

**DOCTORAL THESIS**

Active Methods in  
Entrepreneurship Education:  
A Competency-Based  
Approach to Investigate Their  
Theoretical Foundations and  
Effectiveness

Basel Hammoda

TALLINN UNIVERSITY OF TECHNOLOGY  
DOCTORAL THESIS  
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Foundations and Effectiveness**

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**Declaration:**

Hereby I declare that this doctoral thesis, my original investigation and achievement, submitted for the doctoral degree at Tallinn University of Technology has not been submitted for doctoral or equivalent academic degree.

Basel Hammoda



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**Aktiivõppe meetodid ettevõtlusõppes:  
pädevuspõhine lähenemine nende  
teoreetiliste aluste ja tõhususe uurimiseks**

BASEL HAMMODA





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## List of publications

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### Other publications related to the thesis:

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## **Author's contribution to the publications**

1. Hammoda, B. (2023). Single author: Problematization, literature review, data collection and analysis, discussion and paper write up.
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2. Hammoda, B. (2024c). Single author: Problematization, literature review, discussion and paper write up.

## Introduction

My interest in pursuing this PhD stems mainly from my entrepreneurial activities. As a startup mentor, a previous MBA student in entrepreneurship, and an entrepreneur, I could see discrepancies between the causal approaches followed to educate future entrepreneurs in academic institutions and the dynamism of real-life entrepreneurship. Hence, I realized that the adoption of more active methods is required at higher education institutions (HEIs), to equip entrepreneurial students with the required practical knowledge, skills, and attitudes to survive the realities of the professional environment. Similarly, companies are increasingly emphasizing the need for entrepreneurial and market ready graduates. Something that the traditional theory-laden pedagogies in management and entrepreneurship cannot fulfil adequately. When the time was right, I moved to Estonia to do my PhD at Tallinn University of Technology (Taltech). Tallinn is known to have a dynamic and flourishing startup ecosystem, and a prevailing entrepreneurial culture. Moreover, Taltech promotes the development of entrepreneurial skills among its students regardless of their study discipline and hosts a well-reputed team of entrepreneurship education researchers and lecturers.

.....

Entrepreneurship is largely understood as an economic activity that includes an element of novelty (Acs & Audretsch, 1990; Audretsch, 2012; Schumpeter, 1942). It can take different shapes and forms including new venture creation (Bhave, 1994; Neck et al., 2004), new value creation (Amit & Zott, 2001; Bruyat & Julien, 2001; Fayolle, 2007), cultivate sustainability conscious graduates (Mets et al., 2021), and innovation (Acs & Audretsch, 2005; Zhao, 2005). Teaching entrepreneurship has grown rapidly in the last two decades in higher educational institutions (HEIs) across all regions (Varblane & Mets, 2010) and disciplines (Mawson et al., 2023), with universities making significant investments in entrepreneurship courses and programs (Antonelli et al., 2024; Fayolle, 2018; Mawson et al., 2023; Nabi et al., 2017). It has even witnessed increasing propagation outside HEIs in schools, community organizations, and corporates (Fayolle, 2018; Mawson et al., 2023; Nabi et al., 2017). This propagation could be attributed to the role of entrepreneurship and entrepreneurial behavior in driving economic growth, innovation, and sustainable development goals (Acs, 2008; Carree & Thurik, 2010; Díaz-García et al., 2015, Rashid, 2019), with entrepreneurship education (EE) shown as an important contributor to the development of entrepreneurial characteristics and startup survival (Cosenz & Noto, 2018; Nabi et al., 2017). This development, however, has resulted in diversification and lack of consensus on the definitional terms, foundational principles, and approaches to teach entrepreneurship (Decker-Lange et al., 2021; Gibb, 2002; Kuratko & Morris, 2018). It comes as no surprise then that entrepreneurship education (EE) is defined broadly as “any pedagogical program or process of education for entrepreneurial attitudes and skills” (Fayolle et al. 2006, p. 702), which is the seminal definition followed through. Fayolle’s definition indeed embodies the diversity of the methods used to teach entrepreneurship, which are investigated and represented in the thesis, including classroom-based ones, extracurricular activities, and digital educational technologies. Additionally, it signals that the main purpose of EE as in developing learners’ skills and attitudes, rather than a positivist orientation that aims for venture creation.

The approaches followed at HEIs to teach entrepreneurship can be largely categorized as either traditional or modern/ active/ innovative (Lackéus, 2015; Mwasalwiba, 2010). Traditional pedagogies, that were prevalent previously in HEIs, tend to teach students “about” entrepreneurship (Lackéus, 2015), with common topics discussed including its definitions, geo-demographics, socio-economic impacts, firm lifecycle, etc. These usually rely on lectures and theory-oriented case studies (Decker-Lange et al., 2021) and exhibit a mechanistic knowledge imparting attitude following the behavioral and cognitive models of learning (Higgins et al., 2013). Throughout the years, this approach was challenged for lacking demonstrable impact on students’ interest in entrepreneurship and developing practical knowledge and skills (Hägg & Kurczewska, 2021; Robinson et al., 2016). They are however being gradually replaced with more active approaches that promote practical and self-driven learning attitudes (Günzel-Jensen & Robinson, 2017; Hase & Kenyon, 2000, 2007; Robinson et al., 2016; Neck & Corbett, 2018).

Active methods promote a learning-by-doing approach, that aims at developing entrepreneurial competencies (ECs) (Mwasalwiba, 2010; Neck & Corbett, 2018), which are the set of knowledge, skills, and behaviors exhibited by an entrepreneurial individual (Bacigalupo et al., 2016). These methods are expected to answer to the perceived inadequacies of traditional educational models towards the development of practical entrepreneurial skills that could support entrepreneurial students navigating real-life business and professional settings (From, 2017; Kozlinska et al., 2023; Ilomäki et al., 2016). Examples of active methods can include curricular activities such as groupwork and presentations, extracurricular activities such as student clubs (Pittaway et al., 2015) and venture creation programs (Pocek et al., 2021), and methods that are based on digital technologies such as serious games (Grivokostopoulou et al., 2019).

The introduction of active methods thus contributes and aligns with a competency-based approach in EE (Kozlinska et al., 2023; Morris et al. 2013), which has received more attention from scholars, educators, and policymakers in recent years (Neergaard et al., 2021; QAA, 2018). A competency-based approach promotes the development of a broader skill set among student entrepreneurs that connects to behavioral and affective outcomes and can be deployed in a variety of career options (Glackin & Phelan, 2020; Morris et al., 2013; Nabi et al., 2017; QAA, 2018). Hence, a competency-based approach helps extend the value of EE beyond the prevalent socio-economic driven approaches that were traditionally used to guide entrepreneurship teaching in HEIs, and the assessment of its outcomes such as startup rates, intentions, or amount of funding raised (Bacigalupo et al., 2016; Glackin & Phelan, 2020; Kozlinska et al., 2020; Nabi et al., 2017).

The **problem statement** for this thesis relates to the condition that the accelerated propagation of active methods in EE at HEIs has probably eclipsed the understanding of entrepreneurship educators of the learning theories that underpin these methods (Fayolle, 2018; Kakouris et al., 2023; Neck & Corbett, 2018). Learning theories establish how individuals develop their mental schemas that shape their knowledge, behaviors, and attitudes (Bereiter, 1990), which are of particular importance in guiding the learning of an action-oriented field like entrepreneurship (Neck & Greene, 2011). This situation is thus impeding the ability of EE educators at HEIs to integrate those active methods in their pedagogies effectively and knowledgeably, hindering the development of students’ entrepreneurial competencies (ECs) (Bozward & Rogers-Draycott, 2020; Cope & Watts, 2000; Deakins & Freel, 1998; Lackéus, 2020; Neck & Corbett, 2018). This theoretical frailty extends to our assessment of EE outcomes as in the developed ECs (Antonelli et al., 2024; Mets et al., 2017). We lack an established reference framework (Bird, 2019),

which impedes our ability to assess the competency-based outcomes of active methods in EE (Preedy et al., 2020). Hence, grounding active methods in established and broadly validated theories will allow us to incorporate them more insightfully in EE and more conclusively assess their outcomes (Kakouris et al., 2023; Pittaway et al., 2015). In simple terms, we need to look back to move forward.

In terms of the **research gaps**, the applied pedagogies and methods in EE lack sufficient theoretical grounding, with scarce connections to established learning or entrepreneurship theories (Arranz et al., 2017; Beaumont et al., 2022; Fayolle, 2018; Kakouris et al., 2023; Preedy et al., 2020; Preedy & Jones, 2015). A main reason behind this insufficiency stems from entrepreneurship educators being either entrepreneurship researchers or have some professional entrepreneurial / management experience (Neck & Corbett, 2018). Hence, lacking a sufficient background in education and educational sciences has confined our approaches to conducting EE research and teaching it to “what we already know”, following a more practice driven approach (Kakouris et al., 2023; Kyro, 2015). Fayolle (2013) commented on this as well critiquing EE practice for being poorly theoretically and philosophical founded. In addition, there is an apparent divergence in interpreting and implementing “known” learning theories among entrepreneurship researchers and educators (Kyro, 2015). The criticality of addressing this theoretical fragility arises from what Neck and Corbett (2018) posited, and I agree with their argument, that “Applying classic education theories and frameworks to EE to further advance the question of how entrepreneurship can or should be taught will help faculty and students equally”. (p.35).

Moreover, most available studies rely on a limited set of theories such as the theory of planned behavior (Ajzen, 1991) or experiential learning (Kolb, 1984), without much attention to other conjectures or efforts to connect them with the more widely established learning and entrepreneurship theories (Kakouris et al., 2023; Jones et al., 2015; Morris et al., 2017; Pittaway et al., 2011; 2015). Additionally, despite the recognition of competency-based approaches, there is a divergence in assessment methods that renders the generalizability of any one method debatable (Bird, 2019), with limited investigation of their application (Nabi et al., 2017; Neergaard et al., 2021). Thus, a more theoretically established framework is required to better assess active methods outcomes. Consequently, we are lacking sufficient and conclusive empirical insights on active methods impact on EE competency-based outcomes, and the intricacies of their application (Chen et al., 2021; Duval-Couetil et al., 2016; Hagvall Svensson, 2023; Higgins et al., 2013; Koropogui et al., 2023; Pittaway et al., 2015; Preedy et al., 2020).

This thesis thus **aims** to investigate the theoretical foundations of different active methods, as well as advance our understanding their outcomes, more specifically competency-based outcomes when applied in EE at HEIs. Through the publications in this thesis, I aimed at addressing the following research questions:

- RQ1: What are the theoretical foundations of active methods in EE, deployed to improve its competency-based outcomes?
- RQ2: How can a competency-based approach be operationalized for assessing the outcomes of active methods in EE, as a reliable theoretical framework?
- RQ3: How do active methods contribute to competency-based outcomes in EE?

The thesis relies on six publications, addressing these questions. A brief overview of the relevance of each to the thesis and the research questions is provided in Figure 1. The thesis follows mostly a competence-based perspective of EE, which views it as a learning platform to develop students' ECs to be applied in different careers and not necessarily venture creation (Morris et al., 2013). It relies on qualitative approaches, following an interpretivist paradigm, employing interviews, case studies, and literature reviews-based studies.

**Research aim**

*investigate the theoretical foundations of different active methods, as well as advance our understanding their outcomes, more specifically competency-based outcomes when applied in EE at HEIs*

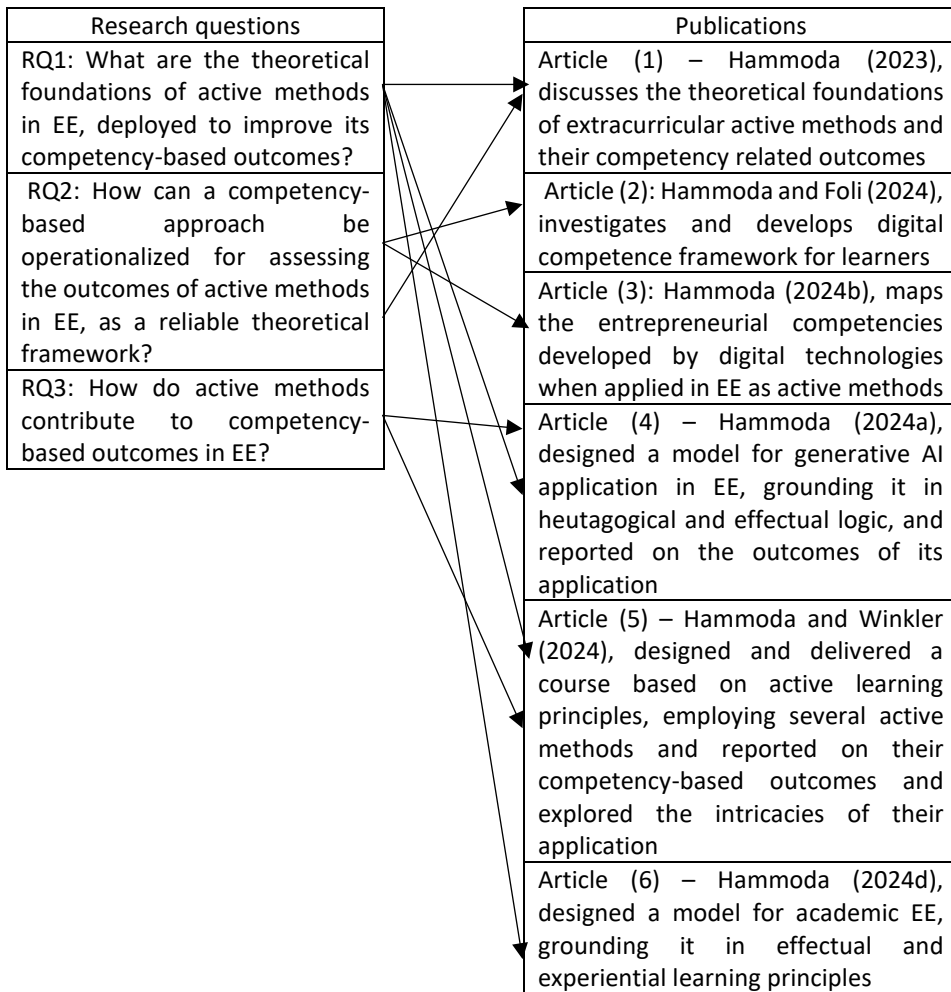


Figure (1). Research questions and corresponding thesis publications  
Source: Created by the author

The thesis has important theoretical and practical contributions, adding to the literature on active methods in EE and competency-based view and providing insightful guidance to entrepreneurship educators at HEIs, mainly.

Regarding the **theoretical contribution**, most importantly, it **grounds existing active methods used in EE in learning and entrepreneurship theories**, something that is currently limited in literature. Thus, allowing for a better understanding of the theoretical origins of these methods, their applications, and limitations. Additionally, the thesis publications build upon and extend existing theories and frameworks, improving our understanding of their potential applications, and offering complementary interpretations of their usage.

Secondly, the thesis **provides insightful practical implications** by exploring and discussing the outcomes of using these active methods when applied in EE, relying on a competency-based view mostly (Morris et al., 2013). Thus, offering practical propositions

for incorporating active methods effectively in EE by educators and HEIs. Moreover, it extends the exploration and application of active methods to new topics and contexts, that are currently under investigated in literature. The contributions of the thesis are discussed in more details later in the cover paper. They can prove useful to the multiple stakeholders involved in the EE process, mainly entrepreneurship educators and scholars, but additionally entrepreneurs and entrepreneurial students. Although the primary focus is on HEIs, the contributions of the thesis could be applied in other informal EE settings such as incubators, accelerators, and training programs.

The thesis consists of a cover paper and six publications. In the first chapter, I provide an overview of the pertinent literature, concepts, and theoretical foundations. These include entrepreneurship education, active methods, competency-based approach, and learning theories. In the second chapter, I highlight the relevance of the adopted interpretivist research paradigm and provide a brief account of the methodological choices related to the thesis publications. The third chapter provides a summary of the findings against the thesis research questions. In chapter 4, I expound on the theoretical and practical contributions of the thesis. Finally, in chapter five, I explain the overall limitations of the thesis and provide some recommendations for future research directions.

## Abbreviations

AI	Artificial Intelligence
ECs	Entrepreneurial Competencies
ECAs	Extracurricular Activities
EE	Entrepreneurship Education
EntreComp	European Union Entrepreneurial Competence framework
ET	Educational Technology
GDP	Gross Domestic Product
HEIs	Higher Education Institutions
STEM	Science, Technology, Engineering, and Mathematics



# 1. Literature background and theoretical foundations

This part provides an overview of the literature pertinent to the thesis' publications and the relevant theoretical foundations applied in them. For more in-depth exploration of literature specific to each publication, please refer to the respective paper.

## 1.1 Entrepreneurship education

Entrepreneurship and EE is a driving force for economic development (Kuratko, 2011). EE was proven to have tangible socio-economic contributions such as venture creation, job creation, and firm growth (Decker-Lange et al., 2024; Matlay, 2008; Nabi et al., 2017; Rideout & Gray, 2013). Additionally, EE was shown to increase affective entrepreneurial outcomes, especially when it follows a competency-based approach (Morris et al., 2013), including entrepreneurial intentions, orientation, mindset, and competencies development (Duval-Couetil, 2013; Ilonen & Heinonen, 2018; Zhang & Cain, 2017).

In the past two decades EE has spread rapidly in HEIs and became a staple topic, not only in business education but amongst other disciplines (Morselli, 2018; Stenard 2023). This educational hyperactivity coincided with huge investments made by countries around the world in developing and promoting EE throughout the years (Fayolle et al., 2006; Fayolle, 2018; Karimi et al., 2016). EE propagation in HEIs has garnered increasing attention from scholars, with a growing number of studies trying to shape the ontological, epistemological, and didactical assumptions of EE, in addition to defining its actors, components, assessment methods and frameworks, and contingencies (Fayolle, 2018; Loi & Fayolle, 2021; Van Gelderen et al., 2021). The aim is to better equip educators and learners with the tools necessary to promote entrepreneurship and entrepreneurial outcomes (Fayolle, 2018; Loi & Fayolle, 2021). Subsequently, the attention of scholars has started shifting from pedagogical content to modes of delivery (Fayolle, 2018; Fellnhofner, 2019), owing primarily to the widening of EE student base and their diverse characteristics and readiness levels (Blenker et al., 2012; Mwasalwiba, 2010; Neergaard et al., 2021). Hence, the need to adjust our methods to more distinctive students' profiles.

Entrepreneurship education can be defined as "any pedagogical program or process of education for entrepreneurial attitudes and skills" (Fayolle et al. 2006, p. 702). In the UK, a more inclusive definition postulate it as "the application of enterprise behaviors, attributes and competencies into the creation of cultural, social or economic value. This can, but does not exclusively, lead to venture creation." (QAA, 2018, p. 7). Its main purpose is to prepare students, graduates, and social agents for the dynamic and rapidly changing professional environment with its economic and employability challenges (Fayolle, 2018). It can thus be said to have a set of primary objectives. These were reported in several studies (e.g., Davis et al., 2016; Fretschner & Weber, 2013; Hytti & O'Gorman, 2004; O'Connor, 2013), and include:

- develop an entrepreneurial mindset,
- develop entrepreneurial intentions,
- build entrepreneurial skills and competencies,
- improve ability to identify and exploit opportunities,
- increase knowledge acquisition of management-related topics,
- improve entrepreneurial abilities and behaviors,
- enhance managerial and professional skills.

EE provides its audience with a set of knowledge, skills, behaviors, and attitudes which are deemed essential in a broad range of settings (Cheung, 2008; Dickson et al., 2008; Fretschner & Weber, 2013; Neegaard et al., 2021). Hence, it helps its recipients fulfil several roles in their communities as competent and well-educated employees, citizens, clients, and leaders, especially within a start-up or small-business context (Thrane et al., 2016). Those diverse roles include the management of small firms or the application of ECs within existing organizations (Kuratko & Morris, 2018; Ustav & Venesaar, 2018). These competencies can be extended to something more akin to “the life skills necessary to live productive lives” (Neck & Corbett, 2018, p. 10), because everyone may benefit from displaying enterprising characteristics (Gibb, 2011; Wiklund et al., 2011). At an institutional level, EE plays an important role in facilitating university-industry and university-industry-government collaborations as well as the development of institutional framework in regions where universities, students, scientist, entrepreneurs, and government benefit from knowledge spillovers (Audretsch & Keilbach, 2007; Bischoff et al., 2018; Tether & Tajar, 2008).

The rapid progression of EE has however witnessed challenges and incited some debates. Unlike other forms of education, there are no guarantees our students will become entrepreneurial at graduation (Winkler et al., 2023b). Therefore, there is a need to educate other stakeholders as to the relative merits of creating potential workers or creators from our programs, which necessitates our adoption of a holistic approach to realizing the outcomes of EE (Jones & Matlay, 2011). This is the primary argument for adopting a competency-based approach in EE (Morris et al., 2013), which I relied upon in the thesis. Moreover, a common criticism of EE at HEIs implies that while universities are able to foment entrepreneurial intention, transforming this intention into reality is often difficult to achieve through traditional methods (Neergaard & Christensen, 2017; Pittaway & Cope 2007; Preedy & Jones, 2017; Souitaris et al., 2007). Enterprise and entrepreneurship are difficult concepts to teach indeed as the rigidity of an academic environment is perceived to conflict with the complexity and variability of the entrepreneurial process (Johannisson, 2016). Moreover, essential ECs such as the ability to cope with risk or failure and dealing with uncertainty are difficult to develop through traditional curricular approaches given their limitations (Preedy et al., 2020). Also, as each student is different, the educator is expected to become an enabler of personalized entrepreneurial learning experiences (Thrane et al., 2016), a role better assumed through active methods that places the learner at the center of the process (Hase & Kenyon, 2007, 2013). Nabi et al. (2017) and Neergaard et al. (2021) argue that it is challenging to achieve the desired outcomes from entrepreneurship education through traditional curricular activities alone. Hence, reaching the desired aims of EE is pendant on adopting pedagogies for enhancing entrepreneurial competencies that are reliant on more action-based methods (Decker-Lange et al., 2021).

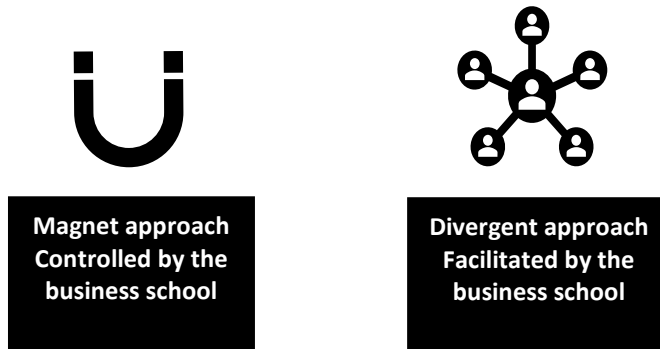


Figure (2). EE approaches at HEIs  
 Source: Created by the author based on relevant literature

In HEIs, EE can be offered in a variety of ways. The first deals with its scope and distinguishes between the exclusive delivery of EE within business disciplines and the promotion of EE across other disciplines in a university-wide approach. Another way of classifying it specifies its locus of control. Similarly, one approach is that of a centralized magnet model, where EE is controlled by the business schools and the other is a radiant approach, that is decentralized and coordinated outside the business schools as well (Katz et al., 2013; Streeter et al. 2002). These different approaches regarding its scope and locus of control are portrayed in figure (2). Hereby, a trend can be observed in EE delivery at HEIs towards university-wide, magnet entrepreneurship education programs (Baggen et al., 2022; Morris et al., 2010; Streeter et al., 2002).

With regards to EE pedagogy, entrepreneurship scholars and educators have researched and experimented with a plethora of approaches and methods to teach entrepreneurship, to try to fathom what works, for which groups of students and why (Kuratko & Morris, 2018). With the rapid growth in EE, the pedagogical approaches have branched and diversified as well. While these lack theoretical foundations and strong grounding in learning theories (Bozward & Rogers-Draycott, 2020; Fayolle, 2018; Neck & Corbett, 2018; Lackéus, 2020), several efforts have been made to develop practical typological classifications. A common approach organizes them into ‘about’, ‘for’, and ‘through’ along an increasing practical and experiential inclination (Lackéus, 2015; Pittaway & Edwards, 2012; Neergaard & Christensen, 2017), as displayed in figure (3). While ‘about’ approaches on the one end focus on imparting knowledge about the entrepreneurial phenomena and theories upon students, ‘through’ approaches exemplify a learning-by-doing approach that is more evident in venture creation programs at HEIs, for example (Pocek et al., 2021).

Additionally, the methods applied in EE can also be largely classified as either ‘traditional’ and ‘active’ / ‘modern’ / ‘progressive’ approaches (Blenker et al., 2012; Lackéus et al., 2016; Mwasalwiba, 2010). (See Table 1). Traditional approaches rely on imparting knowledge upon students through theory laden lectures and case studies. They were shown to be insufficient when educators are attempting to equip learners with the knowledge, skills and experience required to create and manage entrepreneurial businesses (Higgins et al., 2013). Increasingly, they are replaced by more active methods that are action based and experiential (Bell & Bell, 2020; Jones et al., 2014; Mason & Arshed, 2013; Rasmussen & Sørheim, 2006). Active methods are thus receiving growing

scholarly attention and progressive application in entrepreneurship courses, as they were proven to overcome traditional methods shortcomings and contribute effectively to the behavioral and affective outcomes of EE (Fayolle, 2018; Lackeus et al., 2016). Policymakers and commentators have echoed these views (Anderson & Ronteau, 2017; Gibb & Hannon, 2006).

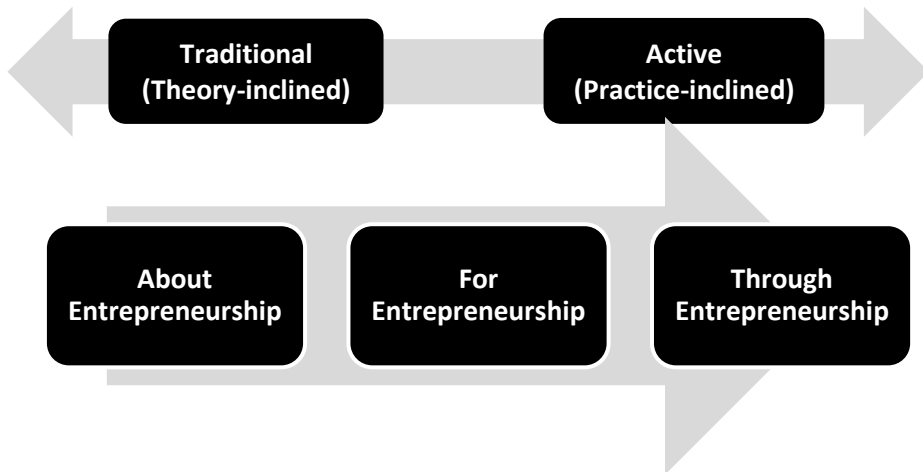


Figure (3). About, for, and through approaches to EE  
 Source: Created by the author based on relevant literature

Table (1). Traditional and Active methods in EE

	<b>Traditional (Theory-inclined)</b>	<b>Active (Practice-inclined)</b>
<b>Theoretical underpinnings</b>	Behaviorism and cognitivism	Active learning
<b>Examples of used methods</b>	Lectures Theory-based case studies	Simulations Group work Student clubs
<b>Main competence development</b>	Cognitive	Affective and Behavioral

Source: Created by the author based on relevant literature

## 1.2 Active methods

There is an accepted view that entrepreneurs are action-orientated and entrepreneurial learning occurs through experience and discovery (Dalley & Hamilton, 2000; Neck & Corbett, 2018; Pittaway & Cope, 2011; Rae, 2000; Rae & Carswell, 2001). Hence, entrepreneurship educators have been exploring and experimenting around with more activating and impactful methods in the hope of better developing entrepreneurial learners' knowledge application and affective competencies (Fayolle et al., 2006; Fayolle, 2018), to overcome traditional methods shortcomings.

Active pedagogies<sup>1</sup> comprise a learning through doing approach (Fayolle, 2018; Lackéus et al., 2016). These can include different methods curricular and extracurricular such as groupwork (Buckley & Lee, 2021), role models (Fellnhöfer, 2017), students clubs (Pittaway et al., 2015), mentorship (Kuratko et al., 2021); and simulation games (Newbery et al., 2016). Students apply reasoning, critical thinking, and problem-solving skills to mental or physical tasks that result in the acquisition of specific knowledge and skills, while updating their cognitive and behavioral capabilities in the process (Dewey, 1974; Piaget, 1970). A core premise of active learning is the natural experiences it offers to learners, with all the complexities and unclarity that characterizes real-life situations. These experiences are essential for the cognitive and behavioral learning processes (Jones & Holt, 2008; Neck & Corbett, 2018).

Active methods can help the students not only acquire but also put into practice, through a variety of activities, the knowledge, and skills they acquired (Ferreira, 2020; Neck et al., 2014). They are increasingly being adopted in EE (Sousa et al., 2019; Loi & Fayolle, 2021). Entrepreneurship students are also growing fond of these approaches as it engages them in the learning process (Pratiko et al., 2021; Sousa et al., 2019). As they learn by doing and reflecting on what they do, they translate their experiences into acquired competencies through interactive practices (Kolb & Kolb, 2005; Robinson et al., 2016). Following an active teaching approach in EE, the teacher's role is thus transformed to orchestration and facilitation (Fiet, 2001; Kyrö, 2015) rather than controlling the learning process through unidirectional knowledge transfer as in behavioristic models (Kyrö, 2015).

However, literature on active methods in EE is fragmented, given the multitude of activities, settings, and contextual factors that can affect their implementation and outcomes (Neck & Corbett, 2018; Pittaway et al., 2023a). There is a lack of sufficient theoretical grounding in designing, delivering, and assessing their outcomes (ibid). Indeed, current active methods lack reference to established learning theories that have been applied in other disciplines for decades, and to the wider entrepreneurship theories and concepts. Publications in this thesis, such as Hammuda (2024b) on ET applications in EE and Hammuda (2023) on ECAs, converge with literature on this point. This could be attributed to the rapid proliferation of active learning in EE, at its different levels and settings. Moreover, there is a lack of conclusive evidence on their value towards the development of affective and behavioral outcomes, and the intricacies of their applications (Preedy et al., 2020).

It is important to note however that the extent to which activities are transformed into knowledge will depend on several factors including the students' learning preferences (Honig & Hopp, 2019) and their readiness to learn (Preedy et al., 2020).

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<sup>1</sup> An umbrella term for "the methods of teaching or imparting knowledge or instruction generally on the one hand – all those processes by which information is given—and on the other, education or development from within outward" (Jones et al., 2019, p. 2).

Also, a balance needs to be struck between active learning approaches and more theory-based methods, as the former play a synergetic and complementary role to the latter, promoting the application of acquired knowledge and enhancing the development of cognitive and affective skills (Buzady & Almeida, 2019). Another caveat that we must be cognizant of when applying active methods, is that the accumulation of entrepreneurial experiences does not necessarily guarantee the success of an entrepreneurial project or even pursuing one (Winkler et al., 2023b).

