseverance, Creative Problem-Solving, Resource Leveraging, Guerrilla Skills, Value Creation, Maintain Focus Yet Adapt, Resilience, Self-Efficacy, Building and Using Networks. These competencies are not only relevant to venture creation but also critical for navigating complex organizational systems, leading innovation, and engaging in strategic foresight. Entrepreneurial competencies increasingly serve as meta-skills, underlying abilities that support a wide range of task-specific behaviors across volatile professional environments. They represent valuable assets for students preparing them to enter careers in industries that are being restructured by AI, platform economies, sustainability imperatives, and geopolitical turbulence (Gulati et al., 2025; Mäkelä, Stephany, 2024).

A parallel development in policy and education is the holistic competency framework such as the European Commission's EntreComp model (Bacigalupo et al., 2016). EntreComp articulates 15 entrepreneurial competencies across three dimensions - 1. Ideas and Opportunities: Spotting opportunities, Creativity, Vision, Valuing ideas, Ethical and sustainable thinking; 2. Resources: Self-awareness and self-efficacy, Motivation and perseverance, Mobilizing resources, Financial and economic literacy, Mobilizing others; 3. Into Action: Taking the initiative, Planning and management, Coping with uncertainty, ambiguity and risk,

Working with others, Learning through experience. A distinguishing feature of EntreComp is its progression model, which frames entrepreneurial learning as a gradual increase in both independent value creation and the ability to operate in increasingly unpredictable, dynamic contexts. The model defines four proficiency levels from Foundation to Expert, enabling its adaptation to diverse audiences and institutional priorities. Importantly, EntreComp positions entrepreneurial learning as context-neutral, applicable across formal education, workplace training, and informal learning. Its flexibility allows for the design of tailored development pathways, where learners build entrepreneurial capacities relevant to their unique environments and ambitions.

This emphasis on entrepreneurial competencies aligns with a growing consensus in entrepreneurship and management education that future-ready graduates must possess not only technical knowledge but also a portfolio of transferable, action-oriented skills (Nägele, Stalder, 2017). For higher education institutions, this reorientation carries profound implications (Blenker et al., 2020). As global labor markets become increasingly volatile and AI-driven transformations accelerate, universities can no longer rely solely on discipline-specific knowledge transmission. Instead, they must equip students with the competencies necessary to think and act entrepreneurially within complex, dynamic systems. Embedding entrepreneurial mindset development into curricula, offers a strategic pathway for preparing graduates not only to launch ventures but to drive innovation, lead adaptive organizations, and contribute to societal resilience.

This framing resonates strongly with ongoing shifts in employer priorities. The World Economic Forum's Future of Jobs Report (2025) projects that by 2030, 39% of workers' core skill sets will have changed, with 92 million jobs displaced and 78 million new roles created. The most valued emerging competencies include analytical thinking, systems judgment, emotional intelligence, and adaptability, many of which overlap with entrepreneurial competencies. Similarly, Deloitte's (2024, 2025) research confirms a global trend toward "skills-based" organizational models that prioritize capabilities such as learning agility and strategic adaptability over formal credentials.

5. Entrepreneurial Mindset

The development of EM is influenced by a set of empirically validated antecedents, particularly at the individual level, an area of special relevance in educational contexts (Daspit et al., 2023; Nägele, Stalder, 2017). Four categories are especially salient: 1. Cognitive Factors: Metacognition, the ability to monitor and regulate one's thinking, underpins adaptive opportunity recognition and problem-solving (Haynie et al., 2010). Self-efficacy, or belief in one's capacity to act, supports initiative-taking under uncertainty (Chen, Greene, Crick, 1998).

