Designing for Success: A Framework for Integrating Design Thinking into University Entrepreneurship Course*

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Abstract

This study examines how integrating design thinking into university courses can enhance entrepreneurial education. Interviews with educators and students from four pioneering European and U.S. institutions identify nine critical components for successful projects, grouped into environmental factors—mentoring, tools and spaces, external recognition—and process factors—interdisciplinarity, fieldwork, experimentation, and user-centred research. Project continuity is emphasised as a critical indicator of course effectiveness. These findings contribute to a framework that empowers educators to develop design thinking-based entrepreneurship projects and fosters impactful student learning experiences.

Keywords: entrepreneurship education, design thinking, constructivist pedagogy
JEL Codes: M13, O32, I23

1. Introduction

Entrepreneurship education at universities has seen significant growth over the past few decades. Initially, only a handful of institutions offered courses related to entrepreneurship in the 1970 s, but by 2005, this figure had surged to over 1,600. Action-based learning, which emphasises learning by doing, has become one of the most popular course delivery methods. Universities offer less classroom-focused activities and more hands-on experiences in group settings (Rasmussen/Sørheim 2006), aligning more closely with the dynamic nature of entrepreneurship.

Action-based entrepreneurship education, characterised by hands-on experiences and group collaboration, aligns with the problem-solving approach inherent in design thinking methodology. Therefore, it is unsurprising that design thinking has been increasingly introduced as a teaching methodology in entrepreneurship courses (Daniel 2016). Its integration aligns seamlessly with the overarching emphasis on experiential learning and the development of innovative mindsets (Linton/Klinton 2019). By embracing design thinking principles, educators can effectively bridge theory and practice, equipping students with the skills and mindset necessary to navigate the complexities of entrepreneurship in a

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dynamic business landscape. Research increasingly highlights the parallels between design and entrepreneurship (Sarasvathy 2004). Penaluna and Penaluna (2009) point to characteristics such as experiential learning, non-linearity, unpredictability, ambiguity, the development of mindsets, and response to constraints to illustrate analogous experiences of designers and entrepreneurs. Stanford University has defined design thinking as "*a catalyst for innovation and bringing new things into the world*" (Plattner/Meinel/Leifer 2011), and Brown (2008:1) has called it *"a methodology that imbues the full spectrum of innovation activities with a human-centred design ethos."*

The rapid advancement of technology, particularly artificial intelligence (A.I.), has transformed various sectors, including education (Chiu/Xia/Zhou/Chai/Cheng 2023) and entrepreneurship (Shepherd/Majchrzak 2022). Integrating design thinking into entrepreneurship education is seen as a method to foster creativity and innovation and equip students with essential IT-related skills. As students engage in design thinking, they inherently develop prototyping and user research skills, both fundamental in the tech industry. Students can gain hands-on experience with data analysis, machine learning, and automation by incorporating A.I. tools and techniques in design thinking projects, enhancing their technical proficiency and entrepreneurial capabilities.

Integrating A.I. into design thinking projects can also foster more innovative and effective solutions. For instance, A.I. can assist in gathering and analysing user data, identifying patterns, and predicting trends, enabling more informed decision-making and solution development. This integration prepares students for the technological demands of the modern entrepreneurial landscape and fosters a mindset that embraces technology as a facilitator of innovation.

Various studies support the role of design thinking in equipping students with IT-related skills. For example, Lynch, Kamovich, Longva, and Steinert (2021) highlight how combining technology and entrepreneurial education through design thinking enhances students' learning experiences and innovation capabilities. Similarly, Linton and Klinton (2019) argue that a design thinking approach in university entrepreneurship education fosters a deeper understanding of technology's role in solving complex problems.

Despite the increasing popularity of design thinking in entrepreneurship education, there remains a gap in understanding the specific mechanisms through which design thinking can be effectively applied within entrepreneurship courses. To address this gap, we conducted a comprehensive study involving in-depth interviews with educators and students from four prestigious European and U.S. institutions. These institutions were selected for their extensive experience and innovative initiatives incorporating design thinking into their entrepreneurship curricula.

Our study intentionally included Slovenia to represent Central and Eastern European (CEE) countries. Entrepreneurial education across Eastern Europe, including Slovenia, has rapidly evolved, drawing inspiration from successful approaches in Western Europe and the United States. The post-socialist transition in these countries introduced new economic systems, fostering the need for entrepreneurial skills as they shifted from state-controlled economies to market-driven ones. As a result, entrepreneurial education developed with a unique focus on addressing the challenges of economic transformation. Recent trends in Eastern European countries, including Slovenia, underscore the importance of integrating entrepreneurship into university curricula, focusing on fostering transversal skills such as digital literacy, initiative, and cultural awareness. In Slovenia specifically, there is a concerted effort to cultivate an entrepreneurial mindset among university students, emphasising practical skills for innovation and venture creation (Zupan/Svetina Nabergoj/Drnovšek 2014).