An important stream of active methods that is being increasingly used in teaching entrepreneurship is technology reliant (Mavlutova et al., 2020). Digital technology represents a collection of digital tools, infrastructure components and services, and interactive platforms (Zahra et al., 2023). It has become a constant in every aspect of life (Vorbach et al., 2019), and the education sector is no different. The facilitation of learning by the application of technology is often coined as Educational Technology (ET) (Januszewski & Molenda, 2013). Technology is used as active methods to make teaching more effective, moving away from the traditional lecture-focused approach to an active and competency-based one (Wu et al., 2018). Teachers are adopting them to enhance their communication of educational messages (Tess, 2013), and motivate students to learn (Chen & Huang, 2012). Tretyakova et al. (2021) and Ratten (2023) argue that as digital technologies become more widely available and accessible to the majority of stakeholders in the education business, the link between technology and education will inevitably continue to grow and the education sector will become heavily reliant on digital technologies.

ET is regarded as a strong foundation for transformative entrepreneurial learning experiences within HEIs (Secundo et al., 2020a). They are regarded as key enablers of active learning experiences in EE (Zahra et al., 2023; Neck & Greene, 2011; Tretyakova et al., 2021). The EE landscape has gradually been witnessing the introduction of several digital methods and artifacts, whether in online or offline forms, to teach students and fortify their learning experience (Chen et al., 2021; Papadakis et al., 2017; Ratten, 2023), aligning with the propagation of active pedagogies in EE (Ratten & Jones, 2021). These can include gaming and simulations (Isabelle, 2020), virtual and augmented reality (Papadakis et al., 2020), multimedia (Wu et al., 2018), big data and related technologies (Mavlutova et al., 2020), among others.

ET is argued to improve entrepreneurial competencies and mindset (Chen et al., 2021; Fayolle, 2018). Moreover, they allow for a more efficient student-centered learning through personalization of content and the learning process. It is acknowledged that the EE curricula could benefit from including ET as it attracts and retains students, enhances their experiences, and improves the learning outcomes (Kuratko, 2005; Wu et al., 2018). Their introduction in EE has provided a strong push for the research and practice of active learning approaches, as digital tools provide practical entrepreneurial experiences (Tretyakova et al., 2021). Hence, modern entrepreneurship pedagogies incorporate ET to influence students' entrepreneurial intentions, mindset, and competencies (Tretyakova et al., 2021).

However, research on the application of ET in EE is still in its infancy (Chen et al., 2021; Lin & Sekiguchi, 2020; Rashid, 2019), with scholars calling for better exploration of this nexus (Ratten & Jones, 2021). The research lag can be explained by the technical intricacies and theoretical and methodological obscurities associated with their implementation (Farrokhnia et al., 2023; Ma et al., 2020). Indeed, the majority of ET studies in EE lack rigorous theoretical foundations, if any (Chen et al., 2021). In addition,

there is a lack of reviews on the outcomes of the different technology-based methods in EE (Chen et al., 2021), with these available lacking a reliable approach to assessing their outcomes (Lin & Sekiguchi, 2020; Ratten & Jones, 2021). It is hoped that an increased scholarly effort in this field can provide a better understanding of theoretical foundations of these tools, as to the intricacies and outcomes of their application in EE and propagate best practices (Fellnhöfer, 2019; Holinska et al., 2019; Nixon et al., 2018), as a representative of active learning methods (Ratten & Jones, 2021; Tretyakova et al., 2021).

### **1.3 Competence and competency based approach**

The concept of 'competence' in education started developing in the second half of last century (Le Deist, F. D., & Winterton, 2005). Although there is not an agreed theoretical origin of what a competence is, as it varies based on the individual, setting and applications (ibid), it can be viewed as the skill level that allows an individual to perform a certain job or function. Spencer and Spencer in (1993), based on analysis of 650 jobs and 20 years of research, proposed the following conceptualization of what a competence is. In their work, they argue that it is suitable for different roles including entrepreneurs, technical professionals, managers, and workers.

*'motives, traits, self-concepts, attitudes or values, content knowledge, or cognitive or behavioral skills – any individual characteristic that can be measured or counted reliably and that can be shown to differentiate significantly between superior and average performers, or between effective and ineffective performers.'* (Spencer & Spencer, 1993, p.4)

A competency-based approach aims to develop the knowledge, skills, and attitudes of learners. Thus, equip them with a broad range of capabilities that can support them in multiple roles and help them navigate the dynamic changing market and technological landscapes (Gervais, 2016; Henrich, 2016). Hence, it rhymes with the application of active methods as they aim to improve the affective and behavioral outcomes, mainly (Morris et al., 2013). The development of these attitudes, values, and skills are important for the effectiveness of EE and are essential influencers of entrepreneurial actions (Mawson et al., 2023). They are also regarded as repertoires for exploring oneself, findings meanings in the surrounding learning and entrepreneurial environments, and navigating entrepreneurial identity work amid changing social and contextual boundaries (Berglund et al., 2020). Two types of competence are relevant and investigated in this thesis: digital competence and most centrally entrepreneurial competence.

#### **1.3.1 Digital competence**

Current university students belong to Generation Z who interact heavily with technology in every task in their daily lives. Hence, it is only natural to assume that using technologies in the classroom will bring a sense of familiarity and liking to the process (Mavlutova et al., 2020). However, to improve the adoption and outcomes of applying technology in the educational process, we need to ensure that the students exhibit an adequate level of digital skills. Indeed, digital competency is perceived as a vital element in today's learning environment (Khan et al., 2022; Polizzi, 2020) and a requirement for an improved student performance (Tohara, 2021). Digital competency is a traversal term that is synonymous with digital literacy, digital skills, technology competencies, and other similar terms (Falloon, 2020; Madsen et al., 2018). It can be defined as:

*'... the ability to access, manage, understand, integrate, communicate, evaluate, and create information safely and appropriately through digital technologies for employment, decent jobs and entrepreneurship. It includes competencies that are variously referred to as computer literacy, ICT literacy, information literacy and media literacy.'* (Law et al., 2018, p.6)

Increasing concerns about digital inclusion and competence, especially in the context of minimum technological literacy requirements across labor markets, has challenged educational institutions to adapt curriculum and teaching practices (Hatlevik & Christophersen, 2013; Ilomäki et al., 2016). Hence, several global and regional organizations and scholars have developed frameworks that identify the digital skills required to function in the modern world. The most widely adopted among them are the Digital Competence Framework for Citizens (DigComp 2.0) by Vuorikari et al. (2016) and the UNESCO's 2018 global framework; Digital Literacy Global Framework (DLGF) by Law et al. (2018). However, these frameworks, although flexible and can be adapted to various contexts, do not address the particular needs and use cases of today's learners or professional careers available to them. Hence, an updated framework that more specifically maps the digital skills required for learners was proposed by Hammada and Foli (2024) (included as a publication in this thesis). It encompasses the varying modalities for interacting with technology platforms and learners' readiness for professional career options, including entrepreneurship.

### **1.3.2 Entrepreneurial competence**

Similarly, within the entrepreneurship context, entrepreneurs require a set of skills and attributes that can help them through their entrepreneurial journey, with education and training regarded a key element in acquiring them (Morris et al., 2013). These are collectively called entrepreneurial competencies (ECs) and represent a set of knowledge, skills, and attributes that someone can possess to pursue an entrepreneurial career (Bacigalupo et al., 2016). Identifying a concrete set of ECs, however, has been difficult due to the variety of settings, types, and understandings of the field of entrepreneurship (Fayolle, 2018; Komarkova et al., 2015). Hence, in recent years an EU commissioned team of researchers managed to identify the essential competencies for entrepreneurs through rigorous review of literature and a series of experts' consultations. Consequently, they developed the European Union Entrepreneurship Competence Framework, also known as EntreComp, as a basic framework that can be adapted and leveraged by individuals and organizations for entrepreneurial skills development and assessment (Bacigalupo et al., 2016).

The EntreComp is made up of three competence areas: 'Ideas and opportunities', 'Resources' and 'Into action' (Figure. 4), with a total of 15 competencies across them. It illustrates the essential knowledge, skills, and attitudes that should be acquired and exhibited by an entrepreneurial person. As a multi-purpose model, it could be applied in the variety of settings and activities that emanate entrepreneurs directly and indirectly. Hence, in recent years it became the most established and widely applied competency framework in entrepreneurship research, education, and practice (Bernadó & Bratzke, 2024; LópezNúñez et al., 2022; Morselli & Gorenc, 2022). It is especially relevant to evaluate and assess the outcomes of different activities and experiences that contribute to the development of ECs (Bacigalupo et al., 2016).



Its adoption and propagation coincide with growing calls among entrepreneurship scholars and educators to adopt a more formative and inclusive reference for measuring the outcomes of entrepreneurship education and support activities (Nabi et al., 2017; Neergaard & Christensen, 2017; Neergaard et al., 2021). ECs are indeed regarded a suitable alternative to the prevailing economic measures such as startup rates and raised funds (ibit). The latter are argued not to reflect the real and broader value of entrepreneurial training and support, as in the development of behavioral and affective outcomes (Kautonen & van Gelderen, 2015; Nabi et al., 2017). Moreover, the promotion of competency-based approaches in entrepreneurship aligns with the broad view of it as an “enterprising behavior”, enacted by individuals who exhibit a set of skills and attitudes that can support them in different paths and careers (Glackin & Phelan, 2020; QAA, 2018). However, the application of competency-based approaches in EE is hindered by the divergence in perspectives and the lack of a reliable framework that can be widely adopted, hence rendering the assessment of competency-based outcomes debatable (ibid).



Figure (4). EntreComp Framework  
Source: Bacigalupo et al. (2016)

## **1.4 Learning theories and perspectives**

In this part, an overview of the main learning theories and perspectives employed in this thesis across its publications is provided, highlighting their links to entrepreneurship education. According to Bereiter (1990), a learning theory establishes how individuals develop their mental schemas (Bereiter, 1990). Additionally, a summative brief of the main theories is presented in table 2.

### **1.4.1 Cognitivism**

Cognitivism views learners as vessels to be filled with knowledge that is readily available (Fox, 1997; Freire, 2018), with learning occurring through the transmission from the source (educator) to the recipient (student), in a mechanistic approach. This model is still observed in some educational settings (Hägg & Gabrielsson, 2020; Robinson et al., 2016) that employ mass education techniques, such as lecture theaters and MOOCs. The student herein assumes a rather passive role in the learning process. Cognitivism reflects a learning about entrepreneurship model which supplies learners with abstract concepts, theories, and information about the entrepreneurial process (Hägg & Kurczewska, 2021; Robinson et al., 2016). Hence, it is still regarded essential to the learning process (Bennett, 2006; Fiet, 2001; Hytti & O’Gorman, 2004; Neck & Corbett, 2018).

### **1.4.2 Active learning theories and perspectives**

Active pedagogies in education stem from the work of several scholars, most notably John Dewey, Jean Piaget, Lev Vygotsky, and David Kolb. Dewey established the principles of active learning in 1903, criticizing the prevailing knowledge-imparting mechanistic approaches at that time and advocating for progressive education. He posited the educator as a maestro who orchestrated knowledge transmission and exchange in the classroom, with students playing an active role in acquiring and processing knowledge through problem-solving based activities (Dewey, 1974). Hence, cognition becomes an active doing, emanating from learners’ experiences rather than passive knowledge ingestion. The former can be achieved through both mental and physical activities in project-based learning.

Piaget also rejected traditional methods of education, highlighting the potential dissonance between teacher’s communicated knowledge and student’s understanding and assimilation of it (Piaget, 1970; 1995). Hence, he posited that learning occurs through a constructive process of adaptation and configuration of knowledge available to the learner through his surrounding environment. Consequently, based on these stimuli, the learner reflects on and updates his mental models and structures, ensuing a virtually continuous process of cognitive development and advancement.

Vygotsky perspectives on learning are however more inclined towards and shaped by social interactive views. These were communicated through his main theories, the socio-cultural developmental and zone of proximal development. In Vygotsky’s philosophy, learning happens through actively interacting with the surrounding artefacts, in a developmental process. Hence, the roles of context (learning environment), peers (classmates), and pedagogue (teacher) are extremely important in shaping the cognitive structures of the learner, in contrast to the focus on the individual learner as the centrum of knowledge assimilation and adaptation in Dewey’s and Piaget’s views. This is reflected more explicitly in his zone of proximal development which highlights the role of the

guidance a child (learner) receives from a more knowledgeable educator or peer. As such, the learner moves from a peripheral zone of incomplete knowledge attainment when relying on himself only to a more competent position supported by his educator (Vygotsky, 1978, 1987).

Kolb (1984) presented his model of experiential learning, which centers on the notion of experiences as the initiator of learning and the source of knowledge. Thus, learning is a “process by which knowledge is created through the transformation of experience” (Kolb, 1984, p. 41). His views were largely influenced by the work of Dewey and Piaget on active and constructivist learning, respectively. Hence, I briefly explain it here and will further the discussion in the following subsection. Kolb depicted his views in the Experiential Learning Cycle which posits that learning follows a rather cyclical process (Kolb & Kolb, 2005). It is initiated by a concrete experience that the learner goes through, followed by a stage of reflective observation on the experience and sense making. Then, conceptualization of the new knowledge and updating his cognitive structure and finally, active experimentation through putting the new/ adapted behaviors to action. A main critique of Kolb’s experiential model is that it delineates the learning process in a rather linear form, i.e., doing then learning which contradicts reality and the active learning principle of learning ‘through’ doing.

The constructivist views of Piaget form the basis for current active learning processes which aim at developing reasoning, problem-solving, critical thinking, and experiential learning skills (Hu & Driscoll, 2013; Kirschner et al., 2006). In a constructivist approach, the learner builds and updates his knowledge structures as he gets exposed to and interacts with artefacts in his surrounding environment (Piaget, 1995). Reflection and conceptualization, two constructs of Kolb’s (1984) experiential learning, are essential elements in the knowledge assimilation and cognitive and behavioral adaptation processes. These resonate with Vygotsky (1978) premise that learning is facilitated by the surrounding context and artefacts and occurs through social, interactive, and collaborative transactions. Hence, the learner indeed plays an active role in acquiring and processing knowledge, and updating his cognitive and behavioral processes (Dewey, 1974).

### **1.4.3 Experiential learning**

Experiential learning emphasizes the centrality of experience to learning processes and is therefore distinct from cognitive or behavioral theories of learning (Kolb, 1984; Kolb et al., 2014). In experiential learning theory, learning is an emergent process continuously shaped by one’s interaction with the surrounding environment. The student goes through cycles of learning experiences from which he extracts and internalizes new knowledge and skills and reflects on those episodes (Neck & Corbett, 2018; Robinson et al., 2016), to update his cognitive and affective readiness (Cope, 2003, 2005; Politis et al., 2019). Experiential learning is thus an element and congruent to active and constructivist learning, in which entrepreneurial students participate in learning episodes and practice the synthesis of information through reflecting on their lived entrepreneurial practical experiences (Neck & Greene, 2011).

Experiential learning has become one of the main pursued approaches to EE in recent years (Jones, 2019; Neck & Corbett, 2018). It provides a platform that facilitates the development of practical entrepreneurial skills (Cope, 2011; Neck & Greene, 2011; van Gelderen et al., 2021), which traditional methods like lectures and readings fail to support (Higgins et al., 2013; Kuratko & Morris, 2018; Tunstall & Neergaard, 2022).

Hence, it equips learners with essential business skills, coinciding with the changing objectives of EE towards competency development. Experiential activities are commended for their contribution to develop learners' competencies through real-life experimentation and can thus be posited as emblematic of entrepreneurship practice (Pittaway et al., 2011, 2015; Preedy et al., 2020; Preedy & Jones, 2015; Rae et al., 2012). They allow learners to project learnt theories onto engaging activities and reflect on their experiences (Gerstein, 2014; Hägg & Kurczewska, 2021), which is difficult to achieve in traditional methods (Blenker et al., 2012; Gibb, 1993; Nabi et al., 2017).

#### **1.4.4 Social learning**

Social models of learning are derived from two streams of logic induction. One is Bandura's (1977) original postulation that learning happens through imitation of behaviors that lead to positive consequences (Bandura, 1977). In this regard, it resembles elements of vicarious learning (Robinson et al., 2016), that is vicarious observation and reinforcement (Bandura & Walters, 1963), as in learning from role models. Wenger (1990, 1998) argued that another dimension of social learning occurs when subjects acquire knowledge and skills and recognize opportunities through transacting with their surroundings (Rae, 2007), following a community of inquiry (COI) model (Garisson et al., 1999). It encompasses four elements: identity development, learning by doing, reflecting on experiences, and community involvement (Lave & Wenger, 1991). Learning truly happens among and through elements that exist within the context of the learner (Lave & Wenger, 1991), and is thus "situated" (Lave & Wenger, 1991, p. 35). Similarly, entrepreneurs learn through daily situations (Cope, 2003; Cope & Watts, 2000; Rae & Carswell, 2000), which are defined by their context (El-Awad et al., 2017; Pittaway & Cope, 2007). Hence, the direct environment forms an integral part of the learning process (Lans et al., 2008).

#### **1.4.5 Situated learning**

Situated learning takes place in communities of practice (COP), among groups of people engaged in similar activities and aspirations (Lave & Wenger, 1991; Wenger, 2011). Learning in COP embodies a scaffolding or apprenticeship approach, as the novice gradually accumulates expertise through observing and interacting with more competent members and undertaking situated activities (Cope, 2005; Pittaway et al., 2023; Rae, 2002). The social and situated learning conceptions posit that knowledge and skills flow through a myriad of situated social interactions (Wenger, 1990), rather than being imparted and transmitted in cognitive and behavioral approaches (Gherardi et al., 1998). They thus emphasize the role of context and networks as sources and facilitators for developing learner's competencies (Hanks, 1991). Active EE methods develop students' skills through environmentally defined professional experiences and social activities (Milner et al., 2016; Preedy & Jones, 2015). They, hence, firmly build on the premise of entrepreneurship education as a socially situated phenomena i.e. better explained and enacted through a series of experiences and networks of interactions within enabling contexts.

### 1.4.6 Heutagogy

Heutagogy emphasizes human agency in the learning process, as a person embarks on an intellectual journey of discovery and experience, guided by his pedagogue / educator (Hase & Kenyon, 2000, 2007; Jones et al., 2019). Herein, heutagogy rhymes with student-centered approaches to education (ibid). This is to be differentiated from pedagogy, which is often used as an umbrella term for “the methods of teaching or imparting knowledge or instruction generally on the one hand – all those processes by which information is given—and on the other, education or development from within outward” (Jones et al., 2019, p. 2). Herein, the educator extends his agency to that of the students. Andragogy, on the other hand further emphasizes the self-directed behavior of the learner, as a responsible for his own learning. Albeit keeping the attachments to the educators and/ or educational institute (Knowles, 1980)

Heutagogical pedagogies emphasize the role of the learner as the center of the learning process and the master of his own learning journey, through an interactive inquisitive approach, which is not confined to the standardized linear curricula (Gibb, 2002; Rae, 2005). In student-centered models, the educator, and universities endeavor to personalize the learning experience of their students and play a rather supportive and mentoring role to support their development of critical thinking skills (ibid). Heutagogy is thus a natural process for educators in the EE domain as it seeks transformational learning outcomes (Jones et al., 2019). Through these interventions, educators assist students in developing reflexivity, high self-efficacy, and competencies to be used in both familiar and novel situations without the educator’s involvement (ibid).

Heutagogy thus aligns with student-centered approaches to education, which active methods embody (Preedy et al., 2020). These instill a learning for self and for life mindset among entrepreneurship learners (QAA, 2018). According to Blaschke and Hase (2014); Gerstein (2014); and Hase and Kenyon (2013), heutagogical approaches have essential principles, which I argue are exemplified in active EE methods. These are: (1) learners are directly involved in planning and assessing their learning, and they are independent from the educator and the university, (2) educators have a rather supportive than controlling role, and (3) learning is non-linear, flexible, and focuses on practical applications of theory. Thus, the heutagogical orientation of active methods suits the very core nature of EE, as a dynamic and experientially learnt discipline (Jones et al., 2015; Neck & Corbett, 2018).

Heutagogical approaches are tied to active knowledge acquisition and application, which is a common denominator they share with entrepreneurial learning and practice (Tunstall & Neergaard, 2022). Given the uncertainty of entrepreneurial realities, it has been argued that the theorizing around heutagogy fits well with entrepreneurship education (Jones et al., 2019; Neck & Corbett, 2018) and heutagogical pedagogies adds an element of learning for life to entrepreneurship students which is a key asset when facing uncertainties (QAA, 2018). Thus, heutagogy is argued to be a fundamental element of transformational learning in any EE context. Rae (2005) also emphasizes the focus on the learner as the fulcrum of entrepreneurial pedagogies.

Table (2). Learning theories and perspectives employed in the thesis

<b>Cognitivism</b>	<b>Active learning</b>	<b>Constructivist learning</b>	<b>Socio-cultural development</b>
Learning occurring through the transmission from the source (educator) to the recipient (student), in a mechanistic approach with learners as vessels to be filled with knowledge that is readily available (Fox, 1997; Freire, 2018).	Learning is an active doing, emanating from learners' experiences rather than passive knowledge ingestion and is achieved through both mental and physical activities in project/task-based learning (Dewey, 1974).	Learning occurs through a constructive process of adaptation and configuration of knowledge available to the learner through his surrounding environment, as the learner reflects on and updates his mental models and structures (Piaget, 1970, 1995).	Learning happens through actively interacting with the surrounding artefacts, in a developmental process. Hence, the roles of context (learning environment), peers (classmates), and pedagogue (teacher) are extremely important in shaping the cognitive structures of the learner (Vygotsky, 1978, 1987)
<b>Experiential</b>	<b>Social</b>	<b>Situated</b>	<b>Heutagogy</b>
Learning is a "process by which knowledge is created through the transformation of experience" (Kolb, 1984, p. 41). Learning follows a cyclical process (Kolb & Kolb, 2005). It is initiated by the experience, followed by reflective observation and sense making. Then, conceptualization of the new knowledge and updating cognitive structure and finally, active experimentation.	Derived from two streams of logic induction. One is Bandura's (1977) original postulation that learning happens through imitation of behaviors that lead to positive consequences. The other is Wenger (1990, 1998) when subjects acquire knowledge and skills and recognize opportunities through transacting with their surroundings, following a community of inquiry (COI) model (Garisson et al., 1999).	Learning takes place in communities of practice (COP), among groups of people engaged in similar activities and aspirations (Lave & Wenger, 1991; Wenger, 2011). Learning in COP embodies a scaffolding or apprenticeship approach, as the novice gradually accumulates expertise through observing and interacting with more competent members and undertaking situated activities.	Learning is centered around the individual who embarks on an intellectual journey of discovery and experience, guided by his pedagogue / educator (Hase & Kenyon, 2000, 2007). The learner is the master of his own learning journey, through an interactive inquisitive approach, with educator role reduced to facilitating and guiding learning.

Source: Created by the author based on relevant literature

## **2. Methodology**

### **2.1. Research paradigm**

The research philosophy that researchers develop and adopt, help in shaping their thinking regarding the ontological, epistemological, and methodological premises that guide their study. These collectively form a paradigm that reflects their principles, beliefs, and hypotheses with regards to a scholarly topic (Guba & Lincoln, 1994; Kuhn, 1962; Blanche et al., 2006). Indeed, our line of inquiry is postulated based on our ontological (i.e., what is truth?), epistemological (i.e., what do we know?), and methodological (i.e., how do we get about knowing it?) assumptions. In more simple terms, the research philosophy highlights the approach researchers follow in addressing their research questions.

There is a diversity in literature with regards to the categorization or classification of research paradigms and levels, with overlapping meanings and interlacing application commonly witnessed (Saunders et al., 2009; Ritchie & Lewis, 2003; Guba and Lincoln, 1994). In my research approach, and the studies conducted within this thesis, I find myself to be following an interpretivist paradigm. For the sake of clarity, I will explain my research strategies and choices against ontological, epistemological, and methodological premises in the following sections.

#### **2.1.1. Ontology**

Ontology refers to a branch of philosophy concerned with “articulating the nature and structure of the world” (Wand & Weber, 1993, p. 220). Broadly speaking, there are two main ontological stances: objectivism and constructivism / interpretivism (Neuman, 2003). Objectivism claims that knowledge and truth are independent from us, real life with its components, and interactions among those. Constructivism/ interpretivism, follows an opposing argument that knowledge/ truth is not absolute but rather built and adapted based on a social process, involving the above.

Interpretivist research believe that knowledge is subjective, based on people’s beliefs and experiences (Mutch, 2005). Hence, knowledge is rather derived from interpretations, either ours or of other individuals, of real-life occurrences. It does not occur separately from our thinking and reasoning (Gephart, 2004). Personally, as an interpretivist researcher I believe that knowledge is out in the real life and held within individuals and communities, and not given. Hence, the theoretical assumptions and methodological designs used in our studies for example are never ‘the right’ ones and are not ‘always correct’ (Walsham, 2006).

This is relevant in the thesis as I investigate action-based methods in learning entrepreneurship, which is often regarded as a social phenomenon, i.e., learning by doing and through interacting with others. This contrasts with traditional mechanistic approaches, i.e., teaching about entrepreneurship, which focuses on the content imparted upon the students in the classroom.

#### **2.1.2. Epistemology**

Epistemology reflects our understanding of a certain area of knowledge and how we approach knowledge acquisition with regards to this area. It refers to “the nature of human knowledge and understanding that can possibly be acquired through different types of inquiry and alternative methods of investigation” (Hirscheim et al., 1995). Again,

in simpler terms this translates to what we know about a certain topic. There are two broad epistemological positions: positivism and interpretivism – constructivism. In positivism, research is an organized endeavor to deduct objective observations from empirical investigations. It aims at confirming and / or discovering hypothesized relationships between components and measures of human, society, and systems behavior.

The interpretivist/constructivist approach is the framing used in most qualitative research. It views any phenomena as constructed experiences that is understood based on the interpretations of the participants in a specified social system (Bogdan & Biklen, 1992; Guba & Lincoln, 1985; Maxwell, 2006). Accordingly, researchers follow an interpretive approach to investigating an inquiry. As they progress with their inquisition, the approach becomes clearer, more meanings are discovered, and answers to their research questions become more complete. Moreover, an interpretivist researcher aims to explore a particular phenomenon without worrying about confirming a hypothesis or generalizing the findings more broadly (Farzanfar, 2005).

This was evident in the studies included in this thesis, as I followed an interpretivist/constructivist path to elicit the hidden meanings and interpret the experiences and data, which might have taken a different form and were incomplete. This included the combination of different sources, such as the case study with STEM entrepreneurship students which relied on interviews with students, classroom observations, and a workshop with educators or even the systematic literature review, where data was gathered from different parts of the articles to extract the learning outcomes and translate it to the corresponding ECs. Additionally, I followed an interpretivist/constructivist approach while interviewing experts for the ECA paper, the interviews were structured as a dialogue between me (the interviewer) and the experts. They were allowed time to reflect on their experiences and connect it with interview questions, which were mostly around students' competencies. In all these examples, my understanding of knowledge was built constructively based on my interpretation of presented information and interactions with data.

## **2.2. Methodological choices**

Myers (2019) argues that a core foundation of interpretive research is that reality is formed through social construction, which is exhibited, observed, and interpreted through conversations, actions, interactions, and held beliefs. Hence, interpretive research does not rely on preset dependent and independent variables but rather aims to demystify and interpret the complexity of the situation under investigation. This was crucial in this thesis as to unearth the value that active methods bring to EE as to their nature and intricacies, and to establish their theoretical origins. These cannot be addressed through direct causal relationships, which is also a main reason for adopting a competency-based approach, which is more suitable for assessing behavioral and affective outcomes.

Interpretive researchers try to develop an understanding of particular issues through the meanings that those involved hold and communicate (Deetz, 1996). Hence, they tend to pursue in-depth inquiry methods, underpinned by close examination through observation, interrogation, and interpretation of the phenomenon in hand. They collect data about occurrences, events, interactions, and individuals within the context of the investigation while interpreting, analyzing, judging, and making meaningful conclusions (Aikenhead, 2003). Interpretive research is predominantly conducted through qualitative frameworks (Bogdan & Biklen, 1992; Guba & Lincoln, 1985; Maxwell, 2006). It is commonly



associated with research in the field of social sciences as studies are largely shaped by 'social' phenomena. Indeed, management research studies phenomena within their natural environment.

Although there is much debate on where and how a certain method relates to a research paradigm (Caelli et al., 2003; Johnson & Duberley, 2000), there are particular methodologies and approaches that are more suited to certain philosophies. Hence, the selection of a research methodology is usually a reflection of the adopted research paradigm. In addition, there are other factors that contribute to these choices that emerge from the research itself and the researcher (Antwi & Hamza, 2015; Leedy & Ormrod, 2010; Saunders et al. 2009). I elaborate on them in relation to the thesis here:

- 1) The nature of the inquiry which emanates from the gaps in existing knowledge, informs the philosophical framework, inclusive of the methodology. Research on EE, especially on active methods lacks sufficient theoretical grounding. Moreover, there are limited exploratory work on the nature and intricacies of active methods, as to their affective outcomes. Hence, interpretivism as a research ideology is better suited to understanding these under researched contextualized areas and provide clear account on the relationships among their components and epistemological premises. Indeed, Myers (2019) posits that the exploratory research is used to develop an understanding of the setting, origin, nature, antecedents, impact, and factors contributing to a particular issue.
- 2) The researcher should ensure that the chosen methods support the achievement of the research purposes. The thesis aims to investigate the utilization of several active methods in teaching entrepreneurship and their theoretical connectedness. These investigations typically include a network of interactions between the activities, tools, and artefacts used in the teaching process, the educator, the students, as well as other actors as relevant to each publication. Moreover, literature assessing the outcomes of entrepreneurship education has relied largely on quantitative studies, to provide objective/quantifiable evidence that can support strategies aimed at propagating EE at the policy level and within HEIs (Nabi et al., 2017). Hence, there is a lack of understanding of the nature of these methods, the nuances of their application, and a fair assessment of the broader and more affective outcomes from using them. Most importantly, learning, especially within an entrepreneurial context is argued to be a socially reliant activity that is defined by the activities, interactions, and experiences of the learner. These views stipulate the adoption of a qualitative approach, within an interpretivist paradigm.
- 3) The researcher should listen to their own voice and leverage their own capabilities when shaping their research approach. The author is more acquainted with qualitative research methods and thematic data analysis. This stems mainly from his previous experiences in the consulting industry. Additionally, data sources for conducting the research originated from the author's role as an entrepreneurship educator, a mentor with several entrepreneurship training and support organizations, and a member of entrepreneurship and management research communities. These preferences and resources facilitated the adoption of a qualitative approach.

Several researchers (e.g., McNabb, 2017; Denzin & Lincoln, 2011; Saunders et al., 2009) confirmed that interpretivism is a core foundation of the qualitative approach, as the latter is usually based on deep observation and investigation of human behavior and actions, through an interactive relationship between the researcher and the study sample (Tolley et al., 2016). Such relationship emanates contextualized insights about the phenomena being investigated, using in depth data collection techniques. Hence, qualitative research is largely of an inductive nature that aims to explore and understand rather than confirm, validate, and generalize (Saunders et al., 2009; Tolley et al., 2016).