Both are directly fostered in pedagogical environments that emphasize iterative challenge, feedback, and autonomy. 2. Life Experiences: Exposure to diverse experiential contexts, such as collaborative projects, international study, or real-world problem-solving, broadens cognitive frames and enhances pattern recognition (Outsios, Kittler, 2018). Project-based learning (PBL), when authentically structured, can simulate these effects by embedding students in ambiguous, cross-functional scenarios. 3. Self-Exploration: Reflective processes that prompt students to examine their goals, values, and identities contribute to EM formation (Shen et al., 2021). Structured reflection cycles within PBL environments help learners develop personal agency by connecting experience with aspiration. 4. Dispositional Attributes: Resilience, optimism, and openness to experience are dispositional traits consistently linked to EM. These traits are not immutable; exposure to emotionally complex, collaborative problem-solving under uncertainty, hallmarks of well-designed PBL, can foster their development. Together, these antecedents provide a robust theoretical rationale for aligning entrepreneurship education with experiential, reflective pedagogies. In particular, they support the legitimacy of models like the validated PBL framework introduced in our earlier research, which operationalizes these principles into structured learning environments designed to cultivate entrepreneurial agency.

6. Project-Based Learning for Developing Entrepreneurial Competencies

The present study draws on a previously developed pedagogical framework designed to foster entrepreneurial competencies through Project-Based Learning (PBL). Compared to other emerging approaches, the proposed model offers a more theoretically grounded and pedagogically structured pathway for cultivating entrepreneurial competencies. Santoso et al. (2021) examined entrepreneurial learning in the context of student startup development using the Entrepreneurial Learning Model (ELM) (Shane et al., 2003), implemented through a combination of training, experiential activities, and mentoring. In a later study, Santoso et al. (2023) introduced PBEL as a framework for fostering venture creation; however, the reported outcomes were modest, and the study neither defined nor systematically assessed entrepreneurial competencies as proposed by Morris et al. (2013), leaving unaddressed the need for a pedagogically grounded model focused on competency-based entrepreneurship education.

Grounded in experiential learning theory (Kolb, 1984), social-cognitive theory (Bandura, 1997), and self-determination theory (Deci, Ryan, 2000), this framework operationalizes six dimensions of entrepreneurial learning aligned with the demands of building entrepreneurial mindset and preparing students for decision-making under conditions of uncertainty. While the current study does not aim to refine this model, its application is theoretically and empirically warranted. While conventional PBL frameworks emphasize inquiry, collaboration, and real-

world problem-solving (Larmer et al., 2015), this adapted model extends these principles by explicitly integrating competencies associated with entrepreneurial mindset formation. The model is structured around six core elements. These elements are interdependent, creating a dynamic learning environment where students iteratively navigate complex tasks, assume leadership, and adaptively respond to feedback and environmental change.

1. Collaborative Learning serves as the foundation for project execution, emphasizing not only teamwork but also the management of imperfect cooperation, emergent leadership roles, and the negotiation of socio-cognitive conflict. This element mirrors entrepreneurial contexts where effective opportunity pursuit relies on navigating diverse, and often uncertain, interpersonal dynamics.
2. Supportive Learning Environment component deliberately cultivates psychological safety, encouraging students to experiment, fail, and iterate without fear of reputational or academic penalty. By normalizing failure as a learning tool, this element fosters effective resilience and dispositional traits associated with entrepreneurial persistence and adaptive coping (Cope, 2011; Byrne, Shepherd, 2015).
3. Engagement in the Learning Process extends beyond sustained inquiry by granting students agency in project direction, task division, and decision-making under evolving conditions. This feature aligns with the entrepreneurial requirement for self-exploration, identity work, and dynamic opportunity assessment under uncertainty (Shen et al., 2021).
4. Reflection on Self-Efficacy is incorporated as a structured, ongoing process throughout project work. Students are guided to regularly evaluate their competencies, confidence levels, and performance strategies, enabling the recalibration of beliefs about their entrepreneurial abilities in response to feedback and project outcomes. This mirrors the iterative metacognitive processes described in entrepreneurial cognition literature (Haynie et al., 2010; Kuratko et al., 2021).
5. Autonomy in the Learning Process element operationalizes entrepreneurial agency by affording students decision-making authority over project priorities, risk management, and iterative adjustments. This promotes adaptive learning management and experiential risk-taking, key drivers of entrepreneurial mindset development (Kouakou et al., 2019).
6. Awareness of Influence and Iterative Environment positions project revision, critique, and reflection as continuous, rather than episodic, activities. Students are encouraged to recognize their personal and collective influence on project direction and group outcomes, fostering iterative leadership skills and adaptive strategy formation within complex, dynamic environments (Daspit et al., 2023).