In our study, we sought to gain insights into design thinking-based projects in the context of entrepreneurship courses and identify the key components contributing to their success. Our analysis revealed several common elements shared among all projects, categorized into nine critical components. These span environmental components, such as mentoring, tools and spaces, and external recognition, which create a supportive ecosystem, and process components, such as interdisciplinarity, fieldwork, experimentation, and user-centred research, which directly impact the practical execution of the project. The presence of these components is essential for creating a conducive environment for student-led entrepreneurial endeavours.

2. Design Thinking as a Teaching Method within Constructivist Learning Theory

Constructivist Learning Theory (CLT) suggests that learning is an active process. Learners build their understanding and knowledge through experience and reflection. Grounded in the theories of Vygotsky and Piaget (Piaget 1954; Vygotsky 1978), CLT emphasises that knowledge acquisition is profoundly personal and interactive with the environment. This approach is aligned with methodologies that engage learners in real-world projects, enhancing essential higher-order thinking skills such as analysis, synthesis, and evaluation in entrepreneurship education.

Problem-Based Learning (PBL) and Action-Based Learning (ABL) are prominent educational strategies embodying the constructivist approach. PBL involves students in solving real-world problems and achieving specific learning outcomes that mirror professional situations they might face as entrepreneurs (Barrows 1986). ABL extends this by having students engage in and reflect on real-life activities, thus deepening their understanding of the subject matter through active participation (Kolb 2014). Both methodologies are designed to prepare students for the complexities of real-world entrepreneurial roles, enhancing their readiness and adaptability to the dynamic business environment.

Design thinking is another emerging educational methodology that complements the principles of both PBL and ABL in the context of entrepreneurship education. It incorporates a creative, iterative process of problem identification and solution development, emphasising human-centred design and innovation—traits essential for successful entrepreneurship (Brown 2008). Design thinking was adopted by entrepreneurship faculty because it was seen as one of the most promising new teaching methodologies in entrepreneurship education (Neck/Greene 2011) as well as linked to successful learning outcomes when used in teacher training settings (Şahin/Sarı/Şen 2024). Its combination of creative and analytical processes makes it particularly effective in fostering both innovative thinking and problem-solving skills. It provides a structure for educators to creatively address complex, multifaceted educational problems, promoting intellectual risk-taking and open-ended problem-solving (Henriksen/Richardson/Mehta 2017).

The process of design thinking unfolds through several stages:

- Understanding: This initial phase involves observation and empathy, techniques that are essential for gathering deep insights about users' needs and experiences (Plattner et al. 2011).
- Defining Problems: This phase starts with surprising observations and quotes and engaging in inference and interpretation. Using tools such as Venn diagrams, scenarios, or storyboards, students formulate precise problem statements, clarifying the challenges that need solutions (Liedtka 2018).
- Generating Ideas: Ideation stages involve individual and team brainstorming and other divergent creative processes to create many potential solutions. They foster a broad exploration of possibilities and then proceed through the selection process to narrow down the solutions entering the next phase (Kelley/Kelley 2013).
- Prototyping: Developing tangible representations of ideas allows students to visualise solutions and explore their practicality through simple methods like sketching or more complex techniques such as 3D modelling (Seidel/Fixson 2013). The goal of prototyping is to explore multiple realities and bring solutions to life as if they existed to test them with users in the next phase.
- Testing: Based on feedback from users and other stakeholders, prototypes are critically evaluated for desirability. The solutions are then refined, making necessary adjustments to better meet user needs (Brown 2008), and tested for viability and feasibility before proceeding into the next development cycle.

This iterative nature of design thinking aligns with CLT by emphasising ongoing learning through experience and reflection, thus enhancing students' critical thinking and problem-solving abilities. Moreover, design thinking encourages collaboration and interdisciplinary thinking, reflecting the social constructivist view that knowledge is co-constructed through interaction with others (Johnson/Johnson 1999).

Additionally, studies have shown that design thinking might influence entrepreneurial intentions in some contexts (Woraphiphat/Roopsuwankun 2023) and design thinking has also been shown to boost both entrepreneurship and intrapreneurship, as highlighted in a comprehensive literature review by Rösch, Tiberius, and Kraus (2023). Their review demonstrates that implementing design thinking enhances creativity, improves problem-solving capabilities, and increases entrepreneurial activity. Moreover, design thinking has been successfully applied to business model innovation, further underscoring its versatility and impact in driving innovation (You 2022).

While design thinking is increasingly being integrated into entrepreneurship education across various educational settings, it is essential to recognise the distinct context of university-level education. Unlike primary school settings, which often focus on foundational skills and creativity development, university-level entrepreneurship education operates within a more complex ecosystem. At the university level, students typically have more advanced cognitive abilities and are preparing for professional careers or entrepreneurial endeavours. Investigating how design thinking enhances entrepreneurship education at the university level is essential for gaining insights specific to the unique needs and goals of higher education institutions and their stakeholders. This understanding will also facilitate the continued advancement of design thinking as an effective pedagogical approach in entrepreneurship education.