Interpretivist research tends to use data collections methods that provide rich accounts and elaborate description of the phenomena being investigated within its social context (Farzanfar, 2005; Neuman, 2003), as they try to emulate and truthfully reflect the real world. It is worth noting that Johnson and Onwuegbuzie (2004) and Guba and Lincoln (1994) stress that research paradigms exhibit inherent flexibility and hence the researcher should not aim to exclude certain methods and data collection and analysis techniques that are not fully aligned with the premises of the philosophical stance of the researcher.

Interpretivism is however better enacted through qualitative methods as they provide a narrative description of the studied phenomena in its natural environment (Denzin & Lincoln, 2011). In qualitative research, the researcher is part of the data collection process and analysis, subjectively interpreting and judging the social occurrence. Instead of relying on standardized tools, they immerse themselves in the research setting, ask questions, observe directly and participantly, record and analyze the data based on the subjects' viewpoints and narratives. A concept referred to as "empathetic understanding" (Weber, 1968). Moreover, the qualitative researcher does not have a predefined set of hypotheses to test, unlike quantitative research, but rather embarks on a journey of discovery and exploration. Hence, the design of the study evolves as more information about the phenomena unfolds through the interactive nature of the inquiry and the subjectivity of the researcher's interpretation of the data.

To provide an overview of the methodological choices, I give an account on the methods, type of study, data origin, and samples (Leedy & Ormrod, 2010; Saunders et al., 2009) for the overall thesis and the publications included within it in the following paragraphs and in Table (3). For further details, please refer to the specific publication.

- Type of research: The thesis represents applied research since the results can be applied in a practical situation (Saunders et al., 2009), which is the application of active methods in EE.
- Nature of research: The research is of exploratory nature (Myers, 2019), aiming at building the understanding the nature, usefulness, and the theoretical connectedness of active methods. In addition to exploring their potential and limitations when applied for educating entrepreneurship students. It also has a descriptive element, aiming to describe the nuances of active methods application and map their relationships to ECs.

Hammoda (2023) investigated which ECAs can be leveraged to improve students and nascent entrepreneurs' competencies. It followed a qualitative approach by conducting in-depth semi-structured interviews (Creswell, 2013), online with 22 entrepreneurship experts from 13 countries around the world, using purposeful sampling (Robinson, 2014). I relied on ecosystem experts for their specific expertise in ECAs and experiential activities

for entrepreneurship (Ahmad et al., 2020; Gibb & Hannon, 2006). The interviews were planned as lengthy dialogues to allow participants to reflect on their experiences with entrepreneurs and elaborate on their feedback thus improving the quality of the narrative data collected (Sykes, 1990). Data from interviews was thematically analyzed using a hybrid approach through integrating the codes driven from interview data with those deduced from learning theories (Creswell, 2013; Fereday & Muir-Cochrane, 2006; Woiceshyn & Daellenbach, 2018).

Hammoda and Foli (2024), followed an integrative review methodology (Torraco, 2005) to inspect extant literature and critique existing digital competence/ literacy frameworks. From a total of 48 eligible articles, and 26 through snowballing, 6 articles, representing 6 frameworks (Carretero et al., 2017; Guitert et al., 2021; López-Meneses et al., 2020; Redecker, 2017), in addition to DigComp 2.0 (Vuorikari et al., 2016) and DLGF (Law et al., 2018) were selected for in-depth review. These frameworks were built through various methods including integrative reviews, experts' feedback, and surveys. Each were investigated in depth, mainly focusing on the context, competence areas, individual competencies, descriptions, use cases, applications, and limitation to contribute to the development of a digital competence framework for learners.

Hammoda (2024b) employed a systematic literature review which is typically used to analyze the state-of-the-art research (Massaro et al., 2016; Petticrew & Roberts, 2006; Rauch, 2020) on the outcomes of using ET in EE. I followed Jesson et al. (2011) six steps approach to systematic reviews. The initial search on Scopus database generated 316 articles, published anytime until 30 June 2023. These were reduced to 26 articles for in-depth analysis, following the application of the inclusion and exclusion criteria. The learning outcomes mentioned in the findings and discussion sections of those articles were then translated into the corresponding ECs, using EntreComp framework (Bacigalupo et al., 2016) as a reference.

Table (3). Overview of the methodology, data collection methods, type of research, data origin, and samples of thesis publications

Publication	Main Methodology	Data origin	Data collection methods	Data analysis	Sampling approach	Sample
Hammoda (2023)	Qualitative	Primary	Interviews	Thematic analysis	-Purposeful -Snowballing	22 entrepreneurship ecosystem experts
Hammoda & Foli (2024)	Qualitative	Secondary	Integrative Literature Review	Integrative review	Inclusion & exclusion criteria	6 articles
Hammoda (2024a)	Mixed Methods	Primary	Survey (Open & closed ended)	-Descriptive statistics	Convenience	20 undergraduate students
Hammoda (2024b)	Qualitative (Mainly)	Secondary	Systematic Literature Review	-Thematic analysis -Descriptive statistics	Inclusion & exclusion criteria	26 articles
Hammoda & Winkler (2024)	Qualitative (Case study)	Primary	Interviews Observations Experts workshop	Thematic analysis	Convenience	18 undergraduate students
Hammoda (2024)	Conceptual	N/A	N/A	N/A	N/A	N/A

Source: Created by the author based on the publications included in the thesis

Hammoda (2024a) applied ChatGPT for a founding team exercise and reported on it in a pedagogical innovation. The learning activity involved 20 students, who were surveyed afterwards for their perceived ease of use, usefulness, and convenience of using ChatGPT for entrepreneurial learning. They were also provided with space to provide additional comments on their experiences. The students' feedback was complemented by educator (author's) observations. A brief survey was sent out directly after the seminar to avoid recall bias (Schmidt et al., 2023). It requested that the students evaluate their experience using ChatGPT for receiving guidance on founding team composition, through three questions and an open feedback comment box. In total, 17 out of the 20 students responded to the survey (85%). The quantitative responses were imported to Microsoft Excel and analyzed descriptively for the mean and standard deviation to understand the general agreement/ disagreement in student responses and the variance in students' views, with regards to the survey questions (Stockemer et al., 2019). Responses to the open-ended questions as to the educator's observations were utilized to adjutant the findings (McKim, 2017).

Hammoda and Winkler (2024) conducted a case study within the context of an entrepreneurship course, designed with guidance from Mäkimurto-Koivumaa and Belt (2016) framework which leveraged active learning principles. The course was delivered to students from technology and engineering backgrounds. The paper investigated the intricacies of applying several active methods of EE, and their perceived challenges and opportunities, following an exploratory case study approach (Yin, 1994) as it allows answering questions of "how" and "why" (Leonard-Barton, 1990). We relied on interviews with the 18 students, the educator (one of the authors) observations, and input from a workshop with 8 EE experts. We followed Yin (1994) and Miles and Huberman (1994) suggested guidelines to data analysis. The data collected from the different sources was refined and reduced. Then categorized and recombined to expose it for analysis, using the active methods as a unit of analysis. This was performed in an inductive and iterative process (Strauss & Corbin, 1998), to satisfy the purpose of the study, deduce conclusions, and validate them in relation to extant literature (Eisenhardt, 1989).

Finally, Hammoda (2024d) conceptualized a model for academic entrepreneurship education and support. I relied on experiential learning (Kolb, 1984; Kolb & Kolb, 2005) and effectual principles (Sarasvathy, 2001) as predominantly active learning conduits that are widely used in a teaching "through" entrepreneurship approach. The conceptual logic is usually welcomed in scholarly areas that lack enough theorizing and/ or existing theoretical frameworks fail to address the research question.

### 3. Summary of findings

In this part, I present a summary of the findings from the different publications included in the thesis, organized according to the research questions. For the detailed findings of each publication and discussion of specific findings, please refer to the respective paper.

#### 3.1. RQ1: What are the theoretical foundations of active methods in EE, deployed to improve its competency-based outcomes?

The theoretical grounding of active methods in EE was part of four of the publications included in the thesis: Hammuda (2023) on ECAs, Hammuda and Winkler (2024) on active methods in STEM EE, Hammuda (2024a) on generative AI in EE, and Hammuda (2024d) applying effectuation and experiential learning for academic EE.

Across the thesis publications, the author aimed mainly to extricate and further establish the theoretical origins and associations of different active methods. These were found and hypothesized to be grounded in different learning and entrepreneurship theories, that provide them with a theoretical frame to understand their effectiveness towards developing entrepreneurial competencies, as to the opportunities and contingencies of their effective application. Extracurricular active methods were connected to five different learning theories and perspectives; experiential, social, situated, existential, and cognitive. Active methods applied in a classroom environment were grounded in active learning views of Piaget, Vygotsky, and Dewey. Moreover, generative AI application for EE and uptake by entrepreneurship students was posited to be better aligned with a heutagogical and effectual logic. Similarly, educating academics on entrepreneurship was conceptualized to follow effectuation and experiential learning principles to better match the needs of academic entrepreneurs. However, it was found that the theoretical affixation of active methods is rather situational. The theoretical relationship of active methods is dependent on the purpose and the context of their application, with several of them exhibiting a modular relationship to the different learning theories.

I highlight here the main findings from these publications. In Hammuda (2023), the paper identified 34 ECAs following in-depth interviews with 22 ecosystem experts, that can help develop entrepreneurial students' competencies. These were mapped against cognitive, experiential, social, situated, and existential theories of learning, as in figure (5). Cognitive ECAs included for example workshops, courses, books, industry news, reports, and documentaries. These can develop financial knowledge and self-confidence, while giving the students creative ideas and the ability to identify opportunities. Experiential ECAs were either virtual, as in simulations and virtual companies, or authentic which included side hustle and launching a crowdfunding campaign. Essentially, these experiential environments can allow students to practice the different aspects of running a business including planning, marketing, supply chain management, taxation, investment, and payrolls. Additionally, students tend to learn how to deal with uncertainty and risk, preparing them for the dynamic startup world.

Social ECAs included mentoring, students' organizations, exchange programs, and online groups and forums. Mentors can provide access to valuable resources and experiences, that could be otherwise unattainable. Additionally, they can provide more specific advice based on the mentor's background like legal or marketing advice. Social ECAs were recommended to help finding team members and co-founders. They also develop teamworking and public speaking skills, and planning and management skills if

they get involved in organizing them. Situated ECAs recommended by the experts can last for either a short period such as hackathons and startup competitions or longer durations as in accelerators and internships. Through these situated learning experiences, students get to develop presentations, business, and financial models in iterations and in teams. They also act as creativity beds as students are expected to come up with an innovative solution to societal and/ or environmental problems. Moreover, these situations act as communities of practice where they get to learn about different entrepreneurial practices from their peers, mentors, advisors, and entrepreneurs. Existential activities were deemed essential as they form a core part of transforming new knowledge and experiences into updated mental models and behaviors. They also allow students to learn more about themselves and their surrounding environment. Hence, developing better awareness and self-efficacy, while igniting their creativity and opportunity identification skills. Several existential activities were recommended by the experts including opportunity walk, reflective practices, engaging in artistic activities, and undertaking self-assessment tests. However, it is worth noting that the proposed theoretical alignment is rather flexible and depends on the context and the purpose of applying an ECA.

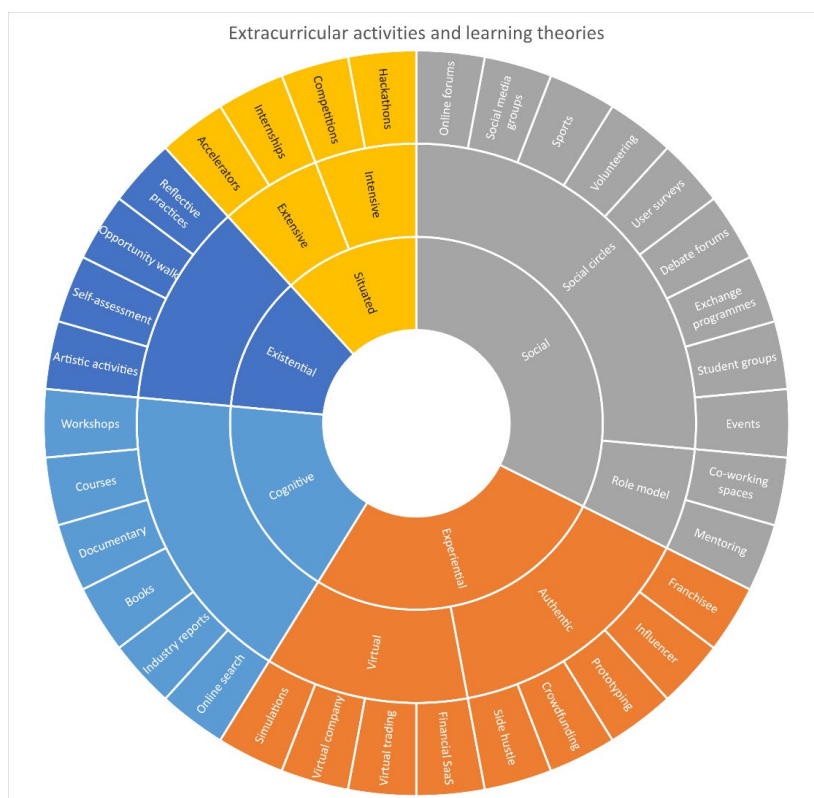


Figure (5): A Typology of Extracurricular activities in entrepreneurship education  
Source: Hammada (2023)

Hammoda and Winkler (2024) studied the application several active methods to teach entrepreneurship to students from engineering and technology backgrounds. They reported on the benefits they bring towards developing students ECs, the potential challenges, and the intricacies of applying them in a classroom environment, using views of the students, educator, and EE experts. In general, introducing active teaching methods was well appreciated and students found active approaches to be very important in learning entrepreneurship, as an unknown topic to them, which provided them with sufficient theoretical knowledge while allowing them to practice it simultaneously. Across the active methods implemented, pitching and presenting and mentoring sessions were the most valued by the students. Regular pitching spurred their motivation and helped them become more creative and self-confident. It also improved their communication skills and taught them better planning and management, through putting theoretical knowledge to application. Mentoring allowed them to receive feedback and ask questions in a criticism free environment. They were also able to acquire knowledge and guidance that is tailored to their individual needs. Students reported that groupwork is an essential skill in modern workplaces. However, to maximize its benefits they would like to work with different people to learn from more diverse experiences and working styles. Guest speakers were well appreciated for allowing them to learn from real-life experiences and explore possible entrepreneurial and career paths. Something that would take years to develop otherwise. Online search or 'Googling' as coined by EE experts was seen as an indispensable skill to gain insights into markets, companies, and competitors. However, students should learn how to perform it effectively, i.e., where to go to find what type of information. Using multimedia and social media improved message communication and clarity, especially for complex theoretical constructs. It also improved the likeness of the course and allowed them to gain more comprehensive view on the social and ethical aspects of running a business.

Moreover, in Hammoda (2024a), generative AI (ChatGPT) was applied in an entrepreneurial pedagogical innovation as the new advanced technology with promising educational applications (Farrokhnia et al., 2023), especially in the field of entrepreneurship (Winkler et al., 2023). Generative AI is conceptualized as a heutagogical learning tool that embodies the effectual decision making of entrepreneurial students and entrepreneurs. It was applied for a founding team activity that aimed at providing students with insights on the different compositions of entrepreneurial teams and how to organize them based on to the type of business they are starting. ChatGPT provided them individualized and contextually relevant, in an evolving and conversational manner. Students perceived it as extremely useful in supporting them in understanding the varying compositions of founding teams pertinent to the type of business and developing an insightful comprehension of the recommended constellations, and relatively easy to use for venture ideation and creation activities. Moreover, they got to comprehend and experiment with the practicalities of team building, financial and equity arrangements, and business modelling. They also found it to be rather convenient for entrepreneurial learning in comparison to the habitual lectures and classroom-based methods.

Hammoda (2024d), designed a conceptual model for academic EE based on effectuation and experiential learning principles. Both are increasingly used in "through" approaches to teach entrepreneurship. Moreover, effectuation and experiential learning are particularly relevant in the context of academic EE as academic entrepreneurs



typically face resource and time constraints (Alexander et al., 2015), and lack exposure to entrepreneurial role models (Miller et al., 2018), and need to improve their practical skills (ibid).

### **3.2. RQ2: How can a competency-based approach be operationalized for assessing the outcomes of active methods in EE, as a reliable theoretical framework?**

A competency-based approach was followed in the thesis and manifested to varying degrees across the thesis publications. More specifically, it was used for identifying the outcomes of active methods in EE and for developing a competency-based framework for digital competence among learners.

A competency-based approach was at the heart of assessing the impact and outcomes of applying active methods in EE. I relied on EntreComp framework, as a validated and applied framework in research on entrepreneurial competencies, to assess the outcomes of applying educational and digital technologies in EE. The learning outcomes were hence mapped to the corresponding entrepreneurial competencies as listed on the EntreComp. This approach helped understand and develop a standardized competency-based approach for assessing the outcomes of several types of educational and digital technologies, including simulations, AI, MOOCs, virtual reality, online communities, and computer-assisted technologies. Moreover, experts reporting on the possibilities of the extracurricular activities in Hammada (2023), were guided by the EntreComp framework in their reporting on the benefits of 34 different types of ECAs, as a tool to align their replies with a competency-based approach to EE. Similarly, a competency-based approach was applied for reporting on the benefits of the eight active methods applied in a classroom environment, leveraging the individual entrepreneurial competencies on the EntreComp in Hammada and Winkler (2024). Additionally, I built on widely adopted digital competence frameworks such as Digital Competence Framework for Citizens (DigComp 2.0) by Vuorikari et al. (2016) and the UNESCO's 2018 global framework; Digital Literacy Global Framework (DLGF) by Law et al. (2018), to conceptualize a Digital Competence Framework for Learners (DCFL) that is updated to become inclusive of learners' skills required to utilize mobile and cloud technologies and to career-related digital platforms.

I hence present the findings from relevant publications in more details. Hammada (2024b) investigation of the impact of using ET to teach entrepreneurship on the learning outcomes, relied the EntreComp framework to analyze and report on the findings. The paper systematically reviewed 26 articles spanning different types of ET and translated the reported learning outcomes in each into the corresponding ECs. These are displayed in figure (6). The review showed that in general, research on ET in EE is at a nascent stage which started gaining momentum a few years ago only. It also lacks sufficient theoretical grounding, if any, and methodological rigorousness.

The Digital Competence Framework for Learners (DCFL) developed through an integrative review in Hammada and Foli (2024), builds on preceding widely adopted digital competence frameworks such as Digital Competence Framework for Citizens (DigComp 2.0) by Vuorikari et al. (2016) and the UNESCO's 2018 global framework; Digital Literacy Global Framework (DLGF) by Law et al. (2018). It proposes a tailored digital competence framework for learners that addresses some of the missing aspects in previous ones, although it maintained all the fundamental competence areas outlined in

the DLGF (Law et al., 2018). Within the “Devices and software operations” competence area, four competencies have been adjusted. These include physical operations of PCs and laptops, software operations in PCs and laptops, physical operations of mobile devices, and software operations in mobile devices. Unlike the DLGF, which covers digital devices in general (Law et al., 2018), our framework focuses exclusively on PCs, laptops, and mobile devices. Additionally, employability competencies were separately highlighted in DLGF in comparison to DigComp 2.0 through the addition of a separate competence area; “Career-related competencies” (Law et al., 2018). We find this competence area very important to the end goal of digital literacy capacity building programs among learners, i.e., improving their entrepreneurial capacities, job market readiness, and employability potential (Ancarani & Di Mauro, 2018; Gallardo-Echenique et al., 2015; Khan et al., 2022). As an extension of this competence area, we introduced two additional individual competencies. The first aspect is “Creating and editing career-related profiles,” which focuses on understanding the components of a curriculum vitae (CV) and effectively presenting skills, knowledge, and experience in a professional and concise manner, including in online environments and professional communities (Florenthal, 2015; Van Dijck, 2013). The second aspect is “Browsing, searching, filtering, and evaluating career opportunities,” which highlights the ability to identify and utilize career-related portals that advertise jobs and projects specific to a particular field.

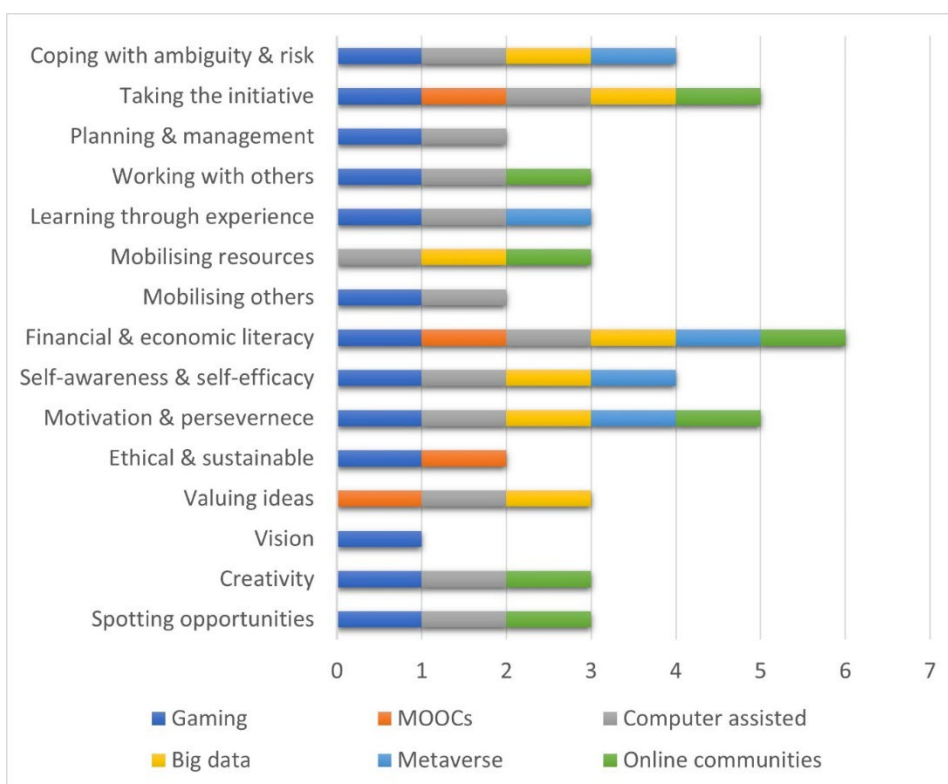


Figure (6): Digital technology contribution to the development of ECs  
Source: Hammada (2024b)

### **3.3. RQ3: How do active methods contribute to competency-based outcomes in EE?**

The thesis explored the contributions of active methods applied in EE towards developing competency-based outcomes, i.e., entrepreneurial competencies, relying chiefly on the EntreComp a reference framework.

Different types of educational and digital technologies were found to impact ECs development differently as in figure 6 (Hammoda, 2024b). Most notably, business simulations and serious games were found to have the most profound impact on developing a broad range of ECs. While MOOCs and online learning environments did not demonstrate significant impact on the development of ECs.

Extracurricular activities were posited by ecosystem experts as beneficial towards the development of students' ECs. While I identified and reported on 34 different ECAs in Hammoda (2023) (see figure 5), mentoring was the most recommended ECA. It was regarded especially beneficial towards the development of a broad range of competencies, including financial literacy, self-awareness and efficacy, and business management. Additionally, ECAs of experiential nature were highlighted by experts as conduits towards the development of practical ECs by learning from experience, identifying opportunities, dealing with uncertainty, and working with others. Existential ECAs such as opportunity walk, self-assessments, and reflective exercises, were especially posited to improve entrepreneurship student's self-efficacy and spotting opportunities. Social and situated ECAs were recommended for developing management and leadership capabilities, getting specific experience to students entrepreneurial interests, and building networks and communication skills. While cognitive ECAs were still deemed essential for acquiring needed financial and economic knowledge and learn from entrepreneurial stories.

In Hammoda and Winkler (2024), several classroom-based active methods were found to help develop students' ECs. These included presentations, guest speakers, mentoring, multimedia and social media, group work, case studies, reflective essays, and online search. The findings provide holistic insights into the nature and intricacies of applying active methods in a classroom environment. The findings provide holistic insights into the nature and intricacies of applying active methods in a classroom environment. Generally, students found active approaches essential in learning entrepreneurship as an unknown topic, providing sufficient theoretical knowledge while allowing them to practice it simultaneously. Presentations were the most valued as it improved their motivation and confidence, taught them better planning, and translating theory to practical applications. Mentoring improved their self-efficacy and improving their management skills more effectively. Guest speakers allowed them to learn from others' experiences, and better spot opportunities. Case studies helped develop their critical thinking and problem-solving skills, their creativity, and build their financial and planning capabilities. Working in groups simulated real-life professional environments and taught them team working, negotiation, and leadership skills. Reflective essays increased their self-awareness and efficacy, and improved their critical thinking and appraisal abilities. Online search and the use of multimedia and social media was seen as a natural occurrence, given the high dependence of modern enterprises on these tools and platforms. Learning to use them effectively improved knowledge acquisition and comprehension about entrepreneurial concepts and examples, and allowed them to better research the market, identify and value opportunities, and become more creative.

## 4. Contributions

In this part, I highlight the main contributions from the articles featured in the thesis. I grouped them into two main contribution areas that corresponds to our research questions, and two subareas emerging from them. These are displayed on figure (7) and are inclusive of the theoretical and practical contributions of the thesis. However, for a more nuanced account of the contributions of each publication, please refer to the respective article.

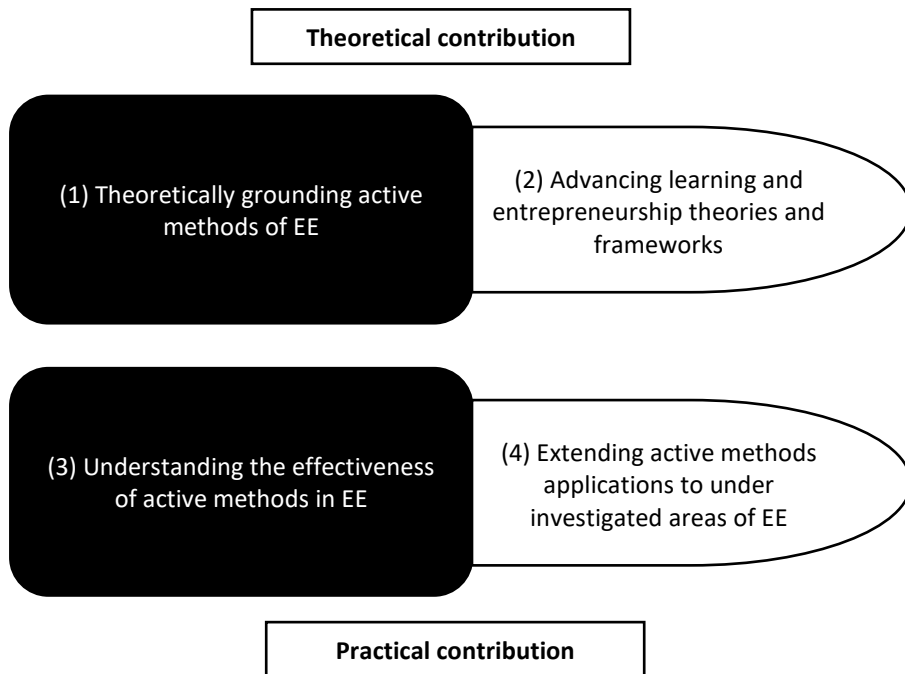


Figure (7): Thesis contributions  
Source: Created by the author

### 4.1. Theoretically grounding active methods of entrepreneurship education

The main contribution of this thesis is in further grounding active methods used in EE in their theoretical foundations. In the profound literature reviews conducted on EE, it became more evident that the development of entrepreneurship pedagogies has in most cases insufficiently grounded them in educational theories and constructs (Fayolle, 2018; Kyrö, 2015). This frailty has been frequently criticized by scholars within and outside the field (Bécharde & Grégoire, 2005; Fayolle, 2013; Kyrö, 2015; Preedy et al., 2020; Rideout & Gray, 2013). In recent years, it became more ‘felt’ as a pressing issue with the diffusion of ‘for’ and ‘through’ pedagogical thinking and methods among entrepreneurship educators (Fayolle, 2018; Lackéus, 2020; Winkler et al., 2015). This was evident in the review on ET in EE (Hammoda, 2024b) as a significant number of the reviewed articles lacked sufficient theoretical and methodological rigorousness. Building

the theoretical foundations of active methods used in EE, based on the different learning models and theories will help us as educators and researchers in understanding what works and why, hence support us in developing better pedagogies (Farrokhnia et al., 2023; Hammoda, 2023; Nabi et al., 2017; Robinson et al., 2016).

Throughout the papers that comprise this thesis, the author focused on theoretically grounding the different active methods that were investigated for teaching entrepreneurship. For example, while ECAs are often explained through an experiential learning lens (Padilla-Angulo, 2019; Preedy et al., 2020), the paper on ECAs for EE (Hammoda, 2023) expanded the discussion on their theoretical interconnectedness to additional constructs, including social, situated, cognitive, and existential learning. The paper provides a basic understanding of the theoretical underpinnings of different ECAs for EE, as one of the few papers that focuses on this as its primary contribution (see also Pittaway et al., 2011; Pocek et al., 2021; Politis et al., 2019). The study also opens the door for theory-based evaluations (Birckmayer & Weiss, 2000) to study the effectiveness of EE approaches and programs, by comparing the expected patterns of learning deduced from theories, against the nature and outcomes of the different ECAs. Theory-based approaches could prove beneficial in assessing the outcomes of an elusive and multidisciplinary educational field, such as entrepreneurship (Duval-Couetil, 2013; Pittaway & Edwards, 2012), and provide an alternative route to the prevailing economic measures (Nabi et al., 2017) and the growing competency based (Morris et al., 2013) evaluations.

Moreover, the conjoint nature of learning theories when applied for EE was exhibited across the discussed ECAs and demonstrates the versatility and richness of EE approaches in comparison to extant literature. The dominance of one theoretical construct over others is thus situational and relies on the intended learning outcomes and the micro activities the learner participates in within a specific learning activity. Additionally, in the active learning in STEM EE paper (Hammoda & Winkler, 2024), we employed the principles of active learning theories based on the perspectives of John Dewey (1974), David Kolb (1984), Jean Piaget (1995) and Lev Vygotsky (1987) in designing and delivering several active methods during an entrepreneurship course. The academic EE publication (Hammoda, 2024d) applied effectuation theory (Sarasvathy, 2001) and experiential learning (Kolb, 1984; Kolb & Kolb, 2005) to the field of academic entrepreneurship education. It provided a new theoretical platform, grounded in effectuation and experiential learning, for educating and supporting academic entrepreneurs.