In sum, the model offers a structured yet flexible learning environment that operationalizes theoretical antecedents of entrepreneurial mindset within the educational context. It moves beyond skill acquisition to emphasize dispositional, cognitive, and behavioral competencies essential for entrepreneurial success in volatile and unpredictable environments.

7. Key Empirical Findings from the Pilot Study

An initial empirical examination of the Project-Based Learning for Developing Entrepreneurial Competencies Model was conducted to assess its feasibility and effectiveness in fostering entrepreneurial competencies within a higher education context. The pilot study, implemented in a university business program, engaged students in PBL projects structured around the model's six core elements. The study aimed to evaluate whether participation in this tailored PBL environment was associated with measurable growth in entrepreneurial competencies as defined by Morris et al. (2013).

The research results provided support for the multidimensional structure of the model, with four dimensions: Facilitating Environment, Engagement, Reflection on Self-Efficacy, and Autonomy, demonstrating acceptable internal consistency (Cronbach's $\alpha > .70$) and clean factor structures. Conversely, two dimensions: Collaborative Learning, and Self-Awareness & Iterative Learning exhibited weaker psychometric properties, including lower reliability and ambiguous factor loadings. Notably, items within the Collaborative Learning subscale failed to adequately capture the complexity of group processes in entrepreneurial learning contexts, while the Self-Awareness & Iterative Learning dimension revealed conceptual and empirical overlap with Autonomy. These findings highlight areas for refinement and suggest that certain experiential distinctions in entrepreneurial learning, while theoretically meaningful, may be experientially blurred for students (Flavell, 1979; Zimmerman, 2002). This prior validation work laid the empirical groundwork for refining the PBL-based model and advancing measurement tools to assess entrepreneurial competency development in higher education settings.

Qualitative data gathered through reflective journals and focus group discussions reinforced these quantitative findings. Students consistently described the importance of psychological safety within the learning environment, emphasizing how the model's emphasis on experimentation, risk tolerance, and iterative revision fostered resilience, adaptability, and reflective learning habits. These qualitative accounts highlighted the model's role in promoting a proactive, opportunity-seeking orientation, key attributes associated with entrepreneurial mindset formation (Kuratko et al., 2021; Daspit et al., 2023).

While the overall findings provide initial support for the model's conceptual alignment with entrepreneurial mindset development, the study also identified areas for refinement. Specifically, elements related to task coordination in collaborative learning and the breadth of reflection within the self-awareness and iterative learning components warranted further development to enhance internal consistency and interpretive clarity. These insights have since informed ongoing revisions of the model and its associated measurement instruments.

Taken together, the pilot study's outcomes affirm the conceptual proposition that a deliberately structured PBL environment, aligned with entrepreneurial mindset antecedents, can foster key entrepreneurial competencies in higher education students. The evidence supports the feasibility of integrating this model into entrepreneurship education curricula as a theoretically grounded, practice-oriented pedagogical innovation.

8. Linking PBL Elements with Entrepreneurial Mindset Formation

While the Project-Based Learning (PBL) for Developing Entrepreneurial Competencies Model was developed from an educational design perspective, recent analysis of entrepreneurial mindset (EM) theory reveals strong conceptual alignment between the model's elements and antecedents of EM as identified in contemporary literature. Entrepreneurial mindset, often described as a constellation of cognitive, behavioral, dispositional, and emotional tendencies that enable individuals to recognize and exploit opportunities in uncertain contexts (Daspit et al., 2023; Kuratko et al., 2021; Naumann, 2017; Kouakou et al., 2019), develops through experiences that foster agency, resilience, adaptive cognition, and reflective practice.

A systematic review of entrepreneurial mindset literature highlights several antecedents relevant to PBL environments. These include individual-level factors such as metacognition and self-efficacy (Haynie et al., 2010; Shen et al., 2021), dispositional traits like optimism and affective resilience, venture-level influences related to leadership and collaborative culture (Daspit et al., 2023), and the critical role of dynamic, uncertain environments in shaping entrepreneurial cognition and action (Kuratko et al., 2021; Sarasvathy, 2001). The PBL model operationalizes these antecedents through its structured design and experiential mechanisms.