3. Methodology

The research aimed to identify the components contributing to the success of a design thinking-based entrepreneurship project within university-level entrepreneurship courses. For our study, we conducted research across four higher education institutions spanning three countries. We selected educators who had recently mentored at least one entrepreneurship course that utilized design thinking and could recall at least one successful project. Similarly, we identified students who had participated in an entrepreneurship course based on design thinking methodology and had completed a course project.

Table 1 below presents the relevant project details. This study focuses on the dynamics of design thinking-based entrepreneurship projects, examining the specific features and processes that define these initiatives. Our primary objective is identifying core components contributing to their success. By doing so, we ensure that our framework is both theoretically sound and practically applicable, providing educators with actionable insights for effectively structuring and supporting entrepreneurship projects within a university setting.

Our sampling approach combined purposive sampling techniques, incorporating critical case sampling and snowball sampling, which are typically employed in preliminary investigations of novel topics and prevalent in exploratory qualitative studies (Noy 2008). We adjusted the interview count based on the incremental contribution of new codes to our research. Acknowledging that purposive sampling allows for flexibility in determining sample sizes, the selected sample size is deemed sufficient for this study, as affirmed by Onwuegbuzie and Leech (2007) and as evident from additional codes gathered from the last three interviews. The research institutions where we conducted interviews were The University of Wales Trinity Saint David with six participants; The University of Ljubljana with four participants; Stanford University with one participant; and Cornell University with one participant. Interviews were selected as the data acquisition method to capture insights from individuals deemed knowledgeable and experienced in the researched topic, enabling the collection of rich and in-depth data about critical aspects of the research project. Table 2 provides details about the interviewees.

Table 1. Project details

Project	Country	Course duration (weeks)	Class size	Project team size	Teaching team size	Project area (industry)
1	Slovenia	14	50	3	2	Wireless ordering device for restaurants
2	U.K.	6	12	6	4	Hi-tech plush toys
3	U.K.	12	100	3	2	Artwork from recycled materials
4	Slovenia	14	50	5	2	Video production
5	U.K.	10	26	1	2	Furniture for children with disabilities
6	U.K.	12	25	5	3	N.A. (participant asked not to disclose information)
7	U.K.	14	30	2	2	Software
8	U.K.	12	35	1	1	Setting up a retail store
9	USA	3	11	1	3	Education
10	USA	12	25	5	1	Helping refugees – a social enterprise
11	Slovenia	6	40	3	2	Event planning
12	Slovenia	12	30	2	1	Mobile application

In-depth interviews, a commonly employed data collection method in qualitative research, were utilised for this study (Bogle 2008). These in-depth interviews facilitate a deep understanding of the subject matter from the participant's perspective through storytelling (Seidman 2013). The interviewing process aimed to minimise interviewer and situational influence to ensure credibility and accuracy in describing, concluding, explaining, and interpreting findings. Utilising nVivo software, relevant data segments were coded, facilitating data organisation and retrieval. The iterative data analysis process involved constant reorganisation, exploration, and integration of the data, with the researchers identifying patterns and making connections. This iterative process continued until sufficient components in the framework were established, achieving researcher consensus. Throughout, emerging components were informed by frequent literature consultations.

Table 2. Participant description

Interview n.	Gender	Position	Background	Location	Interview Type	Interview length
1	Male	Student/ mentor	Business	Slovenia	In-person	65 min
2	Male	Student/ Mentor	Design	U.K.	In-person	34 min
3	Male	Senior faculty	Design	U.K.	In-person	41 min
4	Female	Student	Business	Slovenia	In-person	61 min
5	Male	Senior faculty	Design	U.K.	In-person	37 min
6	Male	Junior faculty	Industrial Design	U.K.	In-person	38 min
7	Male	Senior faculty	Arts	U.K.	In-person	56 min
8	Female	Student/Industry mentor	Arts	U.K.	In-person	44 min
9	Male	Junior faculty	Education	USA	Online	39 min
10	Female	Junior faculty	Anthropology	USA	Online	45 min
11	Male	Student	Business	Slovenia	In-person	61 min
12	Male	Senior faculty	Business	Slovenia	In-person	55 min

Inductive codes were assigned during the coding process, guided by insights from the transcribed text, resulting in two rounds of coding. Initially, we conducted an "as you go" coding approach while reviewing the interviews. Subsequently, all interviews underwent deductive coding based on the initial codes. During the secondary coding, three additional insights emerged, prompting a final analysis of the interviews and the coding of these insights. In the first coding round, 35 codes were identified and colour-coded based on shared characteristics. For example, phases and characteristics of the design thinking process were assigned one colour, while connections with the community and project outreach were assigned another. A total of 46 codes were assigned, with 12 excluded from the analysis due to limited sources. The remaining 34 codes were then logically integrated into nine components of the framework. Table 3 below is an example of one of these components, where six codes were combined to form a higher-level concept named the "Mentoring" component of the framework.