More recently, the rise of generative AI and its applications has provided more questions than answers to the academic community. Researchers, for example, are yet to identify relevant theoretical foundations that can be applied to analyze and implement generative AI in research and teaching (Farrokhnia et al., 2023; Winkler et al., 2023). The pedagogical innovation included in this thesis (Hammoda, 2024a) positions generative AI as a heutagogical (Hase & Kenyon, 2000, 2007) and effectual (Sarasvathy, 2001) tool and thus contributes to the heutagogical remodeling of EE, one that has learners at its center and promotes their independence (Neck & Corbett, 2018). Moreover, the pedagogical innovation serves as an exemplar for applying advanced technology for transformative learning purposes (Mezirow, 2003). Additionally, the pedagogical innovation builds on the effectual logic of Sarasvathy (2001) and adds to it by applying it within the context of entrepreneurship students, in contrast to the original conceptualization of effectuation among expert entrepreneurs. It extends the

argument for applying effectuation as the main logic for generative artificial intelligence applications for entrepreneurial training and support (Lupp, 2023).

Moreover, across the articles in the thesis, and in general as a researcher in EE, I tend to follow a competency-based approach (Morris et al., 2013). This coincides with the broader definition of EE as a developmental endeavor that aims to equip students with specific business knowledge and a variety of skills and attributes that can support them in different career paths (Nabi et al., 2017). As a theoretical reference point for data analysis and interpretation, I followed a competency-based approach relying upon the European Union Entrepreneurship Competence Framework, known as EntreComp (Bacigalupo et al., 2016). EntreComp is the most widely adopted framework for entrepreneurial competencies in research and teaching entrepreneurship and offers a flexible model that can be adapted to the different contexts and applications (LópezNúñez et al., 2022; Morselli & Gorenc, 2022). Hence, employing it in research provides a valid theoretical grounding for analyzing and assessing the outcomes of EE. EntreComp was applied as a reference framework to translate the learning outcomes resultant from applying ET in EE into entrepreneurial competencies (Hammoda, 2024b). It was also applied to understand the usefulness of ECAs deduced from ecosystem experts' interviews towards the development of ECs (Hammoda, 2023). More broadly, it was utilized in principle to investigate the benefits and opportunities of the implementation of different active methods in a STEM EE course (Hammoda & Winkler, 2024).

## **4.2. Advancing learning and entrepreneurship theories and frameworks**

An additional theoretical contribution demonstrated throughout the thesis publications is in advancing and extending the applications of several theories and frameworks within an entrepreneurial learning context, conceptually and empirically. Hence, improving their validity and better establishing their connection to active methods and the scholarly field of EE.

Hammoda (2024b) review on ET in EE, establishes a basic tool that maps the competencies developed by each potential technology when applied in EE. An area that Morris et al. (2013) highlighted, as lacking a standardized tool. Given the divergence in competency-based assessment methods, notwithstanding that the reliability and generalizability of any competency-based method is debatable (Bird, 2019), our approach provides a path that can guide scholars on implementing a more reliable measure. It does so by extending the applications of our reference tool; EntreComp framework (Bacigalupo et al., 2016) into a new pedagogical delivery method, i.e., educational technologies.

The DCFL paper (Hammoda & Foli, 2024) proposes a framework for digital competence among learners by drawing inspiration from DigComp 2.1, an evolved version of DigComp 2.0 (Carretero et al., 2017), and the Digital Literacy Global Framework (DLGF) (Law et al., 2018). This framework is among the few that discusses digital competence within a learner context, as the first to utilize inputs from both DigComp 2.0 (Vuorikari et al., 2016) and UNESCO's Digital Literacy Global Framework (DLGF) (Law et al., 2018), builds on them, and thus extends their remit to the specific learner's context. It adds a comprehensive and updated model that caters for the changes induced by COVID-19 (Zhao et al., 2021), to the short list of digital competence frameworks targeted at learners (Pettersson, 2018).

The academic EE publication (Hammoda, 2024d) extends effectuation principles to an educational context and proposes a conceptual application of experiential learning in a new field, i.e., academic entrepreneurship. Originally, effectuation was developed based on experienced entrepreneurs accounts and hence, it requires adaptation and investigation of its potential applications in other fields (Chandler et al., 2011; Engel et al., 2014), including education (Günzel-Jensen & Robinson, 2017; Li et al., 2022). It also revives the research on EE as a process (Leitch & Harrison, 1999). Similarly, Hammoda (2024a) application of ChatGPT for EE illuminates the potential for effectual and heutagogical approaches in supporting students morphing into active entrepreneurs (Krueger, 2007). Both publications (Hammoda, 2024a, d) provide a much-needed empirical illustration of effectuation principles affixation to education practices (Günzel-Jensen & Robinson, 2017), thus extending our limited understanding of effectuation process applications (Engel et al., 2014). Moreover, I build connections between effectuation and heutagogy (Hammoda, 2024a) and experiential learning (Hammoda, 2024d), in response to Perry et al. (2012) call for building relationships between effectuation and established paradigms.

Additionally, the reflective elements of the proposed models in both papers align with their premise as a core component of the learning process by extracting new meanings and remodeling cognitive maps of learners (Hase & Kenyon, 2000, 2007; Jones et al., 2019; Kolb & Kolb, 2005). Regarding the Hammoda (2024a), more specifically, ElTarabishy (2023) advocates the use of ChatGPT in what he labelled as “The Socratic Method” to engage students in reflective conversations on the recommendations provided by ChatGPT. Hence, it is important for educators and students undertaking a similar learning activity to reflect deeply on the results provided by generative AI applications, in relation to their convictions and realistic entrepreneurial models (Hammoda, 2024a).

### **4.3. Understanding the effectiveness of active methods in entrepreneurship education**

The articles featured in the thesis, provide several practical insights. These are mainly geared towards supporting educators, HEIs and organizations invested in educating and training entrepreneurs in understanding the usefulness of active methods in EE (Koropogui et al., 2023) and integrating them in their entrepreneurship courses and programs more effectively, for improved outcomes.

The ECAs illustrated in Hammoda (2023) can provide enhanced opportunities for ‘learning by doing.’ Thus, updating the entrepreneurial students’ knowledge, skills, and mindset through new experiences (Duval-Couetil et al., 2016; Pittaway et al., 2011). By leveraging the findings of this study and given the complementary nature of ECAs to curricular EE (Lilischkis et al., 2015), educators at HEIs can signpost their students to participate in different activities based on their competencies’ profile to improve their attainment of ECs and complement curricular activities. This can further promote a student-centered approach to learning (Hase & Kenyon, 2000; Jones et al., 2019), which enhances entrepreneurial students’ engagement and drive better outcomes (Robinson et al., 2016). For example, students with limited financial literacy, can benefit from blending cognitive (workshops and course) and experiential (simulations and games) approaches that were recommended by the ecosystem experts, to improve their financial knowledge and practical skills. Moreover, to those students having communication problems and/ or

lower self-confidence, several ECAs such as mentoring and participating in events and student groups, which are predominantly social in nature, can prove remedial. To cover for the experience gap among students, experts recommended activities such as interning, entrepreneurial projects, and community work. Moreover, to resolve the problem of idea-driven entrepreneurship, where students focus on the idea rather than the user and market needs, experts suggested that students engage in customer discovery, reflective practices, discuss ideas openly with others, and prototype their solutions to better identify real societal needs and build meaningful solutions.

The investigation of several active methods in a classroom environment in Hammuda and Winkler (2024) provides valuable insights to entrepreneurship educators on their usefulness, nature, potential and limitations when applied in a classroom environment. The applied active methods helped develop students' broader skill sets, improved their entrepreneurial orientation, and widened their career prospects. (Hagvall Svensson, 2023; Zappe et al., 2023). They enhanced students' entrepreneurial competencies by engaging them in educational activities that resemble real-life settings (Neck & Corbett, 2018). Pitching, for example, helped develop several ECs including management, communication, financial literacy, and self-confidence. Hence, educators might want to repurpose the customary pitch at the end of an entrepreneurship course to repetitive, active learning experiences. Mentoring sessions can be utilized to provide constructive and individualized guidance to students, thus improving their specific weaknesses and self-efficacy. In terms of guest speaking and case studies, while proven impactful in developing students' competencies, it is crucial that educators recognize the potential negative impact of promoting famous, successful entrepreneurial exemplars on their students' morale and self-efficacy. This undesirable impact is what Wraae and Nybye (2024) referred to as the "dark side of entrepreneurship education". Additional and more elaborate insights on several active methods effective utilization is provided in the publication.

Leveraging the mapping of ET to EC in Hammuda (2024b), entrepreneurship educators and program designers can utilize it to integrate technologies more insightfully in their pedagogies, alongside other teaching methods and tools. Hence, achieving better outcomes and improving students' learning experiences. Moreover, they can use it as a basic tool for assessing the effectiveness of applying ET in EE, following a competence-based approach. The appropriateness and usefulness of different ETs are elaborated upon in the findings section and in the respective paper. Moreover, the mapping exercise can be replicated and adapted to assess the outcomes of other methods and tools used in EE and other business and management disciplines. The results of this study can as well support educators and administrators' efforts in building the business case for adopting ET in entrepreneurship and business education, knowing that some of the main barriers to do so is the lack of awareness of their possible applications and potential benefits (Cooper, 2007; Hammuda, 2024c; Secundo et al., 2020b).

The digital competence framework for learners (DCFL) proposed in Hammuda and Foli (2024) can be used as a guide to policymakers and regulators in areas of education, employment, and industry. It can contribute to defining policies and standards for learners' digital competence assessment and development, whether through the educational institute or by themselves (Caena & Redecker, 2019), as it has become evident that user buy-in and engagement are essential for the success of digital skills programs (Conrads et al., 2017). From an economic development perspective, having digitally skilled graduates is becoming a critical success factor in today's technology



reliant businesses and organizations (Ancarani & Di Mauro, 2018; Janssen et al., 2013; Ratten, 2023). Educational institutions have recently started recognizing this urgent need and are prioritizing the development of the digital skills among their students in order to graduate digitally capable manpower (Bond et al., 2018; Ratten, 2023). Thus, this framework supports and contributes towards digital competence development initiatives at education institutions and within life-long learning environments, which can enhance the innovation and entrepreneurial abilities (Caena & Redecker, 2019) of societies' future workforce and entrepreneurs.

Additionally, the effectuation-based model for academic EE proposed in Hammada (2024d) offers an alternative approach to traditional methods at HEIs for educating and supporting nascent and to-be academic entrepreneurs. It answers better to their specific needs, challenges, and situational factors than formal entrepreneurship courses (Günzel-Jensen & Robinson, 2017; Politis, 2005). The model allows for personalized learning, mindset development, and self-awareness, which are critical aspects of entrepreneurial learning (Rae, 2000). Thus, it caters for a broader range of EE outcomes, from competencies development to social capital enrichment, and venture creation.

Moreover, the generative AI (ChatGPT) activity depicted in (Hammada, 2024a) provided insightful guidance on the potential of applying it for EE effectively. Hence, it can help entrepreneurship educators designing effective learning activities for their students. However, I urge educators and leaders across the entrepreneurship ecosystem to improve their digital and AI literacy in order to apply advanced technologies adequately within their classrooms and varying learning spaces (ElBanna & Armstrong, 2023; Kasneci et al., 2023), and guide their students and trainees on using it appropriately.

#### **4.4. Extending active methods applications to under investigated areas of entrepreneurship education**

The publications outlined in the thesis leaned towards investigating active methods in a rather under investigated areas and groups of EE. These have significant value in establishing active methods in EE and EE itself as a distinguishable scholarly subfield and connecting them to broader and more diverse applications and other subfields of entrepreneurship research. Hammada and Winkler (2024) investigated the application of active methods in STEM EE, an under researched area that deserves further exploration given the changes in the market requirements. Graduating engineers are expected to exhibit ECs and orientation to drive innovation through their entrepreneurial ideas and assume leadership roles (Hagvall Svensson, 2023; Winkler et al., 2015; Zappe et al., 2023). Moreover, the pedagogical innovation (Hammada, 2024a) is among the first to report on an empirical application of generative AI (ChatGPT), as an active learning method within the entrepreneurship education field, which is currently lagging other educational and management research disciplines in investigating the applications of advanced technology like generative AI (Winkler et al., 2023a). The entrepreneurship education and support model proposed in Hammada (2024d), extends our understanding of active methods applications, that leverages effectuation (Sarasvathy, 2001) and experiential (Kolb, 1984) principles in a 'through' EE approach (Fayoole & Gailly, 2008) to academic entrepreneurship which is receiving increasing attention recently (Skute, 2019).

Additionally, The ECAs paper (Hammoda, 2023) relied upon entrepreneurship ecosystem experts' views, supporting their incorporation in the EE process as an important step to improving its outcomes (Isenberg, 2010; Kuratko, 2005; Lilischkis et al., 2015). This is especially relevant as existing ECAs studies, as to the wider EE literature, tend to focus on HEIs actors' views only (Bischoff et al., 2018; Rae et al., 2012; Lilschkis et al., 2015). Finally, the review of ET impact on EC (Hammoda, 2024b) contributes to the limited validated knowledge at the nexus of technology, education, and competence development within an entrepreneurship context. So far, there have been limited empirical investigations of the learning outcomes and competencies developed through ET when applied in EE, and even more scarce reviews on their effectiveness (Lin & Sekiguchi, 2020; Ratten & Jones, 2021).

## **5. Limitations and future research**

### **5.1. Limitations of the thesis**

The thesis, as to the individual publications included in it, are not without their limitations. In the following paragraphs, I highlight the main general limitations across the thesis organized against the research questions. For limitations pertinent to each publication, please refer to it.

#### **5.1.1. RQ1: What are the theoretical foundations of active methods in EE, deployed to improve its competency-based outcomes?**

While the thesis aimed to theoretically ground the different active methods of EE investigated throughout its publications. However, it is important to realize that distinctiveness is not absolute and there is inherent flexibility and overlap among implemented theories. Thus, the appropriation of learning and entrepreneurship theories to an active method relies on the intended purpose of using it and the context of its implementation.

#### **5.1.2. RQ2: How can a competency-based approach be operationalized for assessing the outcomes of active methods in EE, as a reliable theoretical framework?**

The thesis relied on a competency-based approach to EE (Morris et al., 2013), leveraging EntreComp framework (Bacigalupo et al., 2016) for entrepreneurial competencies evaluation. However, it is worth noting that the EntreComp framework has its inherent limitations, as a basic and a modular framework that is aimed to be adjusted and built upon according to the purpose of its application. Moreover, as proposed in Hammoda (2024b), there are some rearrangements of the competencies that are due in the framework itself. Additionally, as noted by Bird (2019) there is a lack of agreement on a standard competency-based framework which contributes to the debate on the effectiveness of similar models. Additionally, Hammoda and Foli (2024) developed a digital competence framework specifically for learners, through an integrative review process. However, as to other competency-based frameworks it requires further validation and adaptation to the specific context of its application.

#### **5.1.3. RQ3: How do active methods contribute to competency-based outcomes in EE?**

Several publications in the thesis aimed at investigating the usefulness of the different active methods when applied in EE. However, there are limitations regarding the sample sizes and the qualitative approaches followed across them. This limitation is attributed to the main purpose of the thesis and type of data sources available to the author to conduct research within doctoral studies duration. Hence, in the future, further validation using quantitative and experimental designs is advised. Moreover, additional active methods could be elicited and thus investigated, and the interpretation of their usefulness might differ through the examination of broader and/ or more diverse contexts and participants.

## 5.2. Future research

Similar to the thesis contributions, I highlight here briefly the main future directions of research that can build on the collective work of the thesis. For specific recommendations on future research directions of each study, please refer to the publications.

- 1) In general, I call for further research that aim at better understanding the nuances and usefulness of applying active methods and digital technologies in EE. Most of the scholarly work so far is of a rather exploratory nature, which is required in a nascent field. However, as early studies yielded valuable results, scholars might want to adopt a confirmatory approach, through employing experimental and quantitative methods, for example, to validate and expand upon the findings of the studies included in this thesis. For example, researchers might want to adopt the mapping of ETs versus ECs in Hammada (2024b) and conduct empirical studies on the impact of different ETs used in EE. Additionally, while Hammada (2023) aimed to include a diverse set of entrepreneurship ecosystem experts, these selected were based on three groups only from the external EE stakeholders' categories of Bischoff et al. (2018). Researchers might want to build upon the study and incorporate larger numbers of members from other groups in their sample through quantitative methods, to expose more diverse opinions.

Additionally, the thesis uncovered certain issues when applying active methods that requires further attention from both scholars and educators and adopting a balanced approach when incorporating them. For example, the continued promotion of pitching while useful to develop students' competencies, should be applied as a learning activity rather than having a competition-focus. Moreover, guest speakers, media, and case studies should deviate from the prevalent "hero" entrepreneurial exemplars and become more representative of everyday entrepreneurship realities. Moreover, while digital technology showed promising results in teaching entrepreneurship, it also highlighted some challenges related to teachers' and institutions readiness, and students' motivation. Similarly, it is worth noting that active methods should be complemented with knowledge-intensive lectures to build students' knowledge repository. This could be included either early in the course (See Creed et al. (2002) and Täks et al. (2014, 2016) or at later stages (Mäkimurto-Koivumaa & Belt (2016).

- 2) Additionally, I advocate for continuing the scholarly efforts connecting the innovative methods we use in EE to the established learning and entrepreneurship theories. One approach is to examine the application of additional constructs that I posit to provide value in EE, such as design science, design thinking, embeddedness, stakeholders' theory, and systems thinking. Additionally, while the studies included in the thesis represented a step forward, it also highlighted that the relationship between active methods and their theoretical underpinnings is nonlinear. It is rather transversal and modular, depending on the purpose from applying the active methods and the context of their application. Thus, more inclusive scholarly discussions can prove helpful to further establish the theoretical grounding of these methods, potentially

through the implementation of Delphi method among EE scholars (van Gelderen et al., 2021) or integrative reviews of existing literature (Torraco, 2005).

- 3) Moreover, I encourage EE researchers to direct their attention to underrepresented areas of EE, such as teaching directed to non-business disciplines, EE occurring in informal settings, and corporate entrepreneurship training. STEM EE, which is investigated in this thesis in Hammada and Winkler (2024) is still in early stages, despite the propagated promotion of entrepreneurship courses and incubators to STEM students (Hagvall Svensson, 2023). Additionally, while work on academic entrepreneurship is gathering momentum, there is still a lack of clarity on role definition and the integrative possibilities of the different stakeholders in the entrepreneurship education ecosystem, as to the effectiveness of EE methods that can be implemented (Li et al., 2022; Rippa et al., 2022).
- 4) Building on the thesis publications, the data collected, and the feedback received during the multiple review processes. I identified a few research projects to build upon it. One extension to my work is empirically validating the digital competence framework for learners. Some preparatory work is already underway with an educational organization to plan for it. The other builds on the data collected for the extracurricular activities by investigating the integrative possibilities of entrepreneurship ecosystem actors for improved efficiency and effectiveness, which needs to be complemented by the views of HEIs educators and researchers. A third one came up during the review process of Hammada and Winkler (2024), which is to investigate multidisciplinary approaches to EE. This primarily has been discussed to be conducted using a mixed method approach with a university providing interdisciplinary EE.
- 5) Finally, I advocate for better connecting EE research with other related entrepreneurship domains such as entrepreneurial identity, entrepreneurial passion, intention-action gap, marginalized entrepreneurship, and ecosystems. These could provide EE scholars and educators with valuable insights from different perspectives on the axiological premises of EE, and improve its academic legitimacy, in addition to the theoretical grounding discourse.

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## References

- Acis, Z. J. (2008). Foundations of high impact entrepreneurship. *Foundations and Trends® in Entrepreneurship*, 4(6), 535-620.
- Acis, Z. and Audretsch, D. (1990), "Entrepreneurship as social construction: a multilevel evolutionary approach", *Innovation and Small Firms*, MIT Press, Cambridge, MA.
- Aguinis, H., Ramani, R. S., Alabduljader, N., Bailey, J. R., & Lee, J. (2019). A pluralist conceptualization of scholarly impact in management education: Students as stakeholders. *Academy of Management Learning and Education*, 18(1), 11-42.
- Ahmed, T., Chandran, V. G. R., Klobas, J. E., Liñ'an, F., & Kokkalis, P. (2020). Entrepreneurship education programmes: How learning, inspiration and resources affect intentions for new venture creation in a developing economy. *International Journal of Management in Education*, 18(1), 100327.
- Aikenhead, G. S. (2003). Review of research on humanistic perspectives in science curricula. In *European science education research association (ESERA) conference, Noordwijkerhout, The Netherlands*.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, 50(2), 179-211.
- Ancarani, A., & Mauro, C. D. (2018). Successful digital transformations need a focus on the individual. In *Digitalisierung im Einkauf* (pp. 11-26). Springer Gabler, Wiesbaden.
- Anderson, A., & Ronteau, S. (2017). Towards an entrepreneurial theory of practice; emerging ideas for emerging economies. *Journal of Entrepreneurship in Emerging Economies*, 9(2), 110-120.
- Antonelli, G., Venesaar, U., Riviezzo, A., Kallaste, M., Dorożyński, T., & Kłysik-Urtysek, A. (2024). Find your limits and break them! Nurturing students' entrepreneurship competence through innovative teaching methods and self-assessment. *Journal of Enterprising Communities: People and Places in the Global Economy*, 18(1), 29-48.
- Arranz, N., Ubierna, F., Arroyabe, M. F., Perez, C., & Fdez. de Arroyabe, J. C. (2017). The effect of curricular and extracurricular activities on university students' entrepreneurial intention and competencies. *Studies in Higher Education*, 42(11), 1979-2008.
- Audretsch, D. B., & Keilbach, M. (2007). The theory of knowledge spillover entrepreneurship. *Journal of Management studies*, 44(7), 1242-1254.
- Audretsch, D. (2012). Entrepreneurship research. *Management decision*, 50(5), 755-764.
- Bacigalupo, M., Kampylis, P., Punie, Y., & Van den Brande, G. (2016). EntreComp: The entrepreneurship competence framework. *Luxembourg: Publication Office of the European Union*, 10, 593884.
- Baggen, Y., Lans, T., & Gulikers, J. (2022). Making entrepreneurship education available to all: Design principles for educational programs stimulating an entrepreneurial mindset. *Entrepreneurship Education and Pedagogy*, 5(3), 347-374.
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191-215.
- Bandura, A., & Walters, R. H. (1963). *Social learning and personality development*.



- Barba-Sánchez, V., & Atienza-Sahuquillo, C. (2018). Entrepreneurial intention among engineering students: The role of entrepreneurship education. *European research on management and business economics*, 24(1), 53-61.
- Bell, R., & Bell, H. (2020). Applying educational theory to develop a framework to support the delivery of experiential entrepreneurship education. *Journal of Small Business and Enterprise Development*, 27(6), 987-1004.
- Bennett, R. (2006). Business lecturers' perceptions of the nature of entrepreneurship. *International Journal of Entrepreneurial Behavior & Research*, 12(3), 165-188.
- Bereiter, C. (1990). Aspects of an educational learning theory. *Review of educational research*, 60(4), 603-624.
- Berglund, K., Hytti, U., & Verduijn, K. (2020). Unsettling entrepreneurship education. *Entrepreneurship Education and Pedagogy*, 3(3), 208-213.
- Bernadó, E., & Bratzke, F. (2024). Revisiting EntreComp through a systematic literature review of entrepreneurial competences. Implications for entrepreneurship education and future research. *The International Journal of Management Education*, 22(3), 101010.
- Bhave, M. P. (1994). A process model of entrepreneurial venture creation. *Journal of Business Venturing*, 9(3), 223-242.
- Birckmayer, J. D., & Weiss, C. H. (2000). Theory-based evaluation in practice: What do we learn? *Evaluation Review*, 24(4), 407-431.
- Bird, B. (2019). Chapter 6 Toward a Theory of Entrepreneurial Competency. Seminal Ideas for the Next Twenty-Five Years of Advances, 115-131.
- Bischoff, K., Volkmann, C. K., & Audretsch, D. B. (2018). Stakeholder collaboration in entrepreneurship education: An analysis of the entrepreneurial ecosystems of European higher educational institutions. *The Journal of Technology Transfer*, 43(1), 20-46.
- Blanche, M. T., Blanche, M. J. T., Durrheim, K., & Painter, D. (Eds.). (2006). *Research in practice: Applied methods for the social sciences*. Juta and Company Ltd.
- Blaschke, L. M., & Hase, S. (2014). Heutagogy, technology, and lifelong learning for professional and part-time learners. *Transformative perspectives and processes in higher education* (pp. 75-94). Springer International Publishing.
- Blenker, P., Frederiksen, S. H., Korsgaard, S., Müller, S., Neergaard, H., & Thrane, C. (2012). Entrepreneurship as everyday practice: towards a personalized pedagogy of enterprise education. *Industry and Higher Education*, 26(6), 417-430.
- Bogdan, R. & Biklen, S.K. (1992). *Qualitative Research for Education: An Introduction to Theory and Methods*. London: Allwyn and Bacon.
- Bond, M., Marín, V. I., Dolch, C., Bedenlier, S., & Zawacki-Richter, O. (2018). Digital transformation in German higher education: student and teacher perceptions and usage of digital media. *International Journal of Educational Technology in Higher Education*, 15(1), 1-20.
- Bonesso, S., Gerli, F., Pizzi, C., & Cortellazzo, L. (2018). Students' entrepreneurial intentions: the role of prior learning experiences and emotional, social, and cognitive competencies. *Journal of Small Business Management*, 56, 215-242.
- Bozward, D., & Rogers-Draycott, M. C. (2020). Value creation programmes: lessons from an early-stage implementation. *Entrepreneurship Education*, 3(3), 287-310.
- Bruni-Bossio, V., & Willness, C. (2016). The "Kobayashi Maru" meeting: High-fidelity experiential learning. *Journal of Management Education*, 40(5), 619-647.

- Bruyat, C., & Julien, P. A. (2001). Defining the field of research in entrepreneurship. *Journal of Business Venturing*, 16(2), 165-180.
- Buckley, P., & Lee, P. (2021). The impact of extra-curricular activity on the student experience. *Active Learning in Higher Education*, 22(1), 37-48.
- Buzady, Z., & Almeida, F. (2019, July). FLIGBY—A serious game tool to enhance motivation and competencies in entrepreneurship. In *Informatics* (Vol. 6, No. 3, p. 27). MDPI.
- Caelli, K., Ray, L., & Mill, J. (2003). 'Clear as mud': toward greater clarity in generic qualitative research. *International Journal of Qualitative Methods*, 2(2), 1-13.
- Caena, F., & Redecker, C. (2019). Aligning teacher competence frameworks to 21st century challenges: The case for the European Digital Competence Framework for Educators (Digcompedu). *European Journal of Education*, 54(3), 356-369.
- Carree, M. A., & Thurik, A. R. (2010). *The impact of entrepreneurship on economic growth* (pp. 557-594). Springer New York.
- Carretero, S., Vuorikari, R., & Punie, Y. (2017). *DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use*. Joint Research Centre (European Commission). Retrieved from: <https://data.europa.eu/doi/10.2760/38842>
- Chandler, G.N., DeTienne, D.R., McKelvie, A. and Mumford, T.V. (2011), Causation and effectuation processes: A validation study. *Journal of Business Venturing*, 26(3), 375-390.
- Chen, C. C. & Huang, T. C. (2012). Learning in a u-Museum: Developing a context aware ubiquitous learning environment. *Computers & Education* 59(3), 873-883.
- Chen, L., Ifenthaler, D., & Yau, J. Y. K. (2021). Online and blended entrepreneurship education: a systematic review of applied educational technologies. *Entrepreneurship Education*, 1-43.
- Cheung, C. K. (2008). Entrepreneurship education in Hong Kong's secondary curriculum: Possibilities and limitations. *Education+ Training*, 50(6), 500-515.
- Coccoli, M., Guercio, A., Maresca, P., & Stanganelli, L. (2014). Smarter universities: A vision for the fast changing digital era. *Journal of Visual Languages & Computing* 25(6), 1003-1011.
- Conrads, J., Rasmussen, M., Winters, N., Geniets, A., & Langer, L. (2017). *Digital education policies in Europe and beyond: Key design principles for more effective policies*. Publications Office of the European Union. Retrieved from: <https://data.europa.eu/doi/10.2760/462941>
- Cooper, B. (2007). Central issues in the use of computer-based materials for high volume entrepreneurship education. *Active Learning in Higher Education*, 8(3), 201-217.
- Cope, J. (2003). Entrepreneurial learning and critical reflection: Discontinuous events as triggers for 'higher-level' learning. *Management learning*, 34(4), 429-450.
- Cope, J. (2005). Toward a dynamic learning perspective of entrepreneurship. *Entrepreneurship theory and practice*, 29(4), 373-397.
- Cope, J., & Watts, G. (2000). Learning by doing—an exploration of experience, critical incidents and reflection in entrepreneurial learning. *International Journal of Entrepreneurial Behavior & Research*, 6(3), 104-124.
- Cope, J. (2011). Entrepreneurial learning from failure: An interpretative phenomenological analysis. *Journal of business venturing*, 26(6), 604-623.

- Cosenz, F., & Noto, G. (2018). Fostering entrepreneurial learning processes through Dynamic Start-up business model simulators. *The International Journal of Management Education*, 16(3), 468-482.
- Creed, C. J., Suuberg, E. M. & Crawford, G. P. (2002). Engineering Entrepreneurship: An Example of a Paradigm Shift in Engineering Education. *Journal of Engineering Education*, 91(2), 185-195.
- Creswell, J. W. (2013). *Steps in conducting a scholarly mixed methods study*.
- Dalley, J., & Hamilton, B. (2000). Knowledge, context and learning in the small business. *International Small Business Journal*, 18(3), 51-59.
- Davis, M. H., Hall, J. A., & Mayer, P. S. (2016). Developing a new measure of entrepreneurial mindset: Reliability, validity, and implications for practitioners. *Consulting Psychology Journal: Practice and Research*, 68(1), 21.
- Decker-Lange, C., Lange, K., Dhaliwal, S., & Walmsley, A. (2021). Exploring entrepreneurship education effectiveness at British universities—an application of the World Café method. *Entrepreneurship Education and Pedagogy*, 5(1), 113-136.
- Decker-Lange, C., Lange, K., Walmsley, A. (2024). How does entrepreneurship education affect employability? Insights from UK higher education. *International Journal of Entrepreneurial Behavior & Research*, ahead-of-print.
- Deetz, S. (1996). Crossroads—Describing differences in approaches to organization science: Rethinking Burrell and Morgan and their legacy. *Organization science*, 7(2), 191-207.
- Del Monte, A., Moccia, S., & Pennacchio, L. (2020). Regional entrepreneurship and innovation: Historical roots and the impact on the growth of regions. *Small Business Economics*, 1-23.
- Denzin, N. K., & Lincoln, Y. S. (Eds.). (2011). *The Sage handbook of qualitative research*. Sage.
- Dewey, J. (1974). John Dewey on education: Selected writings.
- Díaz-García, C., Sáez-Martínez, F., & Jiménez-Moreno, J. (2015). Evaluation of the impact of the educational program “Entrepreneurs” on the entrepreneurial intention of the participants. *International Journal of Educational Technology in Higher Education*, 12, 17-31.
- Dickson, P. H., Solomon, G. T., & Weaver, K. M. (2008). Entrepreneurial selection and success: does education matter?. *Journal of small business and enterprise development*, 15(2), 239-258.
- Duval-Couetil, N. (2013). Assessing the impact of entrepreneurship education programs: Challenges and approaches. *Journal of Small Business Management*, 51(3), 394-409.
- Duval-Couetil, N., Shartrand, A., & Reed, T. (2016). The role of entrepreneurship program models and experiential activities on engineering student outcomes. *Advances in Engineering Education*, 5(1), n1.
- Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of management review*, 14(4): 532-550.
- El-Awad, Z., Gabriellson, J., & Politis, D. (2017). Entrepreneurial learning and innovation: The critical role of team-level learning for the evolution of innovation capabilities in technology based ventures. *International Journal of Entrepreneurial Behavior & Research*, 23(3), 381-405.