For instance, Collaborative Learning in the PBL model mirrors venture-level antecedents emphasized by Daspit et al. (2023), who identify the culture of ventures and leadership dynamics as critical in shaping entrepreneurial behavior. Similarly, Supportive Learning Environment aligns with dispositional antecedents such as non-depressiveness, gratefulness, and affective resilience and with Kuratko et al.'s (2021) emphasis on the emotional aspect of entrepreneurial mindset, particularly in navigating stress and risk. Engagement in the Learning Process activates self-exploration, a crucial process for identity work and entrepreneurial agency development under uncertainty (Shen et al., 2021). Meanwhile, Reflection on Self-Efficacy integrates metacognitive processes and belief calibration, which Haynie et al. (2010) and Naumann (2017) argue are foundational for adaptive decision-making in entrepreneurial contexts. Autonomy in the Learning Process fosters entrepreneurial agency, opportunity recognition, and self-directed learning, mechanisms recognized as essential by Kouakou et al. (2019) and Kuratko et al. (2021) for developing an opportunity-seeking, growth-oriented mindset. Finally, Awareness of Influence and Iterative Environment operationalizes the

environment-level antecedents highlighted by Daspit et al. (2023) and the triadic interaction of cognition, behavior, and emotion described by Kuratko et al. (2021). This iterative, dynamic feedback structure is central to entrepreneurial learning and decision-making in complex environments.

Through this alignment, the PBL model emerges not merely as a pedagogical format, but as an educational strategy explicitly designed to foster the cognitive, behavioral, and dispositional antecedents of entrepreneurial mindset. Its structured integration of reflection, autonomy, collaborative inquiry, and adaptive iteration creates a developmentally rich environment for entrepreneurial competency acquisition. In conceptualizing PBL within this theoretical framework, the model offers a replicable and theoretically informed template for entrepreneurship education programs seeking to develop adaptive, opportunity-driven leaders capable of navigating contemporary labor markets characterized by VUCA.

9. Implications for Higher Education and Entrepreneurship Education in a Changing Labor Market

The accelerating pace of technological innovation, particularly the widespread adoption of generative artificial intelligence, is fundamentally reshaping global labor markets and challenging long-standing assumptions about the value proposition of higher education. Contemporary projections anticipate substantial shifts in occupational skill requirements, with employers placing growing emphasis on demonstrable competencies and practical capabilities rather than formal academic credentials (World Economic Forum, 2025). In parallel, alternative credentials such as micro-credentials, digital badges, and short-cycle online programs have rapidly expanded, gaining legitimacy as credible indicators of workforce readiness (OECD, 2023). The proliferation of platforms such as Coursera, Udemy, edX, and LinkedIn Learning has further disrupted traditional credentialing, weakening higher education's monopoly on signaling labor market value. These developments signal not only a disruption of traditional credentialing but a strategic inflection point for higher education institutions.

Within this evolving landscape, entrepreneurship education holds particular significance. As labor markets increasingly demand adaptive, opportunity-oriented, and self-directed capabilities, pedagogical frameworks must move beyond conventional knowledge-based instruction toward models that cultivate entrepreneurial cognition, behavior, and affect. Entrepreneurial competencies provide a timely and resilient response to these shifting demands. Their transdisciplinary and transferable nature makes them ideally suited to navigating volatile, uncertain, and increasingly nonlinear career environments, characterized by frequent transitions, portfolio careers, and dynamic, opportunity-driven pathways (Baruch, 2004).