Table 3. Examples of codes which constitute the "Mentoring" component

Codes (inductive)	Number of sources	Number of references
External mentors at classes	5	6
External mentors – advisers	9	24
Guests	3	3
Professional collaborators	5	11
Role of mentors	12	48
Role of mentors after the course	4	6

The study adopts an integrated approach to analysing insights from both students and teachers to provide a holistic understanding of the factors contributing to the success of design thinking-based entrepreneurship projects. This approach allows us to capture the dynamic interchange between the educators' mentorship roles and the students' experiential learning. Combining these perspectives offers a more nuanced and comprehensive picture of the factors that drive project success. This integration ensures consistency and coherence throughout the analysis, maintaining the narrative flow while highlighting the interconnected associations between the various components of the educational environment. This technique not only preserves the integrity of the data but also enhances the depth of the findings, offering a more complete understanding of how design thinking impacts entrepreneurial education.

4. Results

The courses examined in this study were based on the design thinking teaching methodology with student-led projects following the five steps presented above. In all of them, the learning process unfolded dynamically and iteratively. Initially, professors introduced a problem field for exploration, or students presented problem fields of their interest, initiating the research process to deepen the understanding of the selected challenges. Through various methods, such as interviews and desktop research, students discerned which problems were worth addressing and for whom. Subsequently, armed with insights from their research, students refined existing ideas or generated novel solutions to tackle these identified challenges. The latter half of the analysed courses was dedicated to prototyping and testing these solutions, enabling students to gather constructive feedback from users. This feedback loop informed iterative improvements to their solutions, ensuring they were refined before final implementation. This structured approach fosters creativity and innovation and equips students with the practical skills needed to navigate the complexities of real-world entrepreneurial endeavours.

Each of the twelve projects uniquely combined design thinking and entrepreneurship education elements. However, we have identified several shared commonalities among all projects, detailed in Table 4 and referred to as project components throughout this paper.

Table 4. Project components

Components		Number of specific examples (references)
1.	Meaningfulness of the project	70
Process components		
2.	Experimentation	59
3.	User-centred research	57
4.	Fieldwork	15
5.	Interdisciplinarity	17
Environmental components		
6.	Mentoring	89
7.	Tools and spaces	20
8.	External recognition	49
9.	Continuity	30

These interconnected components form the broad context in which learning takes place. However, these components manifested differently in each of the courses; for example, the tools and spaces used during the project work varied significantly based on the characteristics of each project. Some projects necessitated only basic prototyping materials like Post-it notes and a computer, while others demanded advanced machinery such as CNC machines. In subsequent chapters, we delve deeper into these components and aim to elucidate their roles with supporting literature.

4.1 Meaningfulness

Pursuing meaningful learning experiences is a cornerstone of student engagement and achievement (Assor/Kaplan/Roth 2022). In our study, we define "meaningfulness" as the extent to which students perceive their entrepreneurship projects as significant, relevant, and personally valuable. This concept encompasses several dimensions:

– Personal Relevance: Aligning the project with students' interests, values, and goals enhances their engagement and investment in the project.
– Impact and Purpose: The belief that the project will have a real-world effect, addressing genuine problems and contributing to meaningful change, thereby motivating students.
– Emotional Connection: The emotional investment students feel towards the project, including the satisfaction from tangible results and positive stakeholder feedback.
– Autonomy and Ownership: Students' sense of ownership and control over their projects fosters greater commitment and engagement.

The term "meaningfulness" was derived through in-depth interviews with students and educators, where participants frequently highlighted the importance of these dimensions in their descriptions of successful projects. The recurring themes of personal relevance, impact, emotional connection, and autonomy were identified as key factors contributing to the perceived meaningfulness of the projects.

As our investigation delves into diverse student projects, ranging from business endeavours to community initiatives, a central theme emerges -the profound sense of purpose guiding them. Beyond the confines of academic obligation or instructor directives, these students navigate their educational journey propelled by a deeper connection to their projects. In one of the projects, students were designing solutions for immigrants from Congo, and it resulted in a very personal and emotional experience with their users, as one of the participants observed concerning the interaction between students and their "customers":

> *"... it was an emotional moment when they witnessed Congolese women hugging them [the students]." (Project number 10)*

This connection transcends mere academic pursuits, resonating with the principles of humanistic education theory, which emphasises the importance of personal relevance and intrinsic motivation in learning (Nehari/Bender 1978). In our exploration, we uncover a departure from the traditional educational paradigm, where educators dictate project choices, as students actively seek out and champion causes that hold personal significance. Through their autonomy and agency, students forge meaningful connections with their projects, fostering academic growth and emotional and empathetic bonds with the communities they serve. As exemplified by one educator's encouragement for students to identify and tackle real-world problems, our findings underscore the transformative potential of meaningful learning experiences in shaping the educational landscape. He stated:

> *"We encourage the students to just go out and identify problems." (5)*

In certain instances, the lecturer provided the initial theme for the project challenge, although students were consistently encouraged to devise their solutions. One educator elucidated their approach to supporting students' ideas:

> *"It was just [an] idea, we said to them "take a risk", and we kind of told them what they could do originally with the tweeting, but then they started coming up with ideas." (2)*

By empowering students to navigate their educational journey with purpose and autonomy, we not only align with the principles of humanistic education theory but also help change the educational paradigm. Through their active involvement in projects that hold personal significance, students make deeper connections with their learning, surpassing conventional academic restrictions to create meaningful impacts within their local or wider communities. It becomes evident that supporting meaningful learning experiences is not only an educational aspiration but an important catalyst for empowering students to become active agents of change.

4.2 Process Factors

4.2.1 Experimentation Enhances Learning

Creative experimentation, which included iterative prototyping and testing, was used in all the projects, and all participants indicated that this was a vital part of the design process. Building and testing models through experimentation or prototyping have already received attention as an instructional approach to developing creativity. Schrage (1999) argues that creating models is essential to innovation and that creative improvisation, or 'serious play', is at the core of creative thinking. Experimentation through prototyping has been recognised as an effective creativity-based product development tool that encourages learning from failures (Thomke 1998).

With the use of simple yet concrete physical models, people quickly and in a much richer way communicate, give meaning, and create stories around what were previously intangible thoughts (Hadida 2013), as one student explained:

> *"Actually, the cardboard box, which you have in your hand, gives you the information and motivation to do something more advanced. The possibility of creativity increases." (1)*

Learning through failed tests is a planned way of lowering the risk of projects: experiencing setbacks early in the design process is relatively inexpensive, and designers become better at risk-taking (McGrath 2011). In entrepreneurial ventures, entrepreneurs, from failing, learn about themselves, their ventures, and the environment (Cope 2011). As one educator noted:

> *"They can actually do it, and if it fails, it does not really matter, so they are learning on the job." (8)*

Experimentation was necessary for other reasons as well. One reason was to motivate students to continue with their projects: "*Each prototype that we did was for me the motivation to continue*." (1) They often put in extra hours and developed the projects in their free time. Another reason is the use of prototyping tools. As several participants described, students became proficient in several contextually important skills: for instance, the use of prototyping software, machinery, photography, videography, and drawing. They also embraced risk-taking as a way of learning.

4.2.2 User-centred Research Builds Emotional Connections with the Users

As designing solutions to meaningful problems includes satisfying the individual needs of potential users, the design practice must be user- or human-centred.

To understand users, students used empathy, which "is the art of stepping imaginatively into the shoes of another person, understanding their feelings and perspectives, and using that understanding to guide your actions" (Krznaric 2014). This meant finding and engaging with users to understand them better, as one student noted:

> *"We talked to all of my friends who own bars or know someone who owns a bar." (1)*

Moreover, one senior professor said:

> *"There was a lot of observational studies, questionnaires, and just kind of fundamental sort of research." (5)*

Researchers have correlated empathy with cooperation, sharing, academic achievement, emotional intelligence, and educational outcomes (Salovey/Grewal 2005; Feshbach/Feshbach 2011). Empathy training through user-centred research, therefore, serves two goals. It enhances the quality of solutions and increases students' potential for academic achievement, emotional intelligence, and cooperation-based results.

4.2.3 Fieldwork Drives Authentic Learning

Fieldwork increases student engagement (Walsh/Larsen/Parry 2014), adds to students' personal and social development, and allows students to be socialised into their professions and careers (Nolinske 1995). Fieldwork is a common element of all projects, as one educator explained:

> *"We take a bus to their city, and we spend a day in their lives, in their homes, seeing their neighbourhood." (10)*

Students need to be moved into the field-based exploration mode because they can experience first-hand the role of the entrepreneur in an authentic context. By acting in a business context, students might also enhance their entrepreneurial intentions (Teixeira/Forte 2009). Fieldwork mainly was centred around user observation and testing the prototypes, using observation to collect data, as one student explained:

> *"We worked a lot outside of the university; the prototype was assembled from cardboard at home, the second prototype, a video, we filmed with a colleague in a restaurant." (1)*

Experimental fieldwork improves the quality of findings and the generalisability of results obtained by experimenting on a random population (List, 2011). As a result, the developed solution to a researched problem tested via fieldwork in an authentic environment might be commercially more successful.