- Elbanna, S., & Armstrong, L. (2023). Exploring the integration of ChatGPT in education: adapting for the future. *Management & Sustainability: An Arab Review*
- ElTarabishy, A. (2023, April 24). *AI Meet Socrates*. ICSB | International Council for Small Business. <https://icsb.org/ai-meet-socrates/>
- Engel, Y., Dimitrova, N. G., Khapova, S. N., & Elfring, T. (2014). Uncertain but able: Entrepreneurial self-efficacy and novices' use of expert decision-logic under uncertainty. *Journal of Business Venturing Insights*, 1, 12-17.
- Evers, J. C. (2015). Elaborating on thick analysis: About thoroughness and creativity in qualitative analysis. *Forum Qualitative Sozialforschung Forum: Qualitative Social Research*, 17(1).
- Falloon, G. (2020). From digital literacy to digital competence: the teacher digital competency (TDC) framework. *Educational Technology Research and Development*, 68(5), 2449-2472.
- Farzanfar, R. (2005). Using qualitative research methods to evaluate automated health promotion/disease prevention technologies: A procedures' manual. *Boston University. Robert Wood Johnson Foundation*.
- Farrokhnia, M., Banihashem, S. K., Noroozi, O., & Wals, A. (2023). A SWOT analysis of ChatGPT: Implications for educational practice and research. *Innovations in Education and Teaching International*, 1-15.
- Fayolle, A., Gailly, B., & Lassas-Clerc, N. (2006). Assessing the impact of entrepreneurship education programmes: a new methodology. *Journal of European industrial training*, 30(9), 701-720.
- Fayolle, A. (2007). *Entrepreneurship and new value creation: The dynamic of the entrepreneurial process*. Cambridge university press.
- Fayolle, A., & Gailly, B. (2008). From craft to science: Teaching models and learning processes in entrepreneurship education. *Journal of European industrial training*, 32(7), 569-593.
- Fayolle, A. (2018). Personal views on the future of entrepreneurship education. In *A research agenda for entrepreneurship education* (pp. 127-138). Edward Elgar Publishing.
- Fellnhöfer, K. (2019). Toward a taxonomy of entrepreneurship education research literature: A bibliometric mapping and visualization. *Educational Research Review*, 27, 28-55.
- Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods*, 5(1), 80-92.
- Ferreira, C. C. (2020). Experiential learning theory and hybrid entrepreneurship: factors influencing the transition to full-time entrepreneurship. *International Journal of Entrepreneurial Behavior & Research*, 26(8), 1845-1863.
- Fiet, J. O. (2001). The pedagogical side of entrepreneurship theory. *Journal of business venturing*, 16(2), 101-117.
- Fox, S. (1997). Situated learning theory versus traditional cognitive learning theory: Why management education should not ignore management learning. *Systems Practice*, 10(6), 727-747.
- Freire, P. (2018). *Pedagogy of the oppressed*. Bloomsbury publishing.
- Fretschner, M., & Weber, S. (2013). Measuring and understanding the effects of entrepreneurial awareness education. *Journal of small business management*, 51(3), 410-428.

- From, J. (2017). Pedagogical Digital Competence--Between Values, Knowledge and Skills. *Higher Education Studies*, 7(2), 43-50.
- Gallardo-Echenique, E. E., de Oliveira, J. M., Marqués-Molias, L., Esteve-Mon, F., Wang, Y., & Baker, R. (2015). Digital competence in the knowledge society. *MERLOT Journal of Online Learning and Teaching*, 11(1).
- Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, 2(2-3), 87-105.
- Gephart Jr, R. P. (2004). Qualitative research and the Academy of Management Journal. *Academy of Management Journal*, 47(4), 454-462.
- Gerstein, J. (2014). *Moving from education 1.0 through education 2.0 towards education 3 (0)*.
- Gervais, J. (2016). The operational definition of competency-based education. *The Journal of Competency-Based Education*, 1(2), 98-106.
- Gianesini, G., Cubico, S., Favretto, G., & Leitão, J. (2018). Entrepreneurial competencies: comparing and contrasting models and taxonomies. *Entrepreneurship and the Industry Life Cycle: The Changing Role of Human Capital and Competencies*, 13-32.
- Gibb, A. A. (1993). Enterprise culture and education: Understanding enterprise education and its links with small business, entrepreneurship and wider educational goals. *International Small Business Journal: Researching Entrepreneurship*, 11(3), 11-34.
- Gherardi, S., Nicolini, D., & Odella, F. (1998). Toward a social understanding of how people learn in organizations: The notion of situated curriculum. *Management Learning*, 29(3), 273-297.
- Gibb, A. (2002). In pursuit of a new 'enterprise' and 'entrepreneurship' paradigm for learning: creative destruction, new values, new ways of doing things and new combinations of knowledge. *International Journal of Management Reviews*, 4(3), 233-269.
- Gibb, A., & Hannon, P. (2006). Towards the entrepreneurial university. *International Journal of Entrepreneurship Education*, 4(1), 73-110.
- Gibb, A. (2011). Concepts into practice: meeting the challenge of development of entrepreneurship educators around an innovative paradigm: The case of the International Entrepreneurship Educators' Programme (IEEP). *International Journal of Entrepreneurial Behavior & Research*, 17(2), 146-165.
- Gibb, A., & Hannon, P. (2006). Towards the entrepreneurial university. *International Journal of Entrepreneurship Education*, 4(1), 73-110.
- Glackin, C. E., & Phelan, S. E. (2020). Improving entrepreneurial competencies in the classroom: an extension and in-study replication. *New England Journal of Entrepreneurship*, 23(2), 79-96.
- Grivokostopoulou, F., Kovas, K., & Perikos, I. (2019). Examining the impact of a gamified entrepreneurship education framework in higher education. *Sustainability*, 11(20), 5623.
- Guba, E. & Lincoln, Y. (1985). *Naturalistic Inquiry*. Newbury Park, California. Sage.
- Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. *Handbook of Qualitative Research*, 2(163-194), 105. California. Sage.

- Guitert, M., Romeu, T., & Baztán, P. (2021). The digital competence framework for primary and secondary schools in Europe. *European Journal of Education, 56*(1), 133-149.
- Günzel-Jensen, F., & Robinson, S. (2017). Effectuation in the undergraduate classroom: Three barriers to entrepreneurial learning. *Education+ Training, 59*(7/8), 780-796.
- Hägg, G., & Gabrielsson, J. (2020). A systematic literature review of the evolution of pedagogy in entrepreneurial education research. *International Journal of Entrepreneurial Behavior & Research, 26*(5), 829-861.
- Hägg, G., & Kurczewska, A. (2020). Guiding the student entrepreneur—Considering the emergent adult within the pedagogy–andragogy continuum in entrepreneurship education. *Education+ Training, 62*(7/8), 759-777.
- Hägg, G., & Kurczewska, A. (2021). Toward a learning philosophy based on experience in entrepreneurship education. *Entrepreneurship Education and Pedagogy, 4*(1), 4-29.
- Hagvall Svensson, O. 2023. What makes entrepreneurial learning difficult: cognitive conflicts or cultural clashes?. *European Journal of Engineering Education, 48*(3): 391-406.
- Hatlevik, O. E., & Christophersen, K. A. (2013). Digital competence at the beginning of upper secondary school: Identifying factors explaining digital inclusion. *Computers & Education, 63*, 240-247.
- Hamilton, E. (2011). Entrepreneurial learning in family business: A situated learning perspective. *Journal of Small Business and Enterprise Development, 18*(1), 8-26.
- \*Hammoda, B. (2023). Extracurricular activities for entrepreneurial learning: A typology based on learning theories. *Entrepreneurship Education and Pedagogy*.
- \*Hammoda, B. (2024a). ChatGPT for founding teams: An entrepreneurial pedagogical innovation. *International Journal of Technology in Education (IJTE), 7*(1), 154-173.
- \*Hammoda, B. (2024b). The impact of educational technologies on entrepreneurial competencies: A systematic review of empirical evidence. *Knowledge Management & E-Learning, 16*(2), 309-333.
- \*Hammoda, B. (2024c). Digital Technology in Entrepreneurship Education: An Overview of the Status Quo. In Durst, S. & Pevkur, A. (Eds.), *Digital Transformation for Entrepreneurship. Digital Transformation: Accelerating Organizational Intelligence* (71-93). World Scientific Publishing Company.
- \*Hammoda, B. (2024d). Academic Startup Clinic: Applying effectuation and experiential principles to educate and support academic entrepreneurs. In Beaumont, E., Hall, J., Marrington, M., & Hepworth, R. (Eds.), *Contemporary Enterprise and Entrepreneurship in Context*. Routledge. (Forthcoming)
- \*Hammoda, B., & Foli., S. (2024). A digital competence framework for learners (DCFL): A conceptual framework for digital literacy. *Knowledge Management & E-Learning, 16*(3). (Forthcoming)
- \*Hammoda, B. & Winkler, C. (2024). Active methods in Entrepreneurship Education: A case study with STEM students. *European Journal of Engineering Education*. (Forthcoming)
- Hanks, W. F. (1991). Foreword by William F. Hanks. In J. Lave, & E. Wenger (Eds), *Situated learning: Legitimate peripheral participation* (pp. 13-24). Cambridge University Press.

- Hase, S., & Kenyon, C. (2000). From andragogy to heutagogy. *UltiBASE In-Site*.
- Hase, S., & Kenyon, C. (2007). Heutagogy: A child of complexity theory. *Complicity: An international journal of complexity and education*, 4(1).
- Hase, S., & Kenyon, C. (Eds), (2013). *Self-determined learning: Heutagogy in action*. A&C Black.
- Henrich, J. (2016). Competency-based education: The employers' perspective of higher education. *The Journal of Competency-Based Education*, 1(3), 122-129.
- Higgins, D., Smith, K., & Mirza, M. (2013). Entrepreneurial education: Reflexive approaches to entrepreneurial learning in practice. *The Journal of Entrepreneurship*, 22(2), 135-160.
- Hirschheim, R., Klein, H. K., & Lyytinen, K. (1995). *Information systems development and data modeling: conceptual and philosophical foundations* (Vol. 9). Cambridge University Press.
- Holinska, T., Komarovska, O., Melnyk, O., Pet'ko, L., Shpitsa, R., Sova, O., & Strohal, T. (2019). Cloud technologies in art entrepreneurship education. *Journal of Entrepreneurship Education*, 22(5), 1-6.
- Honig, B., & Hopp, C. (2019). Learning orientations and learning dynamics: Understanding heterogeneous approaches and comparative success in nascent entrepreneurship. *Journal of Business Research*, 94, 28-41.
- Hu, H., & Driscoll, M. P. (2013). Self-regulation in e-learning environments: A remedy for community college?. *Journal of Educational Technology & Society*, 16(4), 171-184.
- Huebscher, J., & Lendner, C. (2010). Effects of entrepreneurship simulation game seminars on entrepreneurs' and students' learning. *Journal of Small Business & Entrepreneurship*, 23(4), 543-554.
- Hytti, U., & O'Gorman, C. (2004). What is "enterprise education"? An analysis of the objectives and methods of enterprise education programmes in four European countries. *Education+ Training*, 46(1), 11-23.
- Ibrahim, A. B., & Soufani, K. (2002). Entrepreneurship education and training in Canada: a critical assessment. *Education+ Training*, 44(8/9), 421-430.
- Ilomäki, L., Paavola, S., Lakkala, M., & Kantosalo, A. (2016). Digital competence—an emergent boundary concept for policy and educational research. *Education and Information Technologies*, 21, 655-679.
- Ilonen, S., & Heinonen, J. (2018). Understanding affective learning outcomes in entrepreneurship education. *Industry and Higher Education*, 32(6), 391-404.
- Isabelle, D. A. (2020). Gamification of entrepreneurship education. *Decision Sciences Journal of Innovative Education*, 18(2), 203-223.
- Isenberg, D. J. (2010). How to start an entrepreneurial revolution. *Harvard Business Review*, 88(6), 40-50.
- Janssen, J., Stoyanov, S., Ferrari, A., Punie, Y., Pannekeet, K., & Sloep, P. (2013). Experts' views on digital competence: Commonalities and differences. *Computers & Education*, 68, 473-481.
- Januszewski, A., & Molenda, M. (Eds.). (2013). *Educational technology: A definition with commentary*. Routledge.
- Jesson, J., Matheson, L., & Lacey, F. M. (2011). *Doing your literature review: Traditional and systematic techniques*.

- Johannisson, B. (2018). Limits to and prospects of entrepreneurship education in the academic context. In *A research agenda for entrepreneurship education* (pp. 139-163). Edward Elgar Publishing.
- Johnson, P., & Duberley, J. (2000). *Understanding management research: An introduction to epistemology*. Sage.
- Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, 33(7), 14-26.
- Jones, C., & English, J. (2004). A contemporary approach to entrepreneurship education. *Education+ Training*, 46(8/9), 416-423.
- Jones, C., & Matlay, H. (2011). Understanding the heterogeneity of entrepreneurship education: going beyond Gartner. *Education+ Training*, 53(8/9), 692-703.
- Jones, C. (2019). A signature pedagogy for entrepreneurship education. *Journal of Small Business and Enterprise Development*, 26(2), 243-254.
- Jones, C., Penaluna, K., & Penaluna, A. (2019). The promise of andragogy, heutagogy and academagogy to enterprise and entrepreneurship education pedagogy. *Education+ Training*, 61(9), 1170-1186
- Jones, P., Forbes-Simpson, K., Maas, G., & Newbery, R. (2015). Beta: An experiment in funded undergraduate start-up. *Industry and Higher Education*, 29(5), 405-418.
- Jones, P., Pickernell, D., Fisher, R., & Netana, C. (2017). A tale of two universities: graduates perceived value of entrepreneurship education. *Education+ Training*, 59(7/8), 689-705.
- Jones, O., & Holt, R. (2008). The creation and evolution of new business ventures: an activity theory perspective. *Journal of Small Business and Enterprise Development*, 15(1), 51-73.
- Kakouris, A., Morselli, D. & Pittaway, C. (2023). Educational theory driven teaching in entrepreneurship. *The International Journal of Management Education*, 21(2).
- Karimi, S., Biemans, H. J., Lans, T., Chizari, M., & Mulder, M. (2016). The impact of entrepreneurship education: A study of Iranian students' entrepreneurial intentions and opportunity identification. *Journal of Small Business Management*, 54(1), 187-209.
- Kasneji, E., Seßler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., ... & Kasneji, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences*, 103, 102274.
- Katz, J. A., Roberts, J., Strom, R., & Freilich, A. (2013). Perspectives on the development of cross campus entrepreneurship education. *Entrepreneurship Research Journal*, 4(1), 13-44.
- Kautonen, T., Van Gelderen, M., & Fink, M. (2015). Robustness of the theory of planned behavior in predicting entrepreneurial intentions and actions. *Entrepreneurship Theory and Practice*, 39(3), 655-674.
- Khan, N., Sarwar, A., Chen, T. B., & Khan, S. (2022). Connecting Digital Literacy in Higher Education to the 21st Century Workforce. *Knowledge Management & E-Learning*, 14(1), 46-61.
- Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist*, 41(2), 75-86.



- Kloepfer, K., & Castrogiovanni, G. J. (2018). Entrepreneurship: venture creation subprocesses, subdomains, and interfaces. *International Entrepreneurship and Management Journal*, 14, 681-696.
- Knowles, M. (1980). *The Modern Practice of Adult Education*, Follett Publishing: Chicago, IL.
- Kolb, D. A. (1984). *Experiential learning*. New Jersey, Eaglewood Cliffs.
- Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of Management Learning & Education*, 4(2), 193-212.
- Kolb, D. A., Boyatzis, R. E., & Mainemelis, C. (2014). Experiential learning theory: Previous research and new directions. In *Perspectives on thinking, learning, and cognitive styles* (pp. 227-247). Routledge.
- Komarkova, I., Conrads, J., & Collado, A. (2015). Entrepreneurship Competence: An Overview of Existing Concepts. *Policies and Initiatives. depth case study report*.
- Koropogui, S. T., St-Jean, É., & Zakariya, S. (2024). Usefulness of Practice-Based Pedagogical Approaches for Nascent Student Entrepreneurs. *Entrepreneurship Education and Pedagogy*, 7(1), 22-61.
- Kozlinska, I., Mets, T., & Rõigas, K. (2020). Measuring learning outcomes of entrepreneurship education using structural equation modeling. *Administrative Sciences*, 10(3), 58.
- Kozlinska, I., Rebmann, A., & Mets, T. (2023). Entrepreneurial competencies and employment status of business graduates: the role of experiential entrepreneurship pedagogy. *Journal of Small Business & Entrepreneurship*, 35(5), 724-761.
- Krueger Jr, N. F. (2007). What lies beneath? The experiential essence of entrepreneurial thinking. *Entrepreneurship theory and practice*, 31(1), 123-138.
- Kuhn, T. S. (1962). *The structure of scientific revolutions*. The University of Chicago Press.
- Kuratko, D. F. (2005). The emergence of entrepreneurship education: Development, trends, and challenges. *Entrepreneurship Theory and Practice*, 29(5), 577-597.
- Kuratko, D. F., & Morris, M. H. (2018). Examining the future trajectory of entrepreneurship. *Journal of Small Business Management*, 56(1), 11-23.
- Kyrö, P. (Ed.). (2015). *Handbook of entrepreneurship and sustainable development research*. Edward Elgar Publishing.
- Lackéus, M. (2014). An emotion based approach to assessing entrepreneurial education. *The International Journal of Management Education*, 12(3), 374-396.
- Lackéus, M., (2015). *Entrepreneurship in Education: What, Why, When, How*. OECD. Retrieved from: [https://www.oecd.org/cfe/leed/BGP\\_Entrepreneurship-in-Education.pdf](https://www.oecd.org/cfe/leed/BGP_Entrepreneurship-in-Education.pdf)
- Lackéus, M., Lundqvist, M., & Middleton, K. W. (2016). Bridging the traditional-progressive education rift through entrepreneurship. *International Journal of Entrepreneurial Behavior & Research*, 22(6), 777-803.
- Lackéus, M. (2020). Comparing the impact of three different experiential approaches to entrepreneurship in education. *International Journal of Entrepreneurial Behavior & Research*, 26(5), 937-971.
- Law, N., Woo, D., & Wong, G. (2018). *A global framework of reference on digital literacy skills for indicator 4.4. 2* (No. 51, p. 146). UNESCO. Retrieved from: <https://docs.edtechhub.org/lib/QB69UIDS>

- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.
- Leedy, P. D. & Ormrod, J. E. (2010). *Practical Research: Planning and Design (9th ed.)*. Boston, MA: Pearson.
- Le Deist, F. D., & Winterton, J. (2005). What is competence?. *Human Resource Development International*, 8(1), 27-46.
- Leitch, C. M., & Harrison, R. T. (1999). A process model for entrepreneurship education and development. *International Journal of Entrepreneurial Behavior & Research*, 5(3), 83-109.
- Leonard-Barton, D. (1990). A dual methodology for case studies: Synergistic use of a longitudinal single site with replicated multiple sites. *Organization science*, 1(3): 248-266.
- Li, Y., Zou, B., Guo, F., & Guo, J. (2022). Academic entrepreneurs' effectuation logic, role innovation, and academic entrepreneurship performance: an empirical study. *International Entrepreneurship and Management Journal*, 18(1), 49-72.
- Lilischkis, S., Volkmann, C., Gruenhagen, M., Bischoff, K., & Halbfas, B. (2015). *Supporting the entrepreneurial potential of higher education*. European Union.
- Lin, J., & Sekiguchi, T. (2020, December). E-learning in Entrepreneurship Education: A Systematic Literature Review. In *2020 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE)* (pp. 83-90). IEEE.
- Loi, M., & Fayolle, A. (2021). Impact of entrepreneurship education: a review of the past, overview of the present, and a glimpse of future trends. *Annals of Entrepreneurship Education and Pedagogy*, 170-193.
- López-Meneses, E., Sirignano, F. M., Vázquez-Cano, E., & Ramírez-Hurtado, J. M. (2020). University students' digital competence in three areas of the DigCom 2.1 model: A comparative study at three European universities. *Australasian Journal of Educational Technology*, 36(3), 69-88.
- López-Núñez, M. I., Rubio-Valdehita, S., Armuña, C., & Pérez-Urria, E. (2022). EntreComp questionnaire: A self-assessment tool for entrepreneurship competencies. *Sustainability*, 14(5), 2983.
- Lupp, D. (2023). Effectuation, causation, and machine learning in co-creating entrepreneurial opportunities. *Journal of Business Venturing Insights*, 19, e00355
- Ma, H., Lang, C., Liu, Y., & Gao, Y. (2020). Constructing a Hierarchical Framework for Assessing the Application of Big Data Technology in Entrepreneurship Education. *Frontiers in Psychology*, 11.
- Madsen, S. S., Thorvaldsen, S., & Archard, S. (2018). Teacher educators' perceptions of working with digital technologies. *Nordic Journal of Digital Literacy*, 13(3), 177-196.
- Mäkimurto-Koivumaa, S. & Belt, P. (2016). About, for, in or Through Entrepreneurship in Engineering Education. *European Journal of Engineering Education*, 41(5), 512-529.
- Mason, C., & Arshed, N. (2013). Teaching entrepreneurship to university students through experiential learning: A case study. *Industry and Higher Education*, 27(6), 449-463.
- Massaro, M., Dumay, J., & Guthrie, J. (2016). On the shoulders of giants: undertaking a structured literature review in accounting. *Accounting, Auditing & Accountability Journal*.

- Matlay, H. (2008). The impact of entrepreneurship education on entrepreneurial outcomes. *Journal of Small Business and Enterprise Development*, 15(2), 382-396.
- Mavlutova, I., Lesinskis, K., Liogys, M., & Hermanis, J. (2020). Innovative teaching techniques for entrepreneurship education in the era of digitalisation. *WSEAS Transactions on Environment and Development*, 16(1), 725-733.
- Mawson, S., Casulli, L., & Simmons, E. L. (2023). A Competence Development Approach for Entrepreneurial Mindset in Entrepreneurship Education. *Entrepreneurship Education and Pedagogy*, 6(3), 481-501.
- Maxwell, J.A. (2006). *Qualitative Research Design: An Interactive Approach*. Thousand Islands. Sage.
- McKim, C. A. (2017). The value of mixed methods research: A mixed methods study. *Journal of Mixed Methods Research*, 11(2), 202-222.
- McMullen, J. S., & Shepherd, D. A. (2006). Entrepreneurial action and the role of uncertainty in the theory of the entrepreneur. *Academy of Management review*, 31(1), 132-152.
- McNabb, D. E. (2017). *Research methods in public administration and nonprofit management*. Routledge.
- Mets, T., Kozlinska, I., & Raudsaar, M. (2017). Patterns in entrepreneurial competences as the perceived learning outcomes of entrepreneurship education: The case of Estonian HEIs. *Industry and Higher Education*, 31(1), 23-33.
- Mets, T., Holbrook, J., & Läänelaid, S. (2021). Entrepreneurship education challenges for green transformation. *Administrative Sciences*, 11(1), 15.
- Mezirow, J. (2003). Transformative learning as discourse. *Journal of Transformative Education*, 1(1), 58–63. <https://doi.org/10.1177/1541344603252172>
- Milner, S., Cousins, W., & McGowan, I. (2016). Does all work and No play make a dull graduate? Perceptions of extra-curricular activities and employability. *Journal of Perspectives in Applied Academic Practice*, 4(1), 13-18.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Sage.
- Morris, N. M., Kuratko, D. F., & Pryor, C. G. (2013). Building blocks for the development of university-wide entrepreneurship. *Entrepreneurship Research Journal*, 4(1), 45-68.
- Morris, M. H., Webb, J. W., Fu, J., & Singhal, S. (2013). A competency-based perspective on entrepreneurship education: Conceptual and empirical insights. *Journal of Small Business Management*, 51(3), 352-369.
- Morris, M. H., Neumeyer, X., & Kuratko, D. F. (2015). A portfolio perspective on entrepreneurship and economic development. *Small Business Economics*, 45(4), 713-728.
- Morris, M. H., Shirokova, G., & Tsukanova, T. (2017). Student entrepreneurship and the university ecosystem: A multi-country empirical exploration. *European Journal of International Management*, 11(1), 65-85.
- Morselli, D. (2018). Teaching a sense of initiative and entrepreneurship with constructive alignment in tertiary non-business contexts. *Education+ Training*, 60(2), 122-138.
- Morselli, D., & Gorenc, J. (2022). Using the EntreComp framework to evaluate two entrepreneurship education courses based on the Korda Method. *The International Journal of Management Education*, 20(1), 100591.

- Mutch, C. (2005). *Doing educational research: A practitioner's guide to getting started*. Wellington, N.Z: NZCER Press.
- Mwasalwiba, E. S. (2010). Entrepreneurship education: a review of its objectives, teaching methods, and impact indicators. *Education+ Training*, 52(1), 20-47.
- Myers, M. D. (2019). Qualitative research in business and management. *Qualitative Research in Business and Management*, 1-364.
- Nabi, G., Liñán, F., Fayolle, A., Krueger, N., & Walmsley, A. (2017). The impact of entrepreneurship education in higher education: A systematic review and research agenda. *Academy of Management Learning & Education*, 16(2), 277-299.
- Neck, H. M., & Greene, P. G. (2011). Entrepreneurship education: known worlds and new frontiers. *Journal of Small Business Management*, 49(1), 55-70.
- Neck, H. M., Greene, P. G., & Brush, C. G. (2014). Practice-based entrepreneurship education using actionable theory. In *Annals of Entrepreneurship Education and Pedagogy—2014* (pp. 3-20). Edward Elgar Publishing.
- Neck, H. M., & Corbett, A. C. (2018). The scholarship of teaching and learning entrepreneurship. *Entrepreneurship Education and Pedagogy*, 1(1), 8-41.
- Neergaard, H., & Christensen, D. R. (2017). Breaking the waves: Routines and rituals in entrepreneurship education. *Industry and Higher Education*, 31(2), 90-100.
- Neergaard, H., Robinson, S., & Jones, S. (2021). Transformative learning in the entrepreneurship education process: the role of pedagogical nudging and reflection. *International Journal of Entrepreneurial Behavior & Research*, 27(1), 251-277.
- Neuman, W. L., (2003). *Social Research Methods: Qualitative and Quantitative Approaches*. Boston. Allyn and Bacon.
- Nixon, E., Scullion, R., & Hearn, R. (2018). Her majesty the student: marketised higher education and the narcissistic (dis) satisfactions of the student-consumer. *Studies in Higher Education*, 43(6), 927-943.
- O'Connor, A. (2013). A conceptual framework for entrepreneurship education policy: Meeting government and economic purposes. *Journal of Business Venturing*, 28(4), 546-563.
- Oosterbeek, H., Van Praag, M., & Ijsselstein, A. (2010). The impact of entrepreneurship education on entrepreneurship skills and motivation. *European Economic Review*, 54(3), 442-454.
- Padilla-Angulo, L. (2019). Student associations and entrepreneurial intentions. *Studies in Higher Education*, 44(1), 45-58.
- Papadakis, S., & Kalogiannakis, M. (2017). Mobile educational applications for children: what educators and parents need to know. *International Journal of Mobile Learning and Organisation*, 11(3), 256-277.
- Papadakis, S., Kalogiannakis, M., & Zaranis, N. (2017). Designing and creating an educational app rubric for preschool teachers. *Education and Information Technologies*, 22(6), 3147-3165.
- Papadakis, S., Vaiopoulou, J., Kalogiannakis, M., & Stamovlasis, D. (2020). Developing and exploring an evaluation tool for educational apps (ETEA) targeting kindergarten children. *Sustainability*, 12(10), 4201.
- Perry, J. T., Chandler, G. N., & Markova, G. (2012). Entrepreneurial effectuation: a review and suggestions for future research. *Entrepreneurship Theory and Practice*, 36(4), 837-861.

- Pettersson, F. (2018). On the issues of digital competence in educational contexts—a review of literature. *Education and information technologies*, 23(3), 1005-1021.
- Petticrew, M., & Roberts, H. (Eds.). (2006). *Systematic Reviews in the Social Sciences*.
- Piaget, J. (1970). Piaget's theory. In P. Mussen, *Carmichaels' manual of child psychology* (3rd ed., vol. I, pp. 703-732). New York: Wiley.
- Piaget, L., (1995). In I. Smith, *Sociological studies* (2nd ed.). (Smith, et al., Trans.) London, New York: Routledge (Original work published 1977).
- Pittaway, L., & Cope, J. (2007). Simulating entrepreneurial learning: Integrating experiential and collaborative approaches to learning. *Management learning*, 38(2), 211-233.
- Pittaway, L., Rodriguez-Falcon, E., Aiyegbayo, O., & King, A. (2011). The role of entrepreneurship clubs and societies in entrepreneurial learning. *International Small Business Journal: Researching Entrepreneurship*, 29(1), 37-57.
- Pittaway, L., & Edwards, C. (2012). Assessment: examining practice in entrepreneurship education. *Education+ Training*, 54(8/9), 778-800.
- Pittaway, L., & Thorpe, R. (2012). A framework for entrepreneurial learning: A tribute to Jason Cope. *Entrepreneurship & Regional Development*, 24(9-10), 837-859.
- Pittaway, L. A., Gazzard, J., Shore, A., & Williamson, T. (2015). Student clubs: Experiences in entrepreneurial learning. *Entrepreneurship & Regional Development*, 27(3-4), 127-153.
- Pittaway, L. A., Tantawy, M. M., Corbett, A. C., & Brush, C. (2023a). Improving Doctoral Educator Development: A Scaffolding Approach. *Journal of Management Education*, 47(6), 618-648.
- Pittaway, L., Brush, C., Corbett, A. C., & Tantawy, M. M. (2023b). Doctoral Programs in Entrepreneurship: Building Cognitive Apprenticeships. *Entrepreneurship Education and Pedagogy*, 25151274231153487.
- Pocek, J., Politis, D., & Gabrielsson, J. (2021). Entrepreneurial learning in extra-curricular startup programs for students. *International Journal of Entrepreneurial Behavior & Research*, 28(2), 325-345.
- Politis, D. (2005). The process of entrepreneurial learning: A conceptual framework. *Entrepreneurship Theory and Practice*, 29(4), 399-424.
- Politis, D., Gabrielsson, J., Galan, N., & Abebe, S. A. (2019). Entrepreneurial learning in venture acceleration programs. *The Learning Organization*, 26(6), 588-603.
- Polizzi, G. (2020). Digital literacy and the national curriculum for England: Learning from how the experts engage with and evaluate online content. *Computers & Education*, 152, 103859.
- Pratikto, H., Hanafiya, R., Ashar, M., Akbar, M. I., & Harsono, Y. T. (2021). Entrepreneurship Game Apps to Enhancement Student Skill Thinking Analytic in Class Online. *Int. J. Interact. Mob. Technol.*, 15(8), 155-162.
- Preedy, S., & Jones, P. (2015). An investigation into university extra-curricular enterprise support provision. *Education+ Training*, 57(8/9), 992-1008.
- Preedy, S., & Jones, P. (2017). Student-led enterprise groups and entrepreneurial learning: A UK perspective. *Industry and Higher Education*, 31(2), 101-112.
- Preedy, S., Jones, P., Maas, G., & Duckett, H. (2020). Examining the perceived value of extracurricular enterprise activities in relation to entrepreneurial learning processes. *Journal of Small Business and Enterprise Development*, 27(7), 1085-1105.