The Project-Based Learning (PBL) for Developing Entrepreneurial Competencies model advanced in this study provides a pedagogical framework capable of addressing these challenges. Grounded in experiential, student-centered learning, the model operationalizes entrepreneurial mindset theory through six core elements that emphasize experiential risk-taking, psychological safety, reflective practice, and iterative decision-making under uncertainty. The conceptual alignment between these pedagogical components and the antecedents of entrepreneurial mindset theory demonstrates the feasibility of embedding such frameworks within higher education curricula. Moreover, the model's emphasis on structured autonomy, collaborative learning, and affective development directly responds to contemporary calls for competency-based education systems that prepare students for roles and industries that may not yet exist (World Economic Forum, 2025). By normalizing failure, embracing uncertainty, and fostering reflective identity work, entrepreneurial pedagogy can effectively cultivate dispositional traits, including resilience, optimism, and tolerance for ambiguity, that underpin adaptive coping and sustained persistence (Wiklund et al., 2019). For instance, experiential modules that expose students to uncertain, real-world challenges have been shown to enhance tolerance for ambiguity by encouraging risk experimentation and iterative reflection. In doing so, entrepreneurial PBL not only serves as a pedagogical innovation but also represents a strategic rearticulation of the university's role in cultivating graduates equipped for complex, opportunity-driven environments.

Finally, these shifts carry significant implications for assessment practices. Traditional summative evaluations are often ill-suited to capture the dynamic, iterative nature of entrepreneurial learning. In contrast, the PBL model advocates for formative, process-oriented assessment strategies that evaluate students' capacity for self-directed learning, decision-making under uncertainty, and reflective recalibration. Aligning assessment with entrepreneurial mindset theory and contemporary trends in skills-based learning is essential if higher education is to remain relevant and impactful.

In sum, the convergence of AI-induced labor market volatility, the rise of alternative credentialing systems, and the widespread prioritization of meta-competencies compel universities to redefine their educational value. Embedding entrepreneurial competencies and mindsets through experiential, opportunity-centered learning models is no longer a desirable innovation but a strategic imperative. Institutions capable of transforming their educational models accordingly will not only safeguard their relevance but also position themselves as engines of economic adaptability and social resilience in an era of perpetual uncertainty.

10.Limitations and Directions for Future Research

While the conceptual alignment between the PBL for Developing Entrepreneurial Competencies Model and entrepreneurial mindset theory offers promising implications for entrepreneurship education, several limitations warrant consideration. First, the empirical evidence supporting the model's efficacy is based on a single pilot study within a specific institutional and cultural context. Although initial results demonstrated competency gains and positive student perceptions, the findings may not generalize across diverse higher education systems, academic disciplines, or national cultures without further validation.

Second, the model's emphasis on experiential learning and iterative reflection, while aligned with entrepreneurial mindset development, presents challenges in large-scale implementation. Variations in institutional resources, faculty readiness, and curricular flexibility may constrain the adoption of such pedagogies in resource-limited or traditionally structured programs. Future research should explore the scalability and adaptability of the model across different institutional types and educational ecosystems.

Third, while this study conceptually links PBL elements to entrepreneurial mindset antecedents identified in the literature (e.g., Daspit et al., 2023; Kuratko et al., 2021), the causal mechanisms through which these pedagogical practices influence mindset development remain underexplored. Longitudinal research designs and mixed-method studies would be valuable in examining how specific elements of the model contribute to sustained changes in entrepreneurial cognition, affect, and behavior over time.

Finally, although the model emphasizes metacognition, self-efficacy, and dispositional traits such as resilience and optimism, its current structure does not explicitly address other important entrepreneurial competencies identified in recent literature, such as ethical judgment, intercultural agility, and digital adaptability (World Economic Forum, 2025). Future iterations of the model could consider integrating these dimensions to better prepare students for the emerging demands of global, AI-driven, and hybrid work environments.

In sum, while this study advances the theorization and application of entrepreneurial mindset development through PBL, it also highlights the need for continued empirical investigation, contextual adaptation, and model refinement. Future research should aim to test, validate, and extend the model across diverse educational and cultural contexts, while exploring its impact on both entrepreneurial competency acquisition and long-term entrepreneurial behavior.