4.2.4 Interdisciplinarity Boosts Creativity

Being an entrepreneur transcends several disciplines, and an educational environment connecting several disciplines is needed to successfully foster entrepreneurial competencies among students (Ochs/Watkins/Boothe 2001). One educator described the multidisciplinary composition of his class:

> *"I have engineers, computer scientists, and business students." (10)*

All projects employed an interdisciplinary team, directly through team members or indirectly through ad-hoc activities. According to the model of learning communities, enrolling students from different backgrounds to work on common assignments strengthens the social and intellectual connections between students (Zhao/Kuh 2004). Educators commented on the collaborative nature of work:

> *"There is a lot of peer-to-peer learning in a studio environment." (6) and "They even had the other teams use the product they created." (9)*

Interdisciplinarity played a significant role, as predicted by design thinking literature (Anderson 2012) and emphasised by research on the role of cultural and gender diversity in team success (Rock/Grant 2016).

4.3 Environmental Factors

4.3.1 Mentoring Enhances Entrepreneurial Learning

Mentors are essential in an entrepreneur's professional development as they influence their decision-making and identity development (Yitshaki 2024). The student respondents recognised this, and as one student explained:

> *"Without mentors, the project would not have even started in the first place. He gave us financial support and motivated us." (4)*

Mentors fluctuated in their level of involvement throughout the projects, sometimes highly engaged and at other times less active but still supportive. One mentor explained his role:

> *"Students are being proactive, and we react to what they need and adapt and change." (6)*

Mentors can be one-time guests, ongoing guides, or professionals brought in by the lecturer or the group. One group included mentors who acted as facilitators and were proficient in the process, though often outside the project's specific challenges. These mentors can be educators, lecturers, faculty members employed by the university, or guest mentors with a general knowledge of the process, such as entrepreneurs. One educator explained how the project was passed over to his colleagues at the university:

> *"So, my role here is to help start the project, which is then passed on to other people the university employs to help with more specific steps. I would set up meetings and bring relevant people who can help the most." (3)*

On the other hand, some mentors had project-specific knowledge and helped one or more groups, depending on the projects these groups were tackling.

Often, these mentors would come from partner companies or the school's alumni network, as one educator explained:

> *"We have a set of companies who come in and advise students, mainly through past student networks." (7)*

Mentoring contributes to the projects' success and the development of the protégé's careers by increasing their knowledge, prospects of high-paying positions, and job satisfaction.

4.3.2 Tools and Spaces Spark Innovation

Studies show that more playful approaches and environments in the classroom support the development of cognitive, social, emotional, creative and physical skills (Parker/Thomsen/Berry 2022). Furthermore, technologically enhanced learning environments significantly and positively affect student learning (Brooks 2011). In some cases, schools did not have sufficiently adaptable tools and spaces, so they had to blend different environments:

> *"We started the workshops in the computer science room, so we would always do the group sessions in the computer science room, but then the art stuff took place in the art department." (2)*

Numerous local communities have recognized the effectiveness of providing access to prototyping tools and spaces, often establishing 'maker spaces' or 'hacking spaces' in academic institutions and libraries. One educator described the space students can use:

> *"We have wood, metal, plastics, fibreglass, and plaster moulding facilities, glass processing facilities; we got access to 3D printing facilities as well and kind of general model making, Styrofoam, automotive styling bay." (5)*

Bringing together people from different backgrounds and diverse ways of thinking is highly encouraged to unlock creativity. To develop a novel synthesis, groups should consist of members with different specialities, which should be as loosely connected as possible. Also, an environment that provides feedback challenges novel solutions.

4.3.3 External Recognition Drives Motivation

One aspect of external recognition is creating an impact, where students' products are used in contexts outside their classroom, usually tied to the community's or industry's needs. This is an element of authentic learning environments, which, in the long term, also motivates students to pursue a particular activity later in their careers (Strobel/Wang/Weber/Dyehouse 2013). Looking for external recognition in an entrepreneurship class supports increasing entrepreneurial intentions and students' probability of becoming entrepreneurs. One student noted the reach of an event he developed as part of the course:

“The main confirmation was 130 visitors. This means that someone is willing to invest their time to come.” (11)

Analysed projects exhibited high levels of faculty involvement; students would get a chance to present their work and receive comments from numerous faculty members, including those with no direct connection to the course. As one educator explained:

“They get a critique from a panel of staff, and it is not just product designers; there are normally at least two product designers, two automotive designers, and other staff would contribute as well.” (5)

Several projects, especially those in which students were cooperating with an outside company, exhibited intensive cooperation efforts between the students and their industry partners, as one educator explained:

"At one point, we [students and the teaching team] went to Germany, where they presented their concepts to the whole industry team." (6)

Additionally, students had a chance to show their work at various local and national events and to the media, as these examples show:

“We have a public exhibition, which is held at the Waterfront museum. We also take that work up to New Designers in London.” (5)

“We get really good coverage by the local media, local press. Sometimes even in the national press.” (8)

External recognition manifested itself in various ways and was a persistent element of all analysed projects. It could be through media exposure, interest from industry peers, interest from users of their developed solution, attending public exhibitions, and the like.