- Quality Assurance Agency (QAA) (2018), 'Enterprise and entrepreneurship education: Guidance for UK higher education providers'. London: The Quality Assurance Agency for Higher Education. Available at: [https://www.qaa.ac.uk/docs/qaas/enhancement-anddevelopment/enterprise-and-entrpreneurship-education-2018.pdf?sfvrsn=15f1f981\\_8](https://www.qaa.ac.uk/docs/qaas/enhancement-anddevelopment/enterprise-and-entrpreneurship-education-2018.pdf?sfvrsn=15f1f981_8)
- Rae, D. (2000). Understanding entrepreneurial learning: a question of how?. *International Journal of Entrepreneurial Behavior & Research*, 6(3), 145-159.
- Rae, D., & Carswell, M. (2001). Towards a conceptual understanding of entrepreneurial learning. *Journal of small business and enterprise development*, 8(2), 150-158.
- Rae, D. (2002). A narrative study of entrepreneurial learning in independently owned media businesses. *The International Journal of Entrepreneurship and Innovation*, 3(1), 53-59.
- Rae, D. (2005). Cultural diffusion: a formative process in creative entrepreneurship?. *The International Journal of Entrepreneurship and Innovation*, 6(3), 185-192.
- Rae, D. (2007). Connecting enterprise and graduate employability: Challenges to the higher education culture and curriculum? *Education + Training*, 49(8/9), 605-619.
- Rae, D. (2009). Entrepreneurship: too risky to let loose in a stormy climate?. *The International Journal of Entrepreneurship and Innovation*, 10(2), 137-147.
- Rae, D., Martin, L., Antcliff, V., & Hannon, P. (2012). Enterprise and entrepreneurship in English higher education: 2010 and beyond. *Journal of Small Business and Enterprise Development*, 19(3), 380-401.
- Rashid, L. (2019). Entrepreneurship education and sustainable development goals: A literature review and a closer look at fragile states and technology-enabled approaches. *Sustainability*, 11(19), 5344.
- Rasmussen, E. A., & Sørheim, R. (2006). Action-based entrepreneurship education. *Technovation*, 26(2), 185-194.
- Ratten, V., & Jones, P. (2021). Covid-19 and entrepreneurship education: Implications for advancing research and practice. *The International Journal of Management Education*, 19(1), 100432.
- Ratten, V., & Usmanij, P. (2021). Entrepreneurship education: Time for a change in research direction?. *The International Journal of Management Education*, 19(1), 100368.
- Ratten, V. (2023). The post COVID-19 pandemic era: Changes in teaching and learning methods for management educators. *The International Journal of Management Education*, 21(2), 100777.
- Ratten, V., & Jones, P. (2023). Generative artificial intelligence (ChatGPT): Implications for management educators. *The International Journal of Management Education*, 21(3), 100857.
- Rauch, A. (2020). Opportunities and threats in reviewing entrepreneurship theory and practice. *Entrepreneurship Theory and Practice*, 44(5), 847-860.
- Redecker, C. (2017). *European framework for the digital competence of educators: DigCompEdu* (No. JRC107466). Joint Research Centre (Seville site).
- Reeves, T. C., & Hedberg, J. G. (2003). *Interactive learning systems evaluation*. Educational Technology.
- Rideout, E. C., & Gray, D. O. (2013). Does entrepreneurship education really work? A review and methodological critique of the empirical literature on the effects of university-based entrepreneurship education. *Journal of Small Business Management*, 51(3), 329-351.

- Rippa, P., Landi, G., Cosimato, S., Turriziani, L., & Gheith, M. (2022). Embedding entrepreneurship in doctoral students: the impact of a T-shaped educational approach. *European Journal of Innovation Management*, 25(1), 249-270.
- Ritchie, J., & Lewis, J. (2003). *The applications of qualitative methods to social research*. London.
- Robinson, O. C. (2014). Sampling in interview-based qualitative research: A theoretical and practical guide. *Qualitative Research in Psychology*, 11(1), 25-41.
- Robinson, S., Neergaard, H., Tanggaard, L., & Krueger, N. F. (2016). New horizons in entrepreneurship education: from teacher-led to student-centered learning. *Education + training*, 58(7/8), 661-683.
- Ronstadt, R. (1985). The educated entrepreneurs: A new era of entrepreneurial education is beginning. *American Journal of Small Business*, 10(1), 7-23.
- Sarasvathy, S. D. (2001). Causation and effectuation: Toward a theoretical shift from economic inevitability to entrepreneurial contingency. *Academy of Management Review*, 26(2), 243-263.
- Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research methods for business students*. Pearson education.
- Schumpeter, J.A. (1942). *Capitalism, Socialism and Democracy*, Harper, New York, NY.
- Schmidt, P., Jendryczko, D., Zurbriggen, C. L., & Nussbeck, F. W. (2023). Recall bias of students' affective experiences in adolescence: The role of personality and internalizing behavior. *Journal of Adolescence*.
- Secundo, G., Del Vecchio, P., & Mele, G. (2020a). Social media for entrepreneurship: myth or reality? A structured literature review and a future research agenda. *International Journal of Entrepreneurial Behavior & Research*, 27(1), 149-177.
- Secundo, G., Rippa, P., & Cerchione, R. (2020b). Digital Academic Entrepreneurship: A structured literature review and avenue for a research agenda. *Technological forecasting and social change*, 157, 120118.
- Shane, S., & Venkataraman, S. (2000). The promise of entrepreneurship as a field of research. *Academy of management review*, 25(1), 217-226.
- Skute, I. (2019). Opening the black box of academic entrepreneurship: a bibliometric analysis. *Scientometrics*, 120(1), 237-265.
- Solomon, G. T., & Fernald Jr, L. W. (1991). Trends in small business management and entrepreneurship education in the United States. *Entrepreneurship theory and practice*, 15(3), 25-40.
- Souitaris, V., Zerbinati, S., & Al-Laham, A. (2007). Do entrepreneurship programmes raise entrepreneurial intention of science and engineering students? The effect of learning, inspiration and resources. *Journal of Business venturing*, 22(4), 566-591.
- Sousa, M. J., Carmo, M., Gonçalves, A. C., Cruz, R., & Martins, J. M. (2019). Creating knowledge and entrepreneurial capacity for HE students with digital education methodologies: Differences in the perceptions of students and entrepreneurs. *Journal of Business Research*, 94, 227-240.
- Stenard, B. S. (2023). Interdisciplinary skills for STEAM entrepreneurship education. *Entrepreneurship Education and Pedagogy*, 6(1), 32-59.
- Stockemer, D., Stockemer, G., & Glaeser, J. (2019). *Quantitative methods for the social sciences* (Vol. 50, p. 185). Cham, Switzerland: Springer International Publishing.
- Strauss, A., & Corbin, J. (1998). *Basics of qualitative research techniques*.

- Streeter, D. H., Jaquette Jr, J. P., & Hovis, K. (2002). *University-wide entrepreneurship education: Alternative models and current trends*. Working paper No. 127271. Ithaca, NY: Cornell University.
- Sykes, W. (1990). Validity and reliability in qualitative market research: A review of the literature. *Journal of the Market Research Society*, 32(3), 289-328.
- Täks, M., Tynjälä, P., Toding, M., Kukemelk, H., & Venesaar, U. (2014). Engineering Students' Experiences in Studying Entrepreneurship. *Journal of Engineering Education*, 103(4), 573-598.
- Täks, M., Tynjälä, P., & Kukemelk, H. (2016). Engineering students' conceptions of entrepreneurial learning as part of their education. *European Journal of Engineering Education*, 41(1): 53-69.
- Terwiesch, C. (2023). Would chat GPT3 get a Wharton MBA? A prediction based on its performance in the operations management course. *Mack Institute for Innovation Management at the Wharton School, University of Pennsylvania*.
- Tess, P. A. (2013). The role of social media in higher education classes (real and virtual)—A literature review. *Computers in Human Behavior*, 29(5), A60-A68.
- Tether, B. S., & Tajar, A. (2008). Beyond industry–university links: Sourcing knowledge for innovation from consultants, private research organisations and the public science-base. *Research Policy*, 37(6-7), 1079-1095.
- Thrane, C., Blenker, P., Korsgaard, S., & Neergaard, H. (2016). The promise of entrepreneurship education: Reconceptualizing the individual–opportunity nexus as a conceptual framework for entrepreneurship education. *International Small Business Journal*, 34(7), 905-924.
- Tohara, A. J. T. (2021). Exploring Digital Literacy Strategies for Students with Special Educational Needs in the Digital Age. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, 12(9), 3345-3358.
- Tolley, E. E., Ulin, P. R., Mack, N., Robinson, E. T., & Succop, S. M. (2016). *Qualitative methods in public health: a field guide for applied research*. John Wiley & Sons.
- Torraco, R. J. (2005). Writing integrative literature reviews: Guidelines and examples. *Human Resource Development Review*, 4(3), 356-367.
- Tunstall, R., & Neergaard, H. (2022). Flashmob: A Heutagogical tool for social learning in entrepreneurship education. *Entrepreneurship Education and Pedagogy*, 5(3), 472-492.
- Tretyakova, N., Lyzhin, A., Chubarkova, E., Uandykova, M., & Lukiyanova, M. (2021). Mobile-learning platform for the development of entrepreneurial competencies of the students. *International Journal of Interactive Mobile Technologies*, 15(9).
- Ustav, S., & Venesaar, U. (2018). Bridging metacompetencies and entrepreneurship education. *Education + Training*, 60(7/8), 674-695.
- van Gelderen, M., Wiklund, J., & McMullen, J. S. (2021). Entrepreneurship in the future: A Delphi study of ETP and JBV editorial board members. *Entrepreneurship Theory and Practice*, 45(5), 1239-1275.
- Varblane, U., & Mets, T. (2010). Entrepreneurship education in the higher education institutions (HEIs) of post-communist European countries. *Journal of Enterprising Communities: People and Places in the Global Economy*, 4(3), 204-219.
- Voogt, J., & Roblin, N. P. (2010). 21st century skills. *Discussienota. Zoetermeer: The Netherlands: Kennisnet*, 23(03), 2000.



- Vorbach, S., Poandl, E. M., & Korajman, I. (2019). Digital entrepreneurship education: The role of MOOCs. *International Journal of Engineering Pedagogy*, 9(3).
- Vuorikari, R., Punie, Y., Carretero, S., & Van den Brande, L. (2016). DigComp 2.0: The digital competence framework for citizens. *Update phase*, 1, 44.
- Vygotsky, L. (1978) *Mind in Society: the development of higher mental processes*. Cambridge: Harvard University Press.
- Vygotsky, L. (1987). *Thinking and speech*. New York: Plenum.
- Walsham, G. (2006). Doing interpretive research. *European Journal of Information Systems*, 15(3), 320-330.
- Wand, Y., & Weber, R. (1993). On the ontological expressiveness of information systems analysis and design grammars. *Information Systems Journal*, 3(4), 217-237.
- Weber, M. (1968). *On charisma and institution building* (Vol. 322). University of Chicago Press.
- Wenger, E. C. (1990). *Toward a theory of cultural transparency: Elements of a social discourse of the visible and the invisible*. University of California.
- Wenger, E. (1998). Communities of practice: Learning as a social system. *Systems thinker*, 9(5), 2-3.
- Wenger, E. (2011). *Communities of practice: A brief introduction*.
- Wiklund, J., Davidsson, P., Audretsch, D. B., & Karlsson, C. (2011). The future of entrepreneurship research. *Entrepreneurship Theory and Practice*, 35(1), 1-9.
- Winkler, C., Hammada, B., Noyes, E., & Van Gelderen, M. (2023a). Entrepreneurship Education at the Dawn of Generative Artificial Intelligence. *Entrepreneurship Education and Pedagogy*, 6(4).
- Winkler, C., Fust, A., & Jenert, T. (2023b). From entrepreneurial experience to expertise: A self-regulated learning perspective. *Journal of Small Business Management*, 61(4), 2071-2096.
- Woiceshyn, J., & Daellenbach, U. (2018). Evaluating inductive vs deductive research in management studies: Implications for authors, editors, and reviewers. *Qualitative Research in Organizations and Management: An International Journal*, 13(2), 183-195.
- Wood, M. S., Bakker, R. M., & Fisher, G. (2021). Back to the future: A time-calibrated theory of entrepreneurial action. *Academy of Management Review*, 46(1), 147-171.
- Wraae, B., & Nybye, N. (2024). What we don't talk about in entrepreneurship: moving the spotlight from the "hero entrepreneur" to the "unremarkable" everyday lives of student entrepreneurs. In Hammada, B. & Durst, S. (Eds.), *Contemporary Entrepreneurship: Global Perspectives and Cases*. Routledge.
- Wu, Y. J., Yuan, C. H., & Pan, C. I. (2018). Entrepreneurship education: an experimental study with information and communication technology. *Sustainability*, 10(3), 691.
- Yin, R. K. (1994). Discovering the future of the case study. Method in evaluation research. *Evaluation practice*, 15(3): 283-290.
- Zahra, S. A., Liu, W., & Si, S. (2023). How digital technology promotes entrepreneurship in ecosystems. *Technovation*, 119, 102457.
- Zappe, S. E., Cutler, S. L., & Gase, L. (2023). A systematic review of the impacts of entrepreneurial support programs in science, technology, engineering, and math fields. *Entrepreneurship Education and Pedagogy*, 6(1): 3-31.

- Zhang, P., & Cain, K. W. (2017). Reassessing the link between risk aversion and entrepreneurial intention: The mediating role of the determinants of planned behavior. *International Journal of Entrepreneurial Behavior & Research*, 23(5), 793-811.
- Zhao, F. (2005). Exploring the synergy between entrepreneurship and innovation. *International Journal of Entrepreneurial Behavior & Research*, 11(1), 25-41.
- Zhao, Y., Llorente, A. M. P., & Gómez, M. C. S. (2021). Digital competence in higher education research: A systematic literature review. *Computers & Education*, 168, 104212.

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A special dedication to my little boy. May you grow in a world that knows no hatred and always be surrounded by love and kindness. Your Pappa.

## **Abstract**

### **Active methods in entrepreneurship education: a competency-based approach to investigate their theoretical foundations and effectiveness**

Entrepreneurship education has grown in popularity in recent years and became a competitive arena for business schools. However, because of the practical nature of entrepreneurship, there have been increasing calls to investigate and adopt more active methods to teach entrepreneurship to students. Traditionally, university level education relied on behavioristic methods to address the knowledge deposition requirements of masses of students. These have shown however to have limited impact on developing practical entrepreneurial skills. Hence, an increasing amount of research has tried to investigate more active and experiential methods, that can complement traditional methods and fill this gap. Yet, research on the intricacies and outcomes of these methods necessitates in-depth exploration of their intricacies and usefulness. Additionally, as a relatively new field of inquiry, active approaches to entrepreneurship education lack sufficient theoretical grounding and connection to the widely adopted learning and entrepreneurship theories. The author, through this thesis, embarked on a journey to investigate the intricacies and usefulness of different active methods: curricular, extracurricular, and digital technology reliant. It furthers the theoretical grounding of different active methods and extends our understanding of their applications to underrepresented areas of entrepreneurship education research.

## Lühikokkuvõte

### **Aktiivõppe meetodid ettevõtlusõppes: pädevuspõhine lähenemine nende teoreetiliste aluste ja tõhususe uurimiseks**

Ettevõtlushariduse populaarsus on viimastel aastatel kasvanud ja sellest on saanud ärikoolide konkurentsiala. Ettevõtluse praktilise olemuse tõttu on aga üha rohkem kutsutud uurima ja kasutusele võtma aktiivsemaid meetodeid ettevõtluse õpetamiseks õpilastele. Traditsiooniliselt tugines ülikoolitaseme haridus biheivioristlikele meetoditele, et täita õpilaste masside teadmiste kogumise nõudeid. Siiski on nende mõju praktiliste ettevõtlusoskuste arendamisele piiratud. Seetõttu on üha rohkem uurimusi püüdnud uurida aktiivsemaid ja kogemuslikumaid meetodeid, mis võivad traditsioonilisi meetodeid täiendada ja seda lünka täita. Kuid nende meetodite keerukuse ja tulemuste uurimine nõuab nende keerukuse ja kasulikkuse põhjalikku uurimist. Lisaks puudub ettevõtlushariduse aktiivsel lähenemisel suhteliselt uue uurimisvaldkonnana piisav teoreetiline alus ja seos laialt levinud õppimis- ja ettevõtlusteooriaga. Selle lõputöö kaudu asus autor teekonnale, et uurida erinevate aktiivmeetodite keerukust ja kasulikkust: õppekava, õppekavavälised ja digitehnoloogiast sõltuvad. See edendab erinevate aktiivmeetodite teoreetilist põhjapanemist ja laiendab meie arusaama nende rakendustest ettevõtlushariduse uurimise alaesindatud valdkondadele.

## Appendix

### Publication I

Hammoda, B. (2023). Extracurricular activities for entrepreneurial learning: A typology based on learning theories. *Entrepreneurship Education and Pedagogy*, 0(0). <https://doi.org/10.1177/25151274231218212>



# Extracurricular Activities for Entrepreneurial Learning: A Typology Based on Learning Theories

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## Abstract

Extracurricular activities are increasingly being recognized for developing practical skills among entrepreneurial learners and connecting entrepreneurship curricula with real life. They offer socially situated learning experiences that can be cognitively stimulating and elicit reflective practices. However, the theoretical and pedagogical underpinnings of extracurricular activities in entrepreneurship are still in early stages, with their contribution towards entrepreneurship education requiring more empirical support. Moreover, current entrepreneurship pedagogies lack a much-needed integration of ecosystem actors' inputs, who possess specific expertise with regards to extracurricular entrepreneurial activities. To address these issues, this study gathered the views of entrepreneurship mentors, consultants, and investors on the extracurricular activities that can be deployed to improve the skills of entrepreneurial learners, through conducting 22 in-depth interviews with experts from 13 countries across the world. We analyzed the results through a hybrid, inductive and deductive, approach. The experts recommended 34 extracurricular activities, that were discursively mapped against relevant learning theories: cognitive, experiential, social, situated, and existential. The study adds to the limited theoretical discussion on the origins of extracurricular activities and paves the way for theoretical evaluations in entrepreneurship education. It can aid educators in effectively integrating extracurricular activities in their curricula to better develop students' entrepreneurial competences.

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**Keywords**

entrepreneurial learning, extracurricular activities, learning theories, entrepreneurship ecosystem experts, entrepreneurship education

**Introduction**

Entrepreneurship scholars and educators have researched and experimented with a plethora of approaches to teach entrepreneurship, to try to fathom what works, for which groups of students and why. Indeed, any approach, method or pedagogy used to prepare an audience of learners with the essential knowledge and skills to pursue an entrepreneurial career, could be labelled as “entrepreneurship education” (EE), according to [Fayolle et al. \(2006\)](#).

This study investigates one of the EE approaches that have not received rightful scholarly investigation, namely extracurricular activities (ECAs). It aims at analyzing the views of entrepreneurship ecosystem experts on the types of ECAs that can be used in EE, the benefits they bring towards students’ skills development, and discusses them against relevant learning theories, aiming at developing a typology of ECAs for EE.

ECAs have been receiving increasing interest in recent years ([Beaumont et al., 2022](#); [Gedye & Beaumont, 2018](#); [Preedy & Jones, 2015](#)). As their name imply, they do not form part of regular curricula and are considered complementary to classroom-based teaching. They contribute, however, to the learning experience of a specific course or program ([Lilischkis et al., 2015](#); [Vanevenhoven & Drago, 2015](#)). They are led by students and driven by their interests, hence ECAs embody a heutagogical approach to learning ([Hase & Kenyon, 2000, 2007](#)). Through nurturing independent behaviors and actions, they can be deemed essential to developing entrepreneurial careers ([Bacigalupo et al., 2016](#); [Neck & Corbett, 2018](#)). In contrast to traditional methods such as lectures and classroom-based instruction, which were shown to have little effect on developing practical competences ([Hytti, 2018](#); [Neck & Greene, 2011](#)), ECAs are argued to incite entrepreneurial skills. They promote entrepreneurial intentions ([Fayolle et al., 2006](#); [Linan, 2008](#)); expand social and professional networks ([Preedy et al., 2020](#)); enhance ECs ([Padilla-Angulo, 2019](#)), and enrich students learning experiences ([Jones et al., 2015](#); [Pittaway et al., 2015](#); [Preedy et al., 2020](#)). This is pertained to ECAs developing students’ skills through professional experiences, social activities, sports, and cultural events ([Milner et al., 2016](#); [Preedy & Jones, 2015](#)). They, hence, firmly build on the premise of entrepreneurial learning as a socially situated phenomena that is better explained and enacted through a series of experiences and networks of interactions within enabling contexts ([El-Awad et al., 2017](#); [Howorth et al., 2012](#); [Neck & Corbett, 2018](#); [Pittaway & Cope, 2007](#); [Pittaways et al., 2015](#); [Rae, 2007](#); [Toutain et al., 2017](#)).

Despite their promising added value, there are several missing elements in our understanding of ECAs in EE. Firstly, we need further empirical insights on their

possible utilization (Higgins et al., 2013; Pittaway et al., 2015; Preedy et al., 2020). Moreover, extant literature lacks enough theorizing of their nature, with scarce connections to learning theories (Arranz et al., 2017; Beaumont et al., 2022; Preedy et al., 2020; Preedy & Jones, 2015). It appears that most available studies apply an aggregate experiential logic to ECAs without much attention to other conjectures (Jones et al., 2015; Morris et al., 2017; Preedy et al., 2020; Shirokova et al., 2017), except for a few instances (e.g., Pittaway et al., 2011, 2015; Pocek et al., 2021; Politis et al., 2019). In addition, existing ECAs studies tend to solely focus on higher education institutions (HEI) perceptions (Lilischkis et al., 2015; Rae et al., 2012; Vanevenhoven & Drago, 2015) and classroom-based activities (Milner et al., 2016). However, EE processes usually involve several elements inside and outside HEIs (Brush, 2014), with the realization of EE benefits contingent on their effective collaboration (Isenberg, 2010; Kuratko, 2005; Lilischkis et al., 2015), and the successful inclusion of ecosystem actors (Bischoff et al., 2018; Galvao et al., 2020; Jones & Matlay, 2011; Wraae & Thomsen, 2019). Still, there is a dearth of studies incorporating ecosystem experts' views in the EE process (Bischoff et al., 2018; Landstrom & Benner, 2010; Matlay, 2009), despite their specific expertise in ECAs and experiential activities (Ahmad et al., 2020; Gibb & Hannon, 2006; Wilson et al., 2009).

This study expounds on the types and benefits of ECAs for EE as recommended by entrepreneurship ecosystem experts. It discusses them against relevant learning theories, namely: experiential, social, situated, existential and cognitive, aiming at developing a typology of ECAs. It follows a qualitative approach though analyzing in-depth interviews conducted with 22 experts from different geographies, who have profound experiences in mentoring, consulting, and investing in startups (Amaral & Magalhaes, 2002; Bischoff et al., 2018), and identified 34 different ECAs accordingly.

The study enriches the scant literature on the nature, types, and potential value of ECAs (Arranz et al., 2017; Preedy et al., 2020). The proposed typology can provide a point of departure for the alignment of learning theories and different ECAs, and can spur theoretical discussions with regards to EE pedagogies and their evaluations. In addition, it adds cogency to the limited research at the nexus of EE and entrepreneurship stakeholders; extending its boundaries beyond HEIs walls (Bischoff et al., 2018; Lilischkis et al., 2015). It also highlights opportunities for educators to incorporate ECAs in EE, complementing classroom-based curricula. The paper is structured as follows. In the next section, we discuss the relevant literature and theoretical concepts related to EE and learning theories, and ECAs. We then explain our methodology, including sampling, research approach, and data collection and analysis. Following from that, we present our findings and discuss them against extant literature. We conclude the paper by highlighting its main contributions to theory and practice, its limitations, and propose future research avenues.

## Literature Review

### *Entrepreneurship Education and Learning Theories*

Entrepreneurship education programs and research have expanded in recent years and extended to include activities occurring in the wider ecosystem (Jones et al., 2017; Kuratko & Morris, 2018; Wenninger, 2019), such as ECAs. EE aims at developing the knowledge, skills, and behaviors of entrepreneurial learners (Fayolle et al., 2006; QAA, 2018), to support them along a variety of career choices, without being confined to the narrow venture creation path (Fayolle & Gailly, 2008).

With the rapid growth in EE, the pedagogical approaches have branched and diversified as well. One common approach organizes them into teaching about, for, or through entrepreneurship, along an incremental practical spectrum. Another approach classifies the methods used in EE largely into traditional (lecture-based) or experiential (activity-based) (Decker-Lange et al., 2021; Fayolle, 2018; Hagg & Kurczewska, 2021; Lackeus, 2015). EE, herein as a reflection of entrepreneurial realities, is a dynamic and multimodal field with a plethora of learning concepts that can help define its methods and activities (Fayolle, 2018; Gibb, 2002; Kuratko & Morris, 2018; Neck & Corbett, 2018). We hereby elaborate on some of those learning theories and concepts that are more relevant to ECAs.

*Heutagogy.* Heutagogy emphasizes human agency in the learning process, as the person embarks independently on an intellectual journey of discovery and experience (Hase & Kenyon, 2000, 2007, 2013; Jones et al., 2019). Thus, it aligns with student-centered approaches to education (ibid), which ECAs embody (Preedy et al., 2020), which instill a learning for self and for life mindset among entrepreneurship learners (QAA, 2018). According to Blaschke and Hase (2014); Gerstein (2014); and Hase and Kenyon (2013), heutagogical approaches have essential principles, which we argue that ECAs exemplify. These are: (1) learners are directly involved in planning and assessing their learning, and they are independent from the educator and the university, (2) educators have a rather supportive than controlling role, and (3) learning is non-linear, flexible, and focuses on practical applications of theory. Thus, the heutagogical orientation of ECAs suits the very core nature of EE, as a dynamic and experientially learnt discipline (Jones et al., 2015; Neck & Corbett, 2018).

*Experiential Learning.* Experiential learning (Kolb, 1984) has become one of the main pursued approaches to EE in recent years (Jones, 2019; Neck & Corbett, 2018). It provides a platform that facilitates the development of practical entrepreneurial skills (Cope, 2011; Neck & Greene, 2011; van Gelderen et al., 2021), which traditional methods like lectures and readings fail to support (Higgins et al., 2013; Kuratko & Morris, 2018; Tunstall & Neergaard, 2022). The student goes through cycles of learning experiences from which he extracts and internalizes new knowledge and skills

and reflects on those episodes (Corbett, 2005; Robinson et al., 2016), to update his cognitive and affective readiness (Cope, 2005; Politis, 2005; Politis et al., 2019).

ECAs are commended for their contribution to develop learners' competences through real-life experimentation and can thus be posited as emblematic of experiential approaches (Pittaway et al., 2011, 2015; Preedy et al., 2020; Preedy & Jones, 2015; Rae et al., 2012). They allow learners to project learnt theories onto engaging activities and reflect on their experiences (Gerstein, 2014; Hagg & Kurczewska, 2021), which is difficult to achieve in curricular methods (Blenker et al., 2012; Gibb, 1993; Nabi et al., 2017). However, there has been limited attention in literature to investigate ECAs-derived learning experiences.

*Social and Situated Learning.* Social models of learning are derived from two streams of logic induction. One is Bandura's (1977) original postulation that learning happens through imitation of behaviors that lead to positive consequences (Bandura, 1977). In this regard, it resembles elements of vicarious learning (Robinson et al., 2016), that is, vicarious observation and reinforcement (Bandura & Walters, 1963), as in learning from role models. Wenger (1990, 1998) argued that another dimension of social learning occurs when subjects acquire knowledge and skills and recognize opportunities through transacting with their surroundings (Rae, 2007), following a community of inquiry (COI) model (Garrison et al., 1999). It encompasses four elements: identity development, learning by doing, reflecting on experiences, and community involvement (Lave & Wenger, 1991).

Learning truly happens among and through elements that exist within the context of the learner (Lave & Wenger, 1991), and is thus "situated" (Lave & Wenger, 1991, p. 35). Similarly, entrepreneurs learn through daily situations (Cope, 2003; Cope & Watts, 2000; Rae & Carswell, 2000), which are defined by their context (El-Awad et al., 2017; Pittaway & Cope, 2007). Hence, the direct environment forms an integral part of the learning process (Lans et al., 2008). Situated learning takes place in communities of practice (COP), among groups of people engaged in similar activities and aspirations (Lave & Wenger, 1991; Wenger, 2011). Learning in COP embodies a scaffolding or apprenticeship approach, as the novice gradually accumulates expertise through observing and interacting with more competent members and undertaking situated activities (Cope, 2005; Pittaway et al., 2023; Rae, 2002).

The social and situated learning conceptions posit that knowledge and skills flow through a myriad of situated social interactions (Wenger, 1990), rather than being imparted and transmitted in cognitive and behavioral approaches (Gherardi et al., 1998). They thus emphasize the role of context and networks as sources and facilitators for developing learner's competences (Hanks, 1991). ECAs develop students' skills through environmentally defined professional experiences and social activities (Milner et al., 2016; Preedy & Jones, 2015). They, hence, firmly build on the premise of entrepreneurial learning as a socially situated phenomena i.e. better explained and enacted through a series of experiences and networks of interactions within enabling contexts.

*Existential Learning.* In existential approaches, learners question and reflect upon the abstract reasons for their existence and engagement in various experiences (e.g., what and why?) (Marton, 1981). Existential learning is symbiotic to the reflective practices in experiential activities and extends to incorporate reflecting on oneself in action, in relation to others, and on existential matters. Consequently, learning becomes more meaningful and suitable (Mezirow, 2003) to influence a change in the learner's identity, values, and orientation (Frick, 1987). Moreover, existential learning transcends knowledge and skills gains to effectively impact learners' mental models, beliefs, and future choices (DeFillipi, 2001; Mathias et al., 2015; Mezirow, 2003). ECAs allow students to reflect on those multiple dimensions, and thus develop their knowledge base and adapt their skills and mindsets to entrepreneurial realities (Duval-Couetil et al., 2016; Pittaway et al., 2011).