11. Conclusion: Strategic Decision-Making and the Role of Entrepreneurial Mindset Development

Strategic decision-making under uncertainty constitutes a critical challenge not only for firms navigating volatile labor markets but also for universities, students, and employers negotiating their roles in an increasingly unpredictable global environment. As Milliken (1987) and Courtney et al. (1997) observed, uncertainty is a condition that constrains rational planning and amplifies the importance of adaptive, opportunity-driven strategies. In today's VUCA environment, entrepreneurial mindset development has become a strategic imperative across sectors.

Our analysis demonstrated how entrepreneurial mindset, conceptualized as a dynamic constellation of cognitive, behavioral, and dispositional attributes (Daspit et al., 2023; Kuratko et al., 2021), can be deliberately cultivated within higher education settings through pedagogies grounded in experiential, iterative, and agency-driven learning processes. The PBL for Developing Entrepreneurial Competencies Model operationalizes these insights by offering a structured framework through which students rehearse entrepreneurial behaviors and decision-making under simulated uncertainty.

For universities, this entails a strategic repositioning of their educational value proposition. In an era where the primacy of degree-centric hiring is being eroded by skills-based hiring and alternative credentials (World Economic Forum, 2025; Deloitte, 2025), higher education institutions must move beyond content delivery and reimagine themselves as providers of opportunity-oriented, mindset-based learning experiences.

For students, entrepreneurial mindset development is no longer an elective enrichment activity but a strategic career management tool. Students must now act as entrepreneurial agents, navigating career uncertainty through proactive upskilling, opportunity creation, and reflective identity work. The capacity to diversify competencies, tolerate ambiguity, and iterate career decisions in response to shifting market dynamics will define employability and professional resilience in the coming decades.

For employers, the transition from workforce planning by job titles to workforce architectures organized around competencies and entrepreneurial behaviors signals a paradigmatic shift in talent management (Deloitte, 2025). In this context, organizations benefit from graduates equipped with entrepreneurial mindsets not only in entrepreneurial ventures but across all roles requiring judgment, creativity, and adaptive learning. The capacity to leverage uncertainty as a competitive advantage has become a strategic organizational capability.

Finally, this analysis highlights the importance of fostering cross-sector collaboration among universities, policymakers, and employers in advancing entrepreneurial mindset development at scale. Frameworks such as EntreComp and policy recommendations from

bodies like the OECD underscore the value of embedding entrepreneurial competencies in educational ecosystems as a public good. Sustained alignment between educational objectives, labor market needs, and organizational strategies will be essential for enabling individuals and institutions to thrive in the uncertain futures ahead.

In sum, by bridging entrepreneurial mindset theory, experiential pedagogy, and labor market strategy, this article contributes a conceptual foundation and actionable framework for entrepreneurship education's role in preparing opportunity-driven leaders for a complex, uncertain world.

References

1. Alvarez, S.A., Barney, J.B. (2007). Discovery and creation: Alternative theories of entrepreneurial action. *Strategic Entrepreneurship Journal*, *1(1-2)*, pp. 11-26. https://doi.org/10.1002/sej.4
2. Bacigalupo, M., Kampylis, P., Punie, Y. Brande, G.V.D. (2016). EntreComp – The entrepreneurship competence framework. *Publications Office*. Retrieved from: https://data.europa.eu/doi/10.2791/160811
3. Baruch, Y. (2004). Transforming careers: From linear to multidirectional career paths: Organizational and individual perspectives. *Career Development International, 9(1)*, pp. 58-73. https://doi.org/10.1108/13620430410518147
4. Bennett, N., Lemoine, G.J. (2014). What a difference a word makes: Understanding threats to performance in a VUCA world. *Business Horizons*, *57(3)*, pp. 311-317. https://doi.org/10.1016/j.bushor.2014.01.001
5. Blenker, P., Kjeldsen, J., Christensen, P.R. (2021). Preparing for a future career through entrepreneurship education. *International Journal of Management Education*, *19(2)*, *100531*. https://doi.org/10.1016/j.ijme.2021.100531
6. Byrne, O., Shepherd, D.A. (2015). Different strokes for different folks: Entrepreneurial narratives of emotion, cognition, and making sense of business failure. *Entrepreneurship Theory and Practice*, *39(2)*, pp. 375-405. https://doi.org/10.1111/etap.12046
7. Chen, C.C., Greene, P.G., Crick, A. (1998). Does entrepreneurial self-efficacy distinguish entrepreneurs from managers? *Journal of Business Venturing*, *13(4)*, pp. 295-316. https://doi.org/10.1016/S0883-9026(97)00029-3
8. Cope, J. (2011). Entrepreneurial learning from failure: An interpretative phenomenological analysis. *Journal of Business Venturing*, *26(6)*, pp. 604-623. https://doi.org/10.1016/j.jbusvent.2010.06.002
9. Courtney, H., Kirkland, J., Viguerie, P. (1997). Strategy under uncertainty. *Harvard Business Review*, *75(6)*, pp. 66-79.