4.4 Continuity Builds Real-World Impact

All projects described by participants continued beyond the class duration, individually or within a group, sometimes in the original class group or with a new team. One student recounted:

“After the course was finished, we decided to continue with the project.” (4)

As they lost access to the university tools, spaces, and mentors, some students connected with companies to develop their projects further. One educator explained how his student cooperated with a company after the course was over and lost access to the product development tools and spaces she needed:

"...looking at how she can, in collaboration with that company, develop the product for commercial launch." (5)

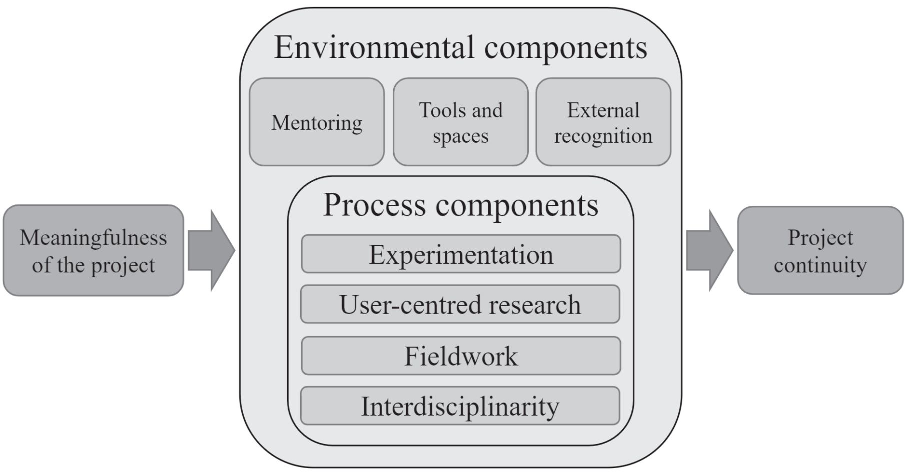
Continuity and meaningfulness are inherently linked, as projects imbued with meaning are more likely to persist beyond the class. In contrast, continuity in out-of-school settings enhances authenticity and deepens learning experiences.

Moreover, the ultimate validation for students in real-world settings lies in attracting paying customers to their projects. Many of the analysed projects acquired paying customers, which added additional motivation to continue the project after completing the course.

5. Discussion of results

Our research identified vital elements for the success of design thinking-based entrepreneurship projects. From these insights, we developed a framework of nine components that significantly enhance entrepreneurship education. Our framework suggests that successful projects share a specific trait, notably continuity. This ongoing nature is influenced by the project's inherent meaningfulness and a combination of nine components, categorized into environmental components and process components. The environmental components include mentoring, tools and spaces, and external recognition, while the process components include interdisciplinarity, fieldwork, experimentation, and user-centred research. As illustrated in Figure 1, these components together provide a comprehensive framework to support the success of an entrepreneurial project.

Figure 1. Framework for Design thinking-based entrepreneurship education



Environmental components, such as mentoring, access to resources, and external recognition, create a supportive ecosystem that boosts project quality and impact. Mentoring, for instance, offers not just guidance but crucial support in navigating the complexities of entrepreneurial endeavours, underscoring the vital role of mentors in entrepreneurship. Process components like interdisciplinarity, experimentation, and user-centred research impact the practical aspects of project execution. Interdisciplinarity encourages a creative and comprehensive approach by incorporating diverse viewpoints, which is crucial for innovative solutions.

Meaningfulness is considered an input force or predictor variable. It is a fundamental component that drives students' engagement and motivation throughout the project. The design thinking methodology inherently fosters meaningfulness by emphasising empathy, real-world problem-solving, and user-centred research. These elements help students connect personally and purposefully with their projects, enhancing their commitment and the overall quality of their work. We, therefore, hypothesise that the design thinking process is instrumental in generating this sense of meaningfulness, making it a critical input variable in our model.

One significant finding from our study is that continuity could be an important indicator of a course's effectiveness. Projects beyond the classroom suggest greater engagement and commitment, which are keys to authentic entrepreneurial success. This observation supports educational theories which argue that meaningful learning extends outside academic settings into practical applications, thereby improving academic achievements and real-world outcomes.

We propose that specific process and environmental components—particularly experimentation, mentoring, user-centred research, external recognition, and project continuity—enhance a project's meaningfulness throughout its duration. Project continuity indicates a project's success and reflects the continuing influence of the educational experience on students. It shows that students are motivated and equipped with the necessary skills to continue their entrepreneurial projects. Thus, project continuity is a direct outcome of the effective integration of design thinking in entrepreneurship education.

By delineating meaningfulness as an input force driven by the design thinking methodology and project continuity as a key output factor, we provide a clearer understanding of their roles within our proposed framework. This distinction underscores the dynamic nature of our model, highlighting how design thinking not only initiates engagement and meaningfulness but also leads to sustained entrepreneurial efforts.