*Cognitive Learning.* Cognitivism views learners as vessels to be filled with knowledge that is readily available (Fox, 1997; Freire, 2018), with learning occurring through the transmission from the source (educator) to the recipient (student), in a mechanistic approach. This model is still observed in some educational settings (Hagg & Gabrielsson, 2020; Robinson et al., 2016) that employ mass education techniques, such as lecture theaters and MOOCs, with the student assuming a rather passive role in the learning process. Cognitivism reflects a learning about entrepreneurship model which supplies learners with abstract concepts, theories, and information about the entrepreneurial process (Hagg & Kurczewska, 2021; Robinson et al., 2016). Hence, it is still regarded essential to the learning process (Bennett, 2006; Fiet, 2001; Gibb, 1993; Ytti & O'Gorman, 2004).

In summation, the richness and variety of ECAs allow for the exhibition of multiple learning concepts and modes through their enaction, as they are inclusive of an expanding array of activities (Arranz et al., 2017; Preedy et al., 2020; Preedy & Jones, 2015).

### *Extracurricular Activities (ECAs)*

After briefly discussing common approaches to entrepreneurship education in literature, the relevant learning theories, and concepts, and hypothesizing their relationship with ECAs, in this part we elucidate on the current understanding of ECAs in literature.

*Background.* ECAs as activating pedagogies are receiving a growing interest from educators (Neck & Corbett, 2018; Preedy & Jones, 2017), as they support self-driven and experimental learning behaviors among students (Blaschke, 2012; Hase & Kenyon, 2000). Extracurricular activities, as their name suggest, are mostly initiated by the students, separately from the prescribed curricula (Souitaris et al., 2007). Still, their core purpose is to contribute to a course or a study program learning objectives (Milner et al., 2016; Preedy et al., 2020; Preedy & Jones, 2015, 2017). They can include cultural, employability, or socially oriented activities and tend to develop students'

practical entrepreneurial skills through active experiences (Milner et al., 2016; Pittaway et al., 2011, 2015; Rae et al., 2012).

*Contribution to EE.* ECAs foment students' intentions, knowledge, and skills, and equip them with practice-based entrepreneurial competences (ECs) such as communication skills, leadership, teamwork, dealing with uncertainty, and perseverance (Arranz et al., 2017; Pittaway et al., 2015; Pocek et al., 2021; Politis et al., 2019; Preedy et al., 2020). They hence complement classroom-based EE (Lilischkis et al., 2015; Vanevenhoven & Drago, 2015). Moreover, Milner et al. (2016) argue that ECAs could help integrate remote learners with their educational institution, breaking the isolation and neglect spiral. Preedy et al. (2020) consonantly argue for a broader view of ECAs contributions as supportive instruments for personal development, employability, social and community engagement. Thus, echoing the wider definition of EE as an entrepreneurial learning endeavor (Fayolle et al., 2006).

*Types of ECA for EE.* ECAs feature a broad range of initiatives that occur either within the university or outside of it (Preedy et al., 2020; Souitaris et al., 2007). Arranz et al. (2017) attempted to classify ECAs in EE based on their role into cognitive-emotional (orientation); informative–formative (knowledge and competences); and instrumental support (resources). Although, they did not affix any ECA to those categories.

Additionally, several scholars developed elaborate lists of ECAs, such as startup projects, conferences and seminars, local workspaces and facilities, business simulations and company visits (Arranz et al., 2017). For example, Preedy and Jones (2015) and Preedy et al. (2020) identified several ECAs upon surveying and interviewing entrepreneurship education and support staff in UK universities. These include hackathons, seminars, mentoring sessions, guest speakers, student groups, grants, incubators, startup competitions, working spaces, and entrepreneurs in residence. Rae et al. (2012), reporting on an Institute of Small Business and Entrepreneurship (ISBE) led survey across UK universities, marked several ECAs including mentoring, awareness campaigns, support programs, legal and technical advice, funding match-making, and startup events. Pittaway et al. (2011; 2015) while investigating student-led entrepreneurship clubs and societies, cited entrepreneurship games, study exchange activities, mentoring, clubs and societies, workshops, business idea competitions, and incubators and pre-incubators. Moreover, Decker-Lange et al. (2021) in their world café study, discussed with participants several possible ECAs. The panels suggested advisory services such as coaching and startup clinics, competitions, networking events, exhibitions, and hackathons.

In conclusion, despite the evident scholarly efforts, research investigating ECAs in EE is still in its infancy (Preedy et al., 2020; Preedy & Jones, 2015). There are only a few attempts to categorize them (e.g., Arranz et al., 2017), while most studies either explored ECAs as part of a wider approach to renovate EE (e.g., Arranz et al., 2017; Decker-Lange et al., 2021; Higgins et al., 2013; Pittaway & Cope, 2007; Rae et al., 2012), or focused on specific types of ECAs such as student groups (Pittaway et al.,

2011, 2015; Preedy & Jones, 2015, 2017), entrepreneurship centers and consulting (Zahra et al., 2011), or venture creation programs (VCPs) (Lackeus & Williams Middleton, 2015; Pocek et al., 2021; Politis et al., 2019). Moreover, the discussions in literature on the theoretical underpinnings of ECAs are limited, and mostly apply an aggregate experiential logic without much attention to other learning conjectures such as social and situated perspectives (Preedy et al., 2020). In addition, studies on ECAs are focused on university-based inputs, with limited attention to ecosystem actors' views (Lilschkis et al., 2015; Rae et al., 2012; Vanevenhoven & Drago, 2015).

## Methodology

### *Approach*

This study investigates what ECAs can be leveraged to improve students and nascent entrepreneurs' competence. It followed a qualitative approach by conducting in-depth semi-structured interviews, online with 22 entrepreneurship experts (Creswell, 2013). The decision to rely on ecosystem experts' views is attributable to their specific expertise in ECAs and experiential activities for entrepreneurship (Ahmad et al., 2020; Gibb & Hannon, 2006; Wilson et al., 2009). The interviews were planned as lengthy dialogues to allow participants to reflect on their experiences with entrepreneurs and elaborate on their feedback regarding suitable ECAs, thus improving the quality of the narrative data collected (Sykes, 1990).

### *Sample*

In selecting our sample, we relied on three groups among the external EE stakeholder's categories developed by Bischoff et al. (2018): financial institutions (FI), support service providers (SSP), and incubators and accelerators (IA). We borrow the definition of an entrepreneurship expert from the Global Entrepreneurship Monitor as individuals who have direct involvement in the provision and evaluation of main components of entrepreneurial support mechanisms (GEM, 2023). The members of those groups are considered experts as they are closely supporting startups through mentoring, consulting, and funding on regular basis, through organizations outside HEIs (Amaral & Magalhaes, 2002; Bischoff et al., 2018).

The interviewed experts were accelerator and incubator managers, investment networks directors, venture capitalists, business angels, startup mentors, business consultants, and government support programs officers. They were located/operating in 13 countries across the United States, Latin America, Europe, Middle East, and Asia. As statistical generalizability is difficult to achieve in qualitative studies, we leveraged the diversity of the sample and the elaborate interviews data collected to ensure the validity and potential generalizability of our findings. A breakdown of the interviewed experts by country and role is provided in Table 1. We followed a purposeful sampling approach (Robinson, 2014) in identifying eligible experts who can provide

comprehensive information to address the study purpose (Suri, 2011). All the short-listed experts must have attained a postgraduate business or management degree and have been working closely with entrepreneurs for at least 5 years.

Initially, a list of experts based on author's networks in the field was prepared ( $n = 87$ ). Then, eligible experts based on the selection criteria were shortlisted and contacted ( $n = 36$ ), with an additional eight recommendations received, bringing the total number of eligible experts contacted to (44). However, only half of the contacted experts responded positively to the interview request ( $n = 22$ ).

## Process

In the beginning, four interviews were conducted with different experts to test the question format and extract some good practices. The question settled upon after the initial phase was:

“What ECAs can be used to improve entrepreneurial competences among nascent entrepreneurs/ entrepreneurial students?”

**Table 1.** Experts' Countries and Roles.

Expert	Country	Role
1	Egypt	Mentor
2	Estonia	Investor
3	US	Mentor & investor
4	Croatia	Mentor
5	France	Mentor & investor
6	US	Mentor & investor
7	US	Mentor
8	Estonia	Mentor & investor
9	Estonia	Mentor
10	Spain	Mentor & investor
11	US	Mentor
12	Denmark	Investor
13	US	Mentor
14	US	Mentor
15	Finland	Mentor
16	Egypt	Mentor
17	Portugal	Mentor
18	India	Mentor
19	US	Investor
20	US	Mentor & policymaker
21	UK & Venezuela	Mentor & policymaker
22	Yemen	Mentor



Interviews were held based on experts' availability. Each interview lasted between 40 min and 2.5 h, as some experts went through specific personal and program experiences to provide context to their answers. We used online conferencing platforms: Microsoft Teams and Zoom, to conduct the interviews as most participants are in a country different from that of the interviewer. This also allowed us to record the interviews, after getting experts consent, and review them as many times as needed during the data analysis process.

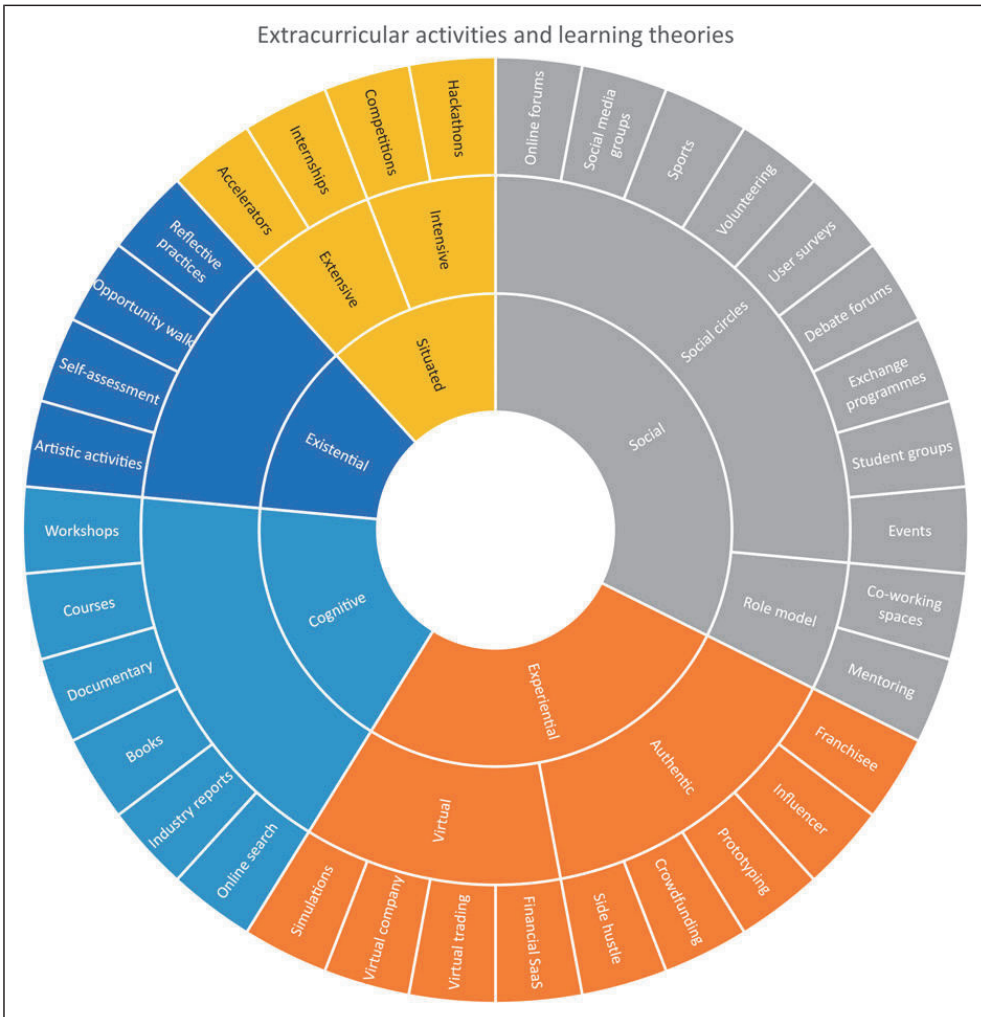
### *Data Analysis*

The data collection and analysis were conducted as an iterative process using manual coding. We applied a hybrid approach to thematic analysis through integrating the codes driven from interview data with those deduced from learning theories (Creswell, 2013; Fereday & Muir-Cochrane, 2006; Woiceshyn & Daellenbach, 2018). We first started with open coding, to identify codes. This was followed axial coding to build relationships between codes, as in individual ECAs and their benefits (Strauss & Corbin, 1998), as reported by the experts. We used an excel sheet, with a research assistant analyzing the data separately from the author. The identified ECAs ( $n = 34$ ) and their benefits were reviewed and discussed several times throughout the analysis process between the author and the research assistant to enhance our understanding, refine the codes, and reach a consensus (Ritchie & Spencer, 2002).

The codes were then grouped into themes (Strauss & Corbin, 1998) derived from relevant learning theories. This approach provided us with theoretical guidance that can ensure the viability of our analysis and hence, the soundness of our proposed arguments (Robinson et al., 2016; Yin, 2015). The theming of ECAs by learning theories is demonstrated in Figure 1. In the following sections, the findings are discussed against relevant literature and theoretical concepts.

### *Analysis of the Findings*

Through the interviews, experts identified and suggested a total of 34 different ECAs to improve entrepreneurial skills and competences of students. The ECAs were thematically grouped based on the nature of the activity, the intended purposes of engaging in it, and its context (Horsfall et al., 2001; Leininger, 1994) (see Figure 1). The themes were both inductively and deductively derived (Fereday & Muir-Cochrane, 2006; Woiceshyn & Daellenbach, 2018) to reflect pertinent learning theories and concepts in EE literature (Pocek et al., 2021; Politis et al., 2019; Robinson et al., 2016), and the codes driven from interview data. The experts' views on ECAs in the following analysis were elaborated upon and enriched with direct quotes to establish adequate rigor (Rice & Ezzy, 1999), and supported by extant literature to improve its validity.



**Figure 1.** A typology of extracurricular activities based on learning theories.

### Cognitive ECAs

Students engage in cognitive ECAs to primarily acquire knowledge related to the entrepreneurial process (Arranz et al., 2017; Mitchell et al., 2000, 2002). Cognitive approaches are useful to educate masses of students about entrepreneurship in a rather standardised form (Bennett, 2006; Fiet, 2001; Hytti & O’Gorman, 2004), which is essentially what experts recommended them for. ECAs of cognitive nature suggested by experts include workshops, courses, documentaries, books, industry reports and online search.

Workshops and courses that focus on financial knowledge, were regarded as “*important means to supply students with needed financial mastery.*” They can improve students’ confidence and self-efficacy, and could be pursued through their own universities, another education provider, government agencies, investment providers or online via MOOCs. Moreover, workshops focused on developing communication, presentation, and public speaking skills were deemed advantageous in improving students’ ability to connect with existing and future team members. Watching documentaries, reading reports, books, and articles narrating startup stories, searching and following their news online was also recommended as a starting point to develop creativity, and identify and assess entrepreneurial opportunities by “*learning from anecdotes.*”

### Experiential ECAs

ECAs of experiential nature exposes students to situations that are difficult to reproduce in classrooms (Preedy et al., 2020; Tunstall & Neergaard, 2022). They hence contribute substantially to the learning process and outcomes (Cope & Watts, 2000; Rae & Carswell, 2000). Experiential ECAs recommended by the experts were grouped into either virtual or authentic.

*Virtual Experiential ECAs.* Simulations expose students to business situations that mirror real life scenarios (Neck & Greene, 2011). In the experts’ views, these can include business simulations and games, virtual stock trading, virtual companies, and accounting/financial SaaS (free/basic tier). Essentially, gamified environments can help with “*practicing doing financial forecasts and crunching the numbers for any idea they got.*” They allow students to practice the different aspects of running a business including planning, marketing, supply chain management, taxation, investment, and payrolls (Kriz & Auchter, 2016; Newbery et al., 2016). Additionally, students tend to learn how to deal with uncertainty and risk, preparing them for the dynamic startup world.

Simulations are exemplars of experiential learning, where projected selves of participants (avatars) learn by doing in the virtual world (Dawley & Dede, 2014), test their plans and reflect on their decisions and experiences (Hew & Cheung, 2010). They emphasize learning by experiencing rather than consumption where the learner assumes a leadership position and learns from his decisions (De Freitas et al., 2010).

*Authentic Experiential ECAs.* Setting up a “*side hustle*” alongside regular education enhances students’ entrepreneurial knowledge and skills and builds their understanding and efficacy for managing a business (Neck & Greene, 2011). Several experts advised students “*not wait until everything becomes perfect*” and suggested several measures including starting an entrepreneurial project, launching a crowdfunding campaign, developing, and testing a prototype, becoming a social media influencer, or franchising an established business. Students can thus “*live the different experiences a real*

*entrepreneur encounters*” such as opportunity recognition, team building, strategy, marketing, finance, and legal functions (Busenitz et al., 2003). For example, working as a social media influencer “*teaches them everything as they manage their accounts from A to Z, more or less like a business.*” Becoming a reseller or franchisee draws parallels with entrepreneurial venturing, as students will take responsibility for managing a project independently (Combs et al., 2011; Ketchen et al., 2011).

Moreover, building and testing a prototype, pushes students beyond their comfort zones. They develop an initiative taking spirit and learn to evaluate the feasibility of their ideas. As one expert said: “*students should go out and try to sell a version of their products to people and gather feedback.*” Similarly, launching crowdfunding campaigns allows them to practice establishing and marketing projects, as a risk-free opportunity to learn (Hui et al., 2014; Muller et al., 2013), and receive real-market evaluation of their innovative venture ideas (Chemla & Tinn, 2020).

### Social ECAs

Social learning emphasizes the role of networks and relationships as indispensable assets for entrepreneurial learning and growth, through providing collaborative learning environments (Clark et al., 2008; Pittaway et al., 2011). Learning from role models for example, plays a role in the formative development of entrepreneurs (Fellnhofer, 2017), while participating in network-based activities, enhances the development of entrepreneurial skills through social interactions (Pittaway et al., 2015).

Several ECAs recommended by the interviewees build on the social learning principles. These are based on either interaction with role models, such as mentoring (guidance) and advice from experts in co-working spaces or through social circles such as student clubs and associations, customer discovery groups, exchange programmes, and events.

**Role Models.** Mentors possess greater level of entrepreneurial knowledge and expertise that they share with learners upon request (Robinson et al., 2016). They hence advance their ECs and self-efficacy (Fellnhofer, 2017).

Mentorship was the ECA recommended the most by experts, as having positive correlation with entrepreneurial progress (Kuratko et al., 2021; Morris et al., 2015). They perceive it as “*invaluable*” and “*provides most competences and support an entrepreneur need*” (Cope & Watts, 2000). Mentors are particularly valuable for advising on the formation and working of entrepreneurial teams and can help draft shareholder agreements and vesting schedules. They can “*use their networks to connect cofounders with complimentary skills*” and “*advise and guide cofounders on how to work effectively together.*” Moreover, mentors with industry experience and connections, facilitate access to specific resources and knowledge (Rigg & O’Dwyer, 2012). Similarly, young entrepreneurs can resort to co-working spaces as social support places (Spinuzzi, 2012; Winkler et al., 2018), to seek advice from experts and find team members as they are typically “*charged with industry professionals, freelancers, and*

*entrepreneurs.*” It is worth noting, however, that the benefit of mentoring depends largely on the founder’s coachability (Kuratko et al., 2021).

*Social Circles.* Entrepreneurs rely on their social capital in acquiring knowledge and resources relevant to their projects (Holland & Andre, 1987; Rigg & O’Dwyer, 2012), while the social networks available to students through universities have always been a fundamental part of their learning (Buckley & Lee, 2021). Experts recommended several social activities that entrepreneurial students can participate in. These are events, student clubs, associations and debate forums, exchange programmes, volunteering and community work, social media and online forums, and sports teams.

They suggest that going to events and “*speaking with people there*” can help students find team members with complementary skills and advisors within their niche. They mentioned several types of events such as universities open days, startup events, meetups, industry conferences, and exhibitions. However, experts emphasized that students should “*do their homework first*” by researching the audience and practicing dialogues, thus improving their self-awareness and efficacy (Pittaway et al., 2011, 2015). Additionally, they emphasized the role of participating in group projects with defined goals through student clubs, associations, and debate forums. These socially oriented ECAs can help them improve their self-esteem, communication, and team-working skills as they practice presenting themselves and working in dynamic groups. They will also practice persuading and influencing, learn from others’ experiences, and the networks they build will prove invaluable in accessing future resources (Buckley & Lee, 2021; Pittaway et al., 2011).

Several experts highlighted the importance of university exchange programmes in improving students’ cultural awareness and developing a global entrepreneurial mindset (Felicio et al., 2015), allowing them to work among diverse groups, and complementing their entrepreneurial curricula (Altbach & Knight, 2007; Minola et al., 2016). Most experts agreed that students should survey and interview their intended customers to identify their real needs and develop relevant solutions (Eisenmann, 2021), as “*building products should be based on solving customers/real world problems.*” It is inevitable that they will get negative comments, but this will make them more resilient and perseverant as they will “*understand the realities of doing business.*”

Volunteering and community work were another ECA suggested to develop students’ ECs (Clarke & Underwood, 2011). In the experts’ opinion, students get to interact with members of their communities and expand their social circles. They also develop some understanding of planning and implementing projects through transacting with their teams (Liszt-Rohlf et al., 2021). Moreover, playing sports was recommended to help improve the resilience and perseverance of entrepreneurial students (Marnoto & Carvalho, 2016), as “*they know that today’s effort will pay you back in the future.*”

In addition, experts advised students to share their ideas on relevant social media groups and online forums, as these are regarded communities of inquiries (COI) (Garisson et al., 1999), that facilitate knowledge sharing, collaborative idea

development, and recruitment of potential team members with similar passion and complementary skills (Dron & Anderson, 2014; Ellison, et al., 2007; Garrison & Arbaugh, 2007).

### *Situated ECAs*

Situated learning occurs when entrepreneurs get involved in COP, acquiring specific expertise and resources as they interact and learn from more experienced members, within a contextually defined environment (Cope, 2005; Rae, 2002). We classify situated ECAs recommended by the experts into two subcategories on a temporal scale. Intensive, and these are of a short duration, include hackathons, bootcamps and competitions, while more extensive ones include accelerators, incubators, and internships. Students' involvement in these ECAs is a valid demonstration of situated entrepreneurial learning as they match startup environments (Gibb, 2002; Pocek et al., 2021).

*Intensive Situated ECAs.* Hackathons, bootcamps and competitions are intensive forms of situated learning, that have been receiving growing attention in policy and practice (Stolz & Sternberg, 2022; Syzmanska et al., 2020). They typically last a few days only. However, experts argue that they exhibit rich exchanges of knowledge and experiences among participating entrepreneurial actors (Passaro et al., 2017; Russell et al., 2008).

They “usually involve developing a business & financial model for their innovation,” an expert mentioned. Hence, students get to learn essential research, planning, and marketing skills (Schwartz et al., 2013; Tunstall & Neergaard, 2022). They were also regarded as “excellent opportunities to get used to preparing slides and pitching your idea,” improving students' communication and presentation skills (Stolz & Sternberg, 2022). Students learn how to work together effectively under time constraints, distributing tasks and assuming leadership roles (Lans et al., 2021). They often “bump into others who share a similar enthusiasm,” leading to constructive dialogues. Students tend to develop better self-awareness and efficacy as they witness significant improvements in their planning, communication, and teamworking skills within a few days (Syzmanska et al., 2020). In addition, experts argue that competitions and hackathons act as “creativity beds” through developing problem solving and critical thinking skills, especially when they address specific challenges.

*Extensive Situated ECAs.* Accelerators and incubators can be viewed as an extended form of hackathons and bootcamps that spread over a few weeks or months. Nascent entrepreneurs get embedded within an entrepreneurial community of practice (Cope, 2005; Rae, 2002) and interact with like-minded people in socially situated learning environment (Kubberod & Pettersen, 2017; Lave & Wenger, 1991). Experts argue that students learn from their peers as well as the mentors and experts that deliver the different workshops and activities (Cope, 2005; Politis et al., 2019; Preedy & Jones, 2015). Here in, they improve their communication, presentation, teamworking,

planning and management skills (Politis et al., 2019; Spigel, 2017; Williams Middleton et al., 2020). Moreover, they improve the motivation and perseverance of nascent entrepreneurs as they must “*abide by certain milestones and deliverables.*”

The potential for transforming ideas into viable businesses is influenced by the industry experience an entrepreneur possesses (Minniti & Bygrave, 2001; Reuber & Fischer, 1999). Hence, interning in an established business or a startup was one of the commonly suggested ECAs by experts to gain experience in a situated environment (Gault et al., 2010; Walmsley et al., 2006). Internships are regarded a form of apprenticeship; a coveted working experience for students (Simons et al., 2012). They provide guided learning experiences and equip entrepreneurial students with a variety of professional skills (Andriany et al., 2022; Ismail, 2018; Lantu et al., 2022). However, to avoid the “secretary” or “office boy” types of internships, experts recommended certain precautions. Internships must have clearly defined roles from the beginning and it is better if students work directly with decision-making executives or startup founders. Also, students “*have to write a reflective report about their experience afterwards and what they learnt,*” which follows the experiential learning premise.

### **Existential ECAs**

Existential learners develop a deeper understanding of their identities, capabilities, and purposes, while revisiting and updating their convictions and values (DeFillipi, 2001; Marton, 1981). These are precursors to effective entrepreneurial learning and action (Bird, 1992; Cope, 2003; Neck et al., 2014). Learning activities of existential nature, however, are difficult to incorporate in curricular EE due to time and space constraints (Neck & Greene, 2011). Thus, it was recommended by experts to practice several ECAs that promote existential thinking and learning, outside classroom environments. These include reflective practices, opportunity walk, self-assessment tests, and participating in artistic activities.

Several experts recommended reflection to improve students’ understanding of themselves, their capabilities, and limitations (Brockbank & McGill, 2007). This was suggested whenever they conclude an activity or a task, to extract lessons from the experience they went through and improve their knowledge and skills (Neck & Corbett, 2018). Experts also argue that students should contemplate on the artefacts and events in their close environments through opportunity walks (Neck et al., 2014; Neck & Greene, 2011), that is, “*try to observe simple problems at your household or neighborhood.*” This will train them on identifying the root causes of problems and opportunities to design creative solutions, which are essential entrepreneurial capabilities. Experts also recommend self-assessment tests such as personality and ECs, to improve students’ self-awareness. This is especially relevant given the elusive nature of what makes an entrepreneur (Caird, 1993).

Participating in art activities, such as acting and theatre classes, were one of the few ECAs that experts recommended to improve students’ creative abilities that traditional EE pedagogies fail to address (Neck & Greene, 2011). Students “*create character*

*profiles and expand their horizons of real-life scenarios.*” They go through the fictional scenarios in an experiential cycle of observing, practicing, reflecting, and learning (Heikkinen, 2002; Passila et al., 2012), which improves their self-awareness and efficacy.

In summation, the elaboration on the 34 ECAs that the experts recommended provide needed empirical insights on the benefits of ECAs towards developing entrepreneurial capabilities. Several learning theories and concepts were deduced and accordingly, the ECAs were organized against them through corroboration with extant literature. The preceding analysis of the interviews and dialogical exchanges with literature, thus provides a fecund ground for discussions on the theoretical alignments and benefits of ECAs within an EE context.

## Discussion

ECAs have been receiving a growing interest from entrepreneurship educators (Neck & Corbett, 2018; Preedy & Jones, 2017), as they tend to improve the practical skills through active experiences (Milner et al., 2016; Pittaway et al., 2011, 2015; Rae et al., 2012). They promote independent knowledge and skills pursuit and development among entrepreneurial learners through embedding them in engaging and flexible socially situated experiences. ECAs thus play a complementary role to EE courses (Lilischkis et al., 2015; Vanevenhoven & Drago, 2015). This heutagogical orientation of ECAs is valuable in preparing students for the dynamic and experiential nature of entrepreneurship (Jones et al., 2015; Neck & Corbett, 2018). While consequently, ECAs are often explained through an experiential learning lens (Padilla-Angulo, 2019; Preedy et al., 2020), this study expanded the discussion on the theoretical interconnectedness of ECAs to additional conceptions, including social, situated, cognitive, and existential learning.

Throughout the analysis in the preceding section, it became more evident that entrepreneurship and entrepreneurial learning are essentially socially situated phenomena, that are predominantly experiential in nature (Politis et al., 2019; Rae, 2007; Robinson et al., 2016). ECAs can provide enhanced opportunities for ‘learning by doing.’ Thus, updating the entrepreneur’s knowledge, skills, and mindset through new experiences (Duval-Couetil et al., 2016; Pittaway et al., 2011). ECAs are also inclusive of the social and situated aspects through knowledge and skills sharing among networks of participants that are influenced and shaped by the context of their occurrence (Cope, 2005; Howorth et al., 2012; Lave & Wenger, 1991; Pittaways et al., 2015), which provide supportive environment for learning from and through others.

Moreover, the learning outcomes of these activities are augmented by existential reflective practices (DeFillipi, 2001; Gerstein, 2014). Existential ECAs hence exhibit a transformative role that transcends ECs development to upgrade learners’ identities, beliefs, and values (Frick, 1987; Mezirow, 2003). However, a transmissive approach of knowledge was still recommended by the experts, in line with extant literature



(e.g., Hytti & O’Gorman, 2004), especially with regards to equipping students with basic financial and entrepreneurial knowledge through courses and workshops.

The conjoint nature of learning theories was exhibited across the recommended ECAs, when compared with literature. The dominance of one of them over others is thus situational and relies on the intended learning outcomes and the micro activities the learner participates in within a specific ECA. For example, mentoring, a predominantly social learning phenomena where knowledge is shared between the mentor and the mentee, can also be framed as a situated learning mode when the entrepreneur steps into a mentoring network (Rigg & O’Dwyer, 2012) or mentorship is provided as part of an accelerator (Kuratko et al., 2021). Student clubs can also be seen as an experiential learning environment when learning occurs chiefly by working on projects (Clark et al., 2008). Also, traditional classes and workshops that are positioned as cognitive means for instilling theoretical knowledge among entrepreneurial learners (Arranz et al., 2017; Mitchell et al., 2000, 2002), can exhibit social learning experiences when they focus on developing communication and public speaking skills through practical exercises.