10. Daspit, J.J., Fox, C.J., Findley, S.K. (2023). Entrepreneurial mindset: An integrated definition, a review of current insights, and directions for future research. *Journal of Small Business Management*. https://doi.org/10.1080/00472778.2021.1907583
11. Deloitte (2024). *The skills-based organization: A new operating model for work and the workforce*. Deloitte Insights. Retrieved from: https://www2.deloitte.com/us/en/insights/topics/talent/organizational-skill-based-hiring.html
12. Deloitte (2025). *2025 Global Human Capital Trends: Navigating the future of work*. Deloitte Insights. Retrieved from: https://www2.deloitte.com/us/en/insights/topics/talent/human-capital-trends.html
13. Deloitte (2025). *The skills-based organization: A new operating model for work and the workforce*. Deloitte Insights. Retrieved from: https://www.deloitte.com/insights/us/en/focus/skills-based-organization.html
14. Develaki, M. (2024). Uncertainty, risk, and decision-making: Concepts, guidelines, and educational implications. *Science & Education*, *33(2)*, pp. 357-382. https://doi.org/10.1007/ s11191-024-00544-w
15. Durville, W. (2025). *Skills-based hiring can help us recruit for jobs that don't exist yet*. World Economic Forum. Retrieved from: https://www.weforum.org/stories/2025/03/skills-based-hiring-jobs-future/
16. Gleißner, W. (2023). Uncertainty and resilience in strategic management: Profile of a robust company. *International Journal of Risk Assessment and Management*, *26(1)*, pp. 75-94. https://doi.org/10.1504/IJRAM.2023.132331
17. Gulati, P., Marchetti, A., Puranam, Ph., Sevcenko, V. (2025). *Generative AI adoption and higher order skills*, doi: 10.48550/arXiv.2503.09212
18. Haynie, J.M., Shepherd, D.A., Patzelt, H. (2012). Cognitive Adaptability and an Entrepreneurial Task: The Role of Metacognitive Ability and Feedback. *Entrepreneurship Theory and Practice*, *36(2)*, pp. 237-265. https://doi.org/10.1111/j.1540-6520.2010.00410.x
19. Kolb, D.A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall.
20. Kouakou, K.K.E., Li, C., Akolgo, I.G., Tchamekwen, A.M. (2019). Evolution view of entrepreneurial mindset theory. *International Journal of Business and Social Science*, *10(6)*, pp. 116-129. https://doi.org/10.30845/ijbss.v10n6p13
21. Kuratko, D.F., Fisher, G., Audretsch, D.B. (2021). Unraveling the entrepreneurial mindset. *Small Business Economics*, *57*, pp. 1681-1691. https://doi.org/10.1007/s11187-020-00372-6
22. Larmer, J., Mergendoller, J., Boss, S. (2015). *Setting the standard for project-based learning: A proven approach to rigorous classroom instruction*. ASCD.
23. Mäkelä, E., Stephany, F. (2024). *Complement or substitute? How AI increases the demand for human skills*, doi: 10.48550/arXiv.2412.19754