The confidence built through active, iterative learning processes typical of design thinking may lead to higher entrepreneurial intentions, demonstrating the method's potential to shape future entrepreneurs.

6. Implications

The proposed framework illustrates the connections among the project's nine components, suggesting that a project's continuity depends on both its process components—interdisciplinarity, fieldwork, experimentation, and user-centred research—and its environmental components—mentoring, tools and spaces, and external recognition—as well as its inherent meaningfulness. Therefore, it is argued that this framework describes and, when implemented in project-based university-level entrepreneurship education, can significantly enhance the design of an effective design thinking-based learning experience. It methodically presents how effective project work can be structured, acknowledging that these findings are limited to the context of the empirical analysis conducted.

The primary practical implication is that integrating design thinking into course content and curriculum enhances entrepreneurship education. Our findings suggest that learning is enhanced under this model, and projects tend to continue beyond the formal course duration. This persistence may increase the likelihood that students will develop marketable products, making this framework a valuable addition to entrepreneurship courses aimed at producing actionable entrepreneurs.

Moreover, design thinking influences entrepreneurial intentions, which are crucial in the entrepreneurial process. Entrepreneurial intentions shape the initial conceptualisation of a business and influence its growth and success. Understanding the drivers that transform these intentions into actions can guide the creation of better support systems and educational offerings for aspiring entrepreneurs. Thus, improving design thinking pedagogy could better prepare students with the skills needed to launch successful ventures.

The findings of this study have significant implications for entrepreneurship educational policy, particularly in advocating for a greater emphasis on non-classroom-based learning. The demonstrated success of design thinking-based projects in fostering practical entrepreneurial skills suggests that traditional, classroom-focused methodologies may be less effective in preparing students for real-world entrepreneurial challenges. By highlighting the importance of process components such as fieldwork, user-centred research, and interdisciplinary collaboration, our study provides a compelling argument for entrepreneurship educational policies to shift towards more hands-on, project-based learning environments. This approach aligns with the dynamic nature of entrepreneurship and enhances student engagement and retention by making learning more meaningful and relevant. Therefore, policymakers should consider integrating and expanding non-class-based learning opportunities within entrepreneurship curricula to better equip students with the skills and mindsets necessary for successful venture creation and innovation in today's rapidly evolving business landscape.

7. Limitations and Future Research

The research is subject to biases and limitations inherent in the data collection instruments, analysis processes, and qualitative methodology. The absence of extensive prior research does not provide a standard template for framing the research questions, methodologies, or analytical processes. Additionally, the sample included only university students and professors from four institutions whose unique jargon, working protocols, and specificities in utilising design thinking as a teaching methodology may affect data analysis and interpretation. This study does not aim to evaluate the quality of the analysed projects or courses or to assess their impacts on students. Nonetheless, researchers and readers must understand that multiple interpretations may arise in relativist inquiry.

The entrepreneurial culture in the USA, U.K., and Slovenia, which are part of this study, inherently influences the findings and their applicability. According to Hofstede's cultural dimensions, these countries exhibit specific traits. Slovenia is a highly individualistic society with much greater uncertainty avoidance than the U.K. or the USA, which can impact entrepreneurial behaviours and educational outcomes. Furthermore, Global Entrepreneurship Monitor (GEM) data highlights regional differences in entrepreneurial activities and education frameworks. As we present our concluding model, it is important to consider its transferability and recognise that it may not be universally applicable. The model's effectiveness could vary significantly in contexts where cultural dimensions and entrepreneurial ecosystems differ. Therefore, while our findings contribute valuable insights into integrating design thinking in entrepreneurship education, they should be adapted cautiously to fit diverse cultural and educational landscapes.

Acknowledging that the framework is a proposal and may be influenced by other unidentified variables is important. However, the constructivist learning approach and the relevant literature tentatively support the usefulness of the components outlined in our study. Still, further research is necessary to confirm their critical role in delivering quality entrepreneurial education. This research should extend to diverse cultural, organisational, and geographical contexts to assess the framework's generalizability and adaptability. Such studies will determine the robustness and broader applicability of the framework, ensuring it can be implemented beyond the initial study environment.

Developing standardised measures for the framework's components would greatly benefit course designers and educators. These metrics would enable detailed assessment and comparison of the components' contributions to the framework, facilitate empirical studies, and enhance the framework's practical utility.

Further testing of the propositions through qualitative and quantitative research is necessary to reaffirm the framework's validity. Future phases might include structural equation modelling to understand better which components effectively indicate project continuity. Moreover, incorporating the process and environmental components presented in our framework, such as teamwork, external recognition, experimentation, mentoring, and user-centred research, into entrepreneurship courses could enhance the meaningfulness of the educational experience. Evaluating the relative importance of these components, among others, could provide valuable insights into enhancing course meaningfulness.

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