24. Milliken, F.J. (1987). Three types of perceived uncertainty about the environment: State, effect, and response uncertainty. *Academy of Management Review*, *12(1)*, pp. 133-143. https://doi.org/10.5465/AMR.1987.4306502
25. Mitchell, R.K., Busenitz, L., Lant, T., McDougall, P.P., Morse, E. A., Smith, J.B. (2002). Toward a Theory of Entrepreneurial Cognition: Rethinking the People Side of Entrepreneurship Research. *Entrepreneurship Theory and Practice*, *27(2)*, pp. 93-104. https://doi.org/10.1111/1540-8520.00001
26. Morris, M.H., Webb, J.W., Fu, J., Singhal, S. (2013). A competency-based perspective on entrepreneurship education. *Journal of Small Business Management*, *51(3)*, pp. 352-369.
27. Nägele, C., Stalder, B.E. (2017). Competence and the need for transferable skills. In: M. Mulder, (Ed.) *Competence-based vocational and professional education* (pp. 739-754). Springer. https://doi.org/10.1007/978-3-319-41713-4_34
28. Naumann, C. (2017). Entrepreneurial mindset: A synthetic literature review. *Entrepreneurial Business and Economics Review*, *5(3)*, pp. 149-172. https://doi.org/10.15678/EBER.2017.050308
29. OECD (2023). *Education at a glance 2023: OECD indicators*. OECD Publishing. https://doi.org/10.1787/b43f957f-en
30. OECD (2023). *Flexible adult learning provision: What it is, why it matters, and how to make it work*. Retrieved from: https://www.oecd.org/content/dam/oecd/en/topics/policy-sub-issues/adult-learning/booklet-flexibility-2023.pdf
31. Organisation for Economic Co-operation and Development (2025). *Trends Shaping Education 2025*. OECD Publishing. https://doi.org/10.1787/ee6587fd-en
32. Outsios, G., Kittler, M. (2018). Entrepreneurship and the mediating role of institutions: A multilevel cross-country analysis. *Journal of Business Research*, *89*, pp. 182-193. https://doi.org/10.1016/j.jbusres.2018.01.033
33. Santoso, R., Junaedi, I., Prayitno, S.H., Santoso, D. (2021). Creating a startup at a university by using Shane's theory and the entrepreneurial learning model: A narrative method. *Journal of Innovation and Entrepreneurship*, *10(1)*, pp. 1-25. https://doi.org/10.1186/s13731-021-00162-8
34. Santoso, R., Prayitno, S.H., Junaedi, I., Santoso, D., Sunaryanto, L, (2023). Project-based entrepreneurial learning (PBEL): A blended model for startup creations at higher education institutions. *Journal of Innovation and Entrepreneurship*, *12(1)*, pp. 1-22. https://doi.org/10.1186/s13731-023-00276-1
35. Sarasvathy, S.D. (2001). Causation and effectuation: Toward a theoretical shift from economic inevitability to entrepreneurial contingency. *Academy of Management Review*, *26(2)*, pp. 243-263. https://doi.org/10.5465/amr.2001.4378020
36. Shane, S., Locke, E.A., Collins, C.J. (2003). Entrepreneurial motivation. *Human Resource Management Review*, *13(2)*, pp. 257-279. https://doi.org/10.1016/S1053-4822(03)00017-2

37. Shen, Y., Wang, Q., Hua, D., Zhang, Z. (2021). Entrepreneurial learning, self-efficacy, and firm performance: Exploring moderating effect of entrepreneurial orientation. *Frontiers in Psychology*, *12*, *Article 731628*. https://doi.org/10.3389/fpsyg.2021.731628
38. Wiklund, J., Nikolaev, B., Shir, N., Foo, M.-D., Bradley, S. (2019). Entrepreneurship and well-being: Past, present, and future. *Journal of Business Venturing*, *34(4)*, pp. 579-588. https://doi.org/10.1016/j.jbusvent.2019.01.002
39. World Economic Forum (2023). *The Future of Jobs Report 2023*. Retrieved from: https://www.weforum.org/reports/the-future-of-jobs-report-2023
40. World Economic Forum (2025). *How AI is reshaping the career ladder, and other trends in jobs and skills on Labour Day*. Retrieved from: https://weforum.org/stories/2025/04/ai-jobs-international-workers-day
41. World Economic Forum (2025). *The Future of Jobs Report 2025*. Retrieved from: https://www.weforum.org/reports/the-future-of-jobs-report-2025