### *Research Contribution*

The paper contributes to literature mainly through providing a basic understanding of the theoretical underpinnings of different ECAs for EE, as one of the few papers that focuses on this as its primary contribution (see also Pittaway et al., 2011; Poceck et al., 2021; Politis et al., 2019). By discussing and establishing relationships with different learning concepts, it demonstrates the versatility and richness of entrepreneurial learning approaches, more specifically ECAs, and provides much-needed rigor to the discussion on the theoretical origins of ECAs (Arranz et al., 2017; Preedy et al., 2020; Preedy & Jones, 2015). It also adds additional support to the broader EE pedagogies theoretical conceptualizations, when drawing parallels with this study, as called for by several scholars (Fayolle, 2018; Fayolle et al., 2016; Neck & Corbett, 2018). It can thus aid educators and researchers in understanding what could work and why (Robinson et al., 2016).

By providing an elaborate list of ECAs and outlining the value each can bring to ECs development (Morris et al., 2013), it enriches the growing stream of research on practice-based EE and its value in engaging students and equipping them with entrepreneurial skills (Galvao et al., 2018; Williams Middleton et al., 2019; Yi & Duval-Couetil, 2021). The study also opens the door for theory-based evaluations (Birkmayer & Weiss, 2000) to study the effectiveness of EE approaches and programs, by comparing the expected patterns of learning deduced from theories, against the nature and outcomes of the different ECAs. Theory-based approaches could prove beneficial in assessing the outcomes of an elusive and multidisciplinary educational field, such as entrepreneurship (Duval-Couetil, 2013; Pittaway & Edwards, 2012; Smith, 2015), and provide an alternative route to the prevailing economic (Nabi et al., 2017) and competency based (Morris et al., 2013) evaluations.

In addition, by relying on entrepreneurship ecosystem experts' views, it supports their incorporation in the EE process as an important step to improving its outcomes (Isenberg, 2010; Kuratko, 2005; Lilischkis et al., 2015). This is especially relevant as existing ECAs studies, as to the wider EE literature, tend to focus on HEIs actors' views (Bischoff et al., 2018; Rae et al., 2012; Lilschkis et al., 2015).

### *Practical Contribution*

By leveraging the findings of this study and given the complementary nature of ECAs to curricular EE (Lilischkis et al., 2015; Vanevenhoven & Drago, 2015), educators can signpost their students to participate in different activities based on their competence profile to improve their attainment of ECs. This can further promote a student-centered approach to learning (Hase & Kenyon, 2000; Jones et al., 2019), which enhances entrepreneurial students' engagement and drive better outcomes (Robinson et al., 2016).

For example, students with limited financial literacy, can benefit from blending cognitive (workshops and course) and experiential (simulations and games) approaches that were recommended by the ecosystem experts, to improve their financial knowledge and practical skills. Moreover, to those students having communication problems and/or lower self-confidence, several ECAs such as mentoring and participating in events and student groups, which are predominantly social in nature, can prove remedial. To cover for the experience gap among students, experts recommended activities such as interning, entrepreneurial projects, and community work. Moreover, to resolve the problem of idea-driven entrepreneurship, experts suggest that students engage in customer discovery, reflective practices, discuss ideas openly with others and online, and prototype their solutions to better identify real societal needs and build meaningful solutions.

### *Limitations and Future Research*

The study relied on the entrepreneurship ecosystem experts' views. While we critique previous literature for focusing solely on HEIs perspectives (Lilschkis et al., 2015; Rae et al., 2012; Vanevenhoven & Drago, 2015), a similar sampling limitation is true for this study. This can be avoided in future research by adopting a multidisciplinary sample featuring entrepreneurship educators and researchers together with ecosystem experts as in the world café study of Decker-Lange et al. (2021). It would be interesting to compare the views of the different groups as well, with regards to their recommended pedagogical approaches (ECAs). Moreover, the experts included in the study, although representing broad geographical backgrounds and diverse entrepreneurial expertise, were based on three groups among Bischoff et al. (2018) mapping of EE ecosystem. Future studies might want to expand its selection to include members of other groups.

The study is one of a few attempts to profile ECAs based on a learning conceptualization. We hence join several scholars' calls for more discursive research of the

theoretical backgrounds of ECAs (Arranz et al., 2017; Preedy et al., 2020) and EE methods in general (Fayolle et al., 2016; Neck & Corbett, 2018). Moreover, as the discussion of the theoretical grounds of ECAs in this study is based on our interpretation of extant literature, which might involve potential subjective bias (Horsfall et al., 2001; Leininger, 1994), we recommend that researchers adopt a more grounded approach in follow-up studies, to garner the perspectives of a broad base of experienced scholars. This can be achieved through applying a Delphi method, e.g., which was used effectively in studies of comparable purposes (e.g., Neck & Corbett, 2018; van Gelderen et al., 2021).

## Conclusion

The paper discusses and proposes a typology of ECAs for entrepreneurship education, building on relevant learning theories and concepts, and comments on their benefits towards the development of entrepreneurial competences, based on interviews conducted with entrepreneurship ecosystem experts. It can help improve our understanding of the nature and value of these activities and provide rigor to the discussion on the theoretical origins of ECAs and similarly, the broader entrepreneurship pedagogies. The findings of this study can also help entrepreneurship educators, inside and outside HEI, better incorporate ECAs in their pedagogies and recommend them to their students.

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## References

- Adisel, A., Andriany, D., Suryati, S., & Putra, P. H. R. (2022). Implementing entrepreneurship education in extracurricular activity (ECA) for students. *International Journal of Education in Mathematics, Science and Technology*, 10(4), 955–970. <https://doi.org/10.46328/ijemst.2621>
- Ahmed, T., Chandran, V. G. R., Klobas, J. E., Liñán, F., & Kokkalis, P. (2020). Entrepreneurship education programmes: How learning, inspiration and resources affect intentions for new

- venture creation in a developing economy. *International Journal of Management in Education*, 18(1), 100327. <https://doi.org/10.1016/j.ijme.2019.100327>
- Altbach, P. G., & Knight, J. (2007). The internationalization of higher education: Motivations and realities. *Journal of Studies in International Education*, 11(3–4), 290–305. <https://doi.org/10.1177/1028315307303542>
- Amaral, A., & Magalhaes, A. (2002). The emergent role of external stakeholders in European higher education governance. *Governing higher education: National perspectives on institutional governance* (pp. 1–21).
- Arranz, N., Ubierna, F., Arroyabe, M. F., Perez, C., & Fdezde Arroyabe, J. C. (2017). The effect of curricular and extracurricular activities on university students' entrepreneurial intention and competences. *Studies in Higher Education*, 42(11), 1979–2008. <https://doi.org/10.1080/03075079.2015.1130030>
- Bacigalupo, M., Kamylyis, P., Punie, Y., & Van den Brande, G. (2016) *EntreComp: The entrepreneurship competence framework*. Publication Office of the European Union.
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191–215. <https://doi.org/10.1037//0033-295x.84.2.191>
- Bandura, A., & Walters, R. H. (1963). *Social learning and personality development*.
- Beaumont, E., Preedy, S., Smith, K., & Walmsley, A. (2022). *Special issue on Extracurricular enterprise and entrepreneurship education*. Entrepreneurship Education and Pedagogy.
- Bennett, R. (2006). Business lecturers' perceptions of the nature of entrepreneurship. *International Journal of Entrepreneurial Behavior & Research*, 12(3), 165–188. <https://doi.org/10.1108/13552550610667440>
- Birckmayer, J. D., & Weiss, C. H. (2000). Theory-based evaluation in practice: What do we learn? *Evaluation Review*, 24(4), 407–431. <https://doi.org/10.1177/0193841X0002400404>
- Bird, B. J. (1992). The operation of intentions in time: The emergence of the new venture. *Entrepreneurship Theory and Practice*, 17(1), 11–20. <https://doi.org/10.1177/104225879201700102>
- Bischoff, K., Volkmann, C. K., & Audretsch, D. B. (2018). Stakeholder collaboration in entrepreneurship education: An analysis of the entrepreneurial ecosystems of European higher educational institutions. *The Journal of Technology Transfer*, 43(1), 20–46. <https://doi.org/10.1007/s10961-017-9581-0>
- Blaschke, L. M. (2012). Heutagogy and lifelong learning: A review of heutagogical practice and self-determined learning. *The International Review of Research in Open and Distributed Learning*, 13(1), 56–71. <https://doi.org/10.19173/irrodl.v13i1.1076>
- Blaschke, L. M., & Hase, S. (2014). Heutagogy, technology, and lifelong learning for professional and part-time learners. *Transformative perspectives and processes in higher education* (pp. 75–94). Springer International Publishing.
- Blenker, P., Frederiksen, S. H., Korsgaard, S., Müller, S., Neergaard, H., & Thrane, C. (2012). Entrepreneurship as everyday practice: Towards a personalized pedagogy of enterprise education. *Industry and Higher Education*, 26(6), 417–430. <https://doi.org/10.5367/ihe.2012.0126>
- Brockbank, A., & McGill, I. (2007). *Facilitating reflective learning in higher education*. McGraw-Hill Education.

- Brush, C. G. (2014). Exploring the concept of an entrepreneurship education ecosystem. In *Innovative Pathways for University Entrepreneurship in the 21st Century (Advances in the Study of Entrepreneurship, Innovation and Economic Growth, Vol. 24)* (pp. 25–39). Emerald Group Publishing Limited.
- Buckley, P., & Lee, P. (2021). The impact of extra-curricular activity on the student experience. *Active Learning in Higher Education*, 22(1), 37–48. <https://doi.org/10.1177/1469787418808988>
- Busenitz, L. W., West, G. P. III, Shepherd, D., Nelson, T., Chandler, G. N., & Zacharakis, A. (2003). Entrepreneurship research in emergence: Past trends and future directions. *Journal of management*, 29(3), 285–308. [https://doi.org/10.1016/s0149-2063\\_03\\_00013-8](https://doi.org/10.1016/s0149-2063_03_00013-8)
- Caird, S. P. (1993). What do psychological tests suggest about entrepreneurs? *Journal of Managerial Psychology*, 8(6), 11–20. <https://doi.org/10.1108/02683949310047428>
- Chemla, G., & Tinn, K. (2020). Learning through crowdfunding. *Management Science*, 66(5), 1783–1801. <https://doi.org/10.1287/mnsc.2018.3278>
- Clark, G., Dawes, F., Heywood, A., & McLaughlin, T. (2008). Students as transferors of knowledge: The problem of measuring success. *International Small Business Journal: Researching Entrepreneurship*, 26(6), 735–758. <https://doi.org/10.1177/0266242608096091>
- Clarke, J., & Underwood, S. (2011). Learning based on ‘entrepreneurial volunteering’ using enterprise education to explore social responsibility. *Industry and Higher Education*, 25(6), 461–467. <https://doi.org/10.5367/ihe.2011.0068>
- Combs, J. G., Ketchen, D. J. Jr., & Short, J. C. (2011). Franchising research: Major milestones, new directions, and its future within entrepreneurship. *Entrepreneurship Theory and Practice*, 35(3), 413–425. <https://doi.org/10.1111/j.1540-6520.2011.00443.x>
- Cope, J. (2003). Entrepreneurial learning and critical reflection: Discontinuous events as triggers for ‘higher-level’ learning. *Management Learning*, 34(4), 429–450. <https://doi.org/10.1177/1350507603039067>
- Cope, J. (2005). Toward a dynamic learning perspective of entrepreneurship. *Entrepreneurship theory and practice*, 29(4), 373–397. <https://doi.org/10.1111/j.1540-6520.2005.00090.x>
- Cope, J. (2011). Entrepreneurial learning from failure: An interpretative phenomenological analysis. *Journal of Business Venturing*, 26(6), 604–623. <https://doi.org/10.1016/j.jbusvent.2010.06.002>
- Cope, J., & Watts, G. (2000). Learning by doing—an exploration of experience, critical incidents and reflection in entrepreneurial learning. *International Journal of Entrepreneurial Behavior & Research*, 6(3), 104–124. <https://doi.org/10.1108/13552550010346208>
- Corbett, A. C. (2005). Experiential learning within the process of opportunity identification and exploitation. *Entrepreneurship theory and practice*, 29(4), 473–491. <https://doi.org/10.1111/j.1540-6520.2005.00094.x>
- Creswell, J. W. (2013). *Steps in conducting a scholarly mixed methods study*.
- Dawley, L., & Dede, C. (2014). Situated learning in virtual worlds and immersive simulations. *Handbook of research on educational communications and technology*, 723–734. [https://doi.org/10.1007/978-1-4614-3185-5\\_58](https://doi.org/10.1007/978-1-4614-3185-5_58)

- Decker-Lange, C., Lange, K., Dhaliwal, S., & Walmsley, A. (2021). Exploring entrepreneurship education effectiveness at British universities—an application of the World Café method. *Entrepreneurship Education and Pedagogy*, 5(1), 113–136. <https://doi.org/10.1177/2515127420935391>
- DeFillippi, R. J. (2001). Introduction: Project-based learning, reflective practices and learning. *Management Learning*, 32(1), 5–10. <https://doi.org/10.1177/1350507601321001>
- De Freitas, S., Rebollo-Mendez, G., Liarokapis, F., Magoulas, G., & Poulouvasilis, A. (2010). Learning as immersive experiences: Using the four-dimensional framework for designing and evaluating immersive learning experiences in a virtual world. *British Journal of Educational Technology*, 41(1), 69–85. <https://doi.org/10.1111/j.1467-8535.2009.01024.x>
- Dron, J., & Anderson, T. (2014). *Teaching crowds: Learning and social media*. Athabasca University Press.
- Duval-Couetil, N. (2013). Assessing the impact of entrepreneurship education programs: Challenges and approaches. *Journal of Small Business Management*, 51(3), 394–409. <https://doi.org/10.1111/jsbm.12024>
- Duval-Couetil, N., Shartrand, A., & Reed, T. (2016). The role of entrepreneurship program models and experiential activities on engineering student outcomes. *Advances in Engineering Education*, 5(1), n1.
- Eisenmann, T. (2021). *Why startups fail: A new roadmap for entrepreneurial success*. Currency.
- El-Awad, Z., Gabrielsson, J., & Politis, D. (2017). Entrepreneurial learning and innovation: The critical role of team-level learning for the evolution of innovation capabilities in technology-based ventures. *International Journal of Entrepreneurial Behavior & Research*, 23(3), 381–405. <https://doi.org/10.1108/ijeb-06-2016-0177>
- Ellison, N. B., Steinfield, C., & Lampe, C. (2007). The benefits of Facebook “friends:” Social capital and college students’ use of online social network sites. *Journal of Computer-Mediated Communication*, 12(4), 1143–1168. <https://doi.org/10.1111/j.1083-6101.2007.00367.x>
- Fayolle, A. (2018). Personal views on the future of entrepreneurship education. *A research agenda for entrepreneurship education* (pp. 127–138). Edward Elgar Publishing.
- Fayolle, A., & Gailly, B. (2008). From craft to science: Teaching models and learning processes in entrepreneurship education. *Journal of European Industrial Training*, 32(7), 569–593. <https://doi.org/10.1108/03090590810899838>
- Fayolle, A., Gailly, B., & Lassas-Clerc, N. (2006). Assessing the impact of entrepreneurship education programmes: A new methodology. *Journal of European Industrial Training*, 30(9), 701–720. <https://doi.org/10.1108/03090590610715022>
- Fayolle, A., Verzat, C., & Wapshott, R. (2016). In quest of legitimacy: The theoretical and methodological foundations of entrepreneurship education research. *International Small Business Journal: Researching Entrepreneurship*, 34(7), 895–904. <https://doi.org/10.1177/0266242616649250>
- Fellnhöfer, K. (2017). Entrepreneurship education revisited: Perceived entrepreneurial role models increase perceived behavioural control. *International Journal of Learning and Change*, 9(3), 260–283. <https://doi.org/10.1504/IJLC.2017.086856>

- Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods*, 5(1), 80–92. <https://doi.org/10.1177/160940690600500107>
- Felicio, J. A., Caldeirinha, V. R., & Ribeiro-Navarrete, B. (2015). Corporate and individual global mind-set and internationalization of European SMEs. *Journal of Business Research*, 68(4), 797–802. <https://doi.org/10.1016/j.jbusres.2014.11.031>
- Fiet, J. O. (2001). The theoretical side of teaching entrepreneurship. *Journal of Business Venturing*, 16(1), 1–24. [https://doi.org/10.1016/s0883-9026\(99\)00041-5](https://doi.org/10.1016/s0883-9026(99)00041-5)
- Fox, S. (1997). Situated learning theory versus traditional cognitive learning theory: Why management education should not ignore management learning. *Systems Practice*, 10(6), 727–747. <https://doi.org/10.1007/bf02557922>
- Freire, P. (2018). *Pedagogy of the oppressed*. Bloomsbury publishing.
- Frick, W. B. (1987). The symbolic growth experience: Paradigm for a humanistic-existential learning theory. *Journal of Humanistic Psychology*, 27(4), 406–423. <https://doi.org/10.1177/0022167887274003>
- Galvao, A., Ferreira, J. J., & Marques, C. (2018). Entrepreneurship education and training as facilitators of regional development: A systematic literature review. *Journal of Small Business and Enterprise Development*, 25(1), 17–40. <https://doi.org/10.1108/jsbed-05-2017-0178>
- Galvao, A., Marques, C., & Ferreira, J. J. (2020). The role of entrepreneurship education and training programmes in advancing entrepreneurial skills and new ventures. *European Journal of Training and Development*, 44(6/7), 595–614. <https://doi.org/10.1108/ejtd-10-2019-0174>
- Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The internet and higher education*, 2(2–3), 87–105. [https://doi.org/10.1016/s1096-7516\(00\)00016-6](https://doi.org/10.1016/s1096-7516(00)00016-6)
- Garrison, D. R., & Arbaugh, J. B. (2007). Researching the community of inquiry framework: Review, issues, and future directions. *The Internet and higher education*, 10(3), 157–172. <https://doi.org/10.1016/j.iheduc.2007.04.001>
- Gault, J., Leach, E., & Duey, M. (2010). Effects of business internships on job marketability: The employers’ perspective. *Education + Training*, 52(1), 76–88. <https://doi.org/10.1108/00400911011017690>
- Gedye, S., & Beaumont, E. (2018). “The ability to get a job”: Student understandings and definitions of employability. *Education + Training*, 60(5), 406–420. <https://doi.org/10.1108/et-10-2017-0159>
- GEM (2023). *Global entrepreneurship Monitor 2022/2023 global report: Adapting to a “new Normal”*. GEM.
- Gerstein, J. (2014). *Moving from education 1.0 through education 2.0 towards education 3.0* (0).
- Gherardi, S., Nicolini, D., & Odella, F. (1998). Toward a social understanding of how people learn in organizations: The notion of situated curriculum. *Management Learning*, 29(3), 273–297. <https://doi.org/10.1177/1350507698293002>
- Gibb, A. (2002). In pursuit of a new ‘enterprise’ and ‘entrepreneurship’ paradigm for learning: Creative destruction, new values, new ways of doing things and new combinations of

- knowledge. *International Journal of Management Reviews*, 4(3), 233–269. <https://doi.org/10.1111/1468-2370.00086>
- Gibb, A., & Hannon, P. (2006). Towards the entrepreneurial university. *International Journal of Entrepreneurship Education*, 4(1), 73–110.
- Gibb, A. A. (1993). Enterprise culture and education: Understanding enterprise education and its links with small business, entrepreneurship and wider educational goals. *International Small Business Journal: Researching Entrepreneurship*, 11(3), 11–34. <https://doi.org/10.1177/026624269301100301>
- Hagg, G., & Gabriëlsson, J. (2020). A systematic literature review of the evolution of pedagogy in entrepreneurial education research. *International Journal of Entrepreneurial Behavior & Research*, 26(5), 829–861. <https://doi.org/10.1108/ijebr-04-2018-0272>
- Hagg, G., & Kurczewska, A. (2021). Toward a learning philosophy based on experience in entrepreneurship education. *Entrepreneurship Education and Pedagogy*, 4(1), 4–29. <https://doi.org/10.1177/2515127419840607>
- Hanks, W. F. (1991). Foreword by William F. Hanks. In J. Lave, & E. Wenger (Eds), *Situated learning: Legitimate peripheral participation* (pp. 13–24). Cambridge University Press.
- Hase, S., & Kenyon, C. (2000). From andragogy to heutagogy. *UltiBASE in-Site*.
- Hase, S., & Kenyon, C. (2007). Heutagogy: A child of complexity theory. *Complicity: An International Journal of Complexity and Education*, 4(1). <https://doi.org/10.29173/cmplct8766>
- Hase, S., & Kenyon, C. (Eds), (2013). *Self-determined learning: Heutagogy in action*. A&C Black.
- Heikkinen, H. L. (2002). *Whatever is narrative research. Narrative research: Voices from teachers and philosophers* (pp. 13–25).
- Hew, K. F., & Cheung, W. S. (2010). Use of three-dimensional (3-D) immersive virtual worlds in K-12 and higher education settings: A review of the research. *British Journal of Educational Technology*, 41(1), 33–55. <https://doi.org/10.1111/j.1467-8535.2008.00900.x>
- Higgins, D., Smith, K., & Mirza, M. (2013). Entrepreneurial education: Reflexive approaches to entrepreneurial learning in practice. *Journal of Entrepreneurship*, 22(2), 135–160. <https://doi.org/10.1177/0971355713490619>
- Holland, A., & Andre, T. (1987). Participation in extracurricular activities in secondary school: What is known, what needs to be known? *Review of Educational Research*, 57(4), 437–466. <https://doi.org/10.2307/1170431>
- Horsfall, D., Byrne-Armstrong, H., & Higgs, J. (2001). Researching critical moments. In H. Byrne-Armstrong, J. Higgs, & D. Horsfall (Eds), *Critical moments in qualitative research* (pp. 3–16). Butterworth Heinemann.
- Howorth, C., Smith, S. M., & Parkinson, C. (2012). Social learning and social entrepreneurship education. *The Academy of Management Learning and Education*, 11(3), 371–389. <https://doi.org/10.5465/amle.2011.0022>
- Hui, J. S., Greenberg, M. D., & Gerber, E. M. (2014). Understanding the role of community in crowdfunding work. *Proceedings of the 17th ACM conference on Computer supported cooperative work & social computing* (pp. 62–74).



- Hytti, U. (2018). Epilogue: Critical entrepreneurship education: A form of resistance to McEducation? *Revitalizing entrepreneurship education* (pp. 228–234). Routledge.
- Hytti, U., & O’Gorman, C. (2004). What is “enterprise education”? An analysis of the objectives and methods of enterprise education programmes in four European countries. *Education+ Training*, 46(1), 11–23.
- Isenberg, D. J. (2010). How to start an entrepreneurial revolution. *Harvard Business Review*, 88(6), 40–50.
- Ismail, Z. (2018). *Benefits of internships for interns and host organisations*.
- Jones, C. (2019). A signature pedagogy for entrepreneurship education. *Journal of Small Business and Enterprise Development*, 26(2), 243–254. <https://doi.org/10.1108/jsbed-03-2018-0080>
- Jones, C., & Matlay, H. (2011). Understanding the heterogeneity of entrepreneurship education: Going beyond Gartner. *Education + Training*, 53(8/9), 692–703. <https://doi.org/10.1108/00400911111185026>
- Jones, C., Penaluna, K., & Penaluna, A. (2019). The promise of andragogy, heutagogy and academagogy to enterprise and entrepreneurship education pedagogy. *Education+ Training*, 61(9), 1170–1186.
- Jones, P., Forbes-Simpson, K., Maas, G., & Newbery, R. (2015). Beta: An experiment in funded undergraduate start-up. *Industry and Higher Education*, 29(5), 405–418. <https://doi.org/10.5367/ihe.2015.0271>
- Jones, P., Pickernell, D., Fisher, R., & Netana, C. (2017). A tale of two universities: Graduates perceived value of entrepreneurship education. *Education+ Training*, 59(7), 689–705.
- Ketchen, D. J. Jr., Short, J. C., & Combs, J. G. (2011). Is franchising entrepreneurship? Yes, no, and maybe so. *Entrepreneurship Theory and Practice*, 35(3), 583–593. <https://doi.org/10.1111/j.1540-6520.2011.00442.x>
- Kolb, D. A. (1984). *Experience as the source of learning and development*. Prentice Hall.
- Kriz, W. C., & Auchter, E. (2016). 10 years of evaluation research into gaming simulation for German entrepreneurship and a new study on its long-term effects. *Simulation & Gaming*, 47(2), 179–205. <https://doi.org/10.1177/1046878116633972>
- Kubberod, E., & Pettersen, I. B. (2017). Exploring situated ambiguity in students’ entrepreneurial learning. *Education + Training*, 59(3), 265–269.
- Kuratko, D. F. (2005). The emergence of entrepreneurship education: Development, trends, and challenges. *Entrepreneurship theory and practice*, 29(5), 577–597. <https://doi.org/10.1111/j.1540-6520.2005.00099.x>
- Kuratko, D. F., & Morris, M. H. (2018). Examining the future trajectory of entrepreneurship. *Journal of Small Business Management*, 56(1), 11–23. <https://doi.org/10.1111/jsbm.12364>
- Kuratko, D. F., Neubert, E., & Marvel, M. R. (2021). Insights on the mentorship and coachability of entrepreneurs. *Business Horizons*, 64(2), 199–209. <https://doi.org/10.1016/j.bushor.2020.11.001>
- Lackeus, M. (2015). *Entrepreneurship in education: What, why, when, how*. European Commission.

- Lackeus, M., & Williams Middleton, K. (2015). Venture creation programs: Bridging entrepreneurship education and technology transfer. *Education + Training*, 57(1), 48–73. <https://doi.org/10.1108/et-02-2013-0013>
- Landstrom, H., & Benner, M. (2010). Entrepreneurship research: A history of scholarly migration. *Historical foundations of entrepreneurship research*. Edward Elgar Publishing.
- Lans, T., Biemans, H., Verstegen, J., & Mulder, M. (2008). The influence of the work environment on entrepreneurial learning of small-business owners. *Management Learning*, 39(5), 597–613. <https://doi.org/10.1177/1350507608098117>
- Lans, T., Lubberink, R., Ploum, L., Ammann, M., & Gondwe, S. (2021). Entrepreneurial learning at the boundary: How to learn from a local cheese maker. *Entrepreneurship Education and Pedagogy*, 4(3), 527–548. <https://doi.org/10.1177/2515127420925015>
- Lantu, D. C., Suharto, Y., Fachira, I., Permatasari, A., & Anggadwita, G. (2022). Experiential learning model: Improving entrepreneurial values through internship program at start-ups. *Higher Education, Skills and Work-based Learning*, 12(1), 107–125. <https://doi.org/10.1108/heswbl-01-2021-0014>
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge University Press.
- Leininger, M. (1994). Evaluation criteria and critique of qualitative research studies. In J. Morse (Ed), *Critical issues in qualitative research methods* (pp. 95–115). Sage.
- Lilischkis, S., Volkmann, C., Gruenhagen, M., Bischoff, K., & Halbfas, B. (2015). *Supporting the entrepreneurial potential of higher education*. European Union.
- Linan, F. (2008). Skill and value perceptions: How do they affect entrepreneurial intentions? *The International Entrepreneurship and Management Journal*, 4(3), 257–272. <https://doi.org/10.1007/s11365-008-0093-0>
- Liszt-Rohlf, V., Fields, M., Gerholz, K. H., Seco, V., & Haury, C. (2021). The benefits of volunteering, volunteers' competencies, and their integration into business education. *International Journal for Business Education*, 161(1), 5.
- Marnoto, S., & Carvalho, J. (2016). Developing entrepreneurship skills in children and teenagers. *Education for Entrepreneurship: International Journal of Education for Entrepreneurship*, 6, 67–78.
- Marton, F. (1981). Phenomenography—describing conceptions of the world around us. *Instructional Science*, 10(2), 177–200. <https://doi.org/10.1007/bf00132516>
- Mathias, B. D., Williams, D. W., & Smith, A. R. (2015). Entrepreneurial inception: The role of imprinting in entrepreneurial action. *Journal of Business Venturing*, 30(1), 11–28. <https://doi.org/10.1016/j.jbusvent.2014.07.004>
- Matlay, H. (2009). Entrepreneurship education in the UK: A critical analysis of stakeholder involvement and expectations. *Journal of Small Business and Enterprise Development*, 16(2), 355–368. <https://doi.org/10.1108/14626000910956100>
- Mezirow, J. (2003). Transformative learning as discourse. *Journal of Transformative Education*, 1(1), 58–63. <https://doi.org/10.1177/1541344603252172>
- Milner, S., Cousins, W., & McGowan, I. (2016). Does all work and No play make a dull graduate? Perceptions of extra-curricular activities and employability. *Journal of Perspectives in Applied Academic Practice*, 4(1), 13–18. <https://doi.org/10.14297/jpaap.v4i1.183>

- Minniti, M., & Bygrave, W. (2001). A dynamic model of entrepreneurial learning. *Entrepreneurship theory and practice*, 25(3), 5–16. <https://doi.org/10.1177/104225870102500301>
- Minola, T., Donina, D., & Meoli, M. (2016). Students climbing the entrepreneurial ladder: Does university internationalization pay off? *Small Business Economics*, 47(3), 565–587. <https://doi.org/10.1007/s11187-016-9758-1>
- 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), 93–104. <https://doi.org/10.1111/1540-8520.00001>
- Mitchell, R. K., Smith, B., Seawright, K. W., & Morse, E. A. (2000). Cross-cultural cognitions and the venture creation decision. *Academy of Management Journal*, 43(5), 974–993. <https://doi.org/10.5465/1556422>
- Morris, M. H., Neumeyer, X., & Kuratko, D. F. (2015). A portfolio perspective on entrepreneurship and economic development. *Small Business Economics*, 45(4), 713–728. <https://doi.org/10.1007/s11187-015-9678-5>
- Morris, M. H., Shirokova, G., & Tsukanova, T. (2017). Student entrepreneurship and the university ecosystem: A multi-country empirical exploration. *European J. of International Management*, 11(1), 65–85. <https://doi.org/10.1504/ejim.2017.081251>
- Morris, M. H., Webb, J. W., Fu, J., & Singhal, S. (2013). A competency-based perspective on entrepreneurship education: Conceptual and empirical insights. *Journal of Small Business Management*, 51(3), 352–369. <https://doi.org/10.1111/jsbm.12023>
- Muller, M., Geyer, W., Soule, T., Daniels, S., & Cheng, L. T. (2013). Crowdfunding inside the enterprise: Employee-initiated initiatives for innovation and collaboration. *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 503–512).
- Nabi, G., Liñán, F., Fayolle, A., Krueger, N., & Walmsley, A. (2017). The impact of entrepreneurship education in higher education: A systematic review and research agenda. *The Academy of Management Learning and Education*, 16(2), 277–299. <https://doi.org/10.5465/amle.2015.0026>
- Neck, H. M., & Corbett, A. C. (2018). The scholarship of teaching and learning entrepreneurship. *Entrepreneurship Education and Pedagogy*, 1(1), 8–41. <https://doi.org/10.1177/2515127417737286>
- Neck, H. M., & Greene, P. G. (2011). Entrepreneurship education: Known worlds and new frontiers. *Journal of Small Business Management*, 49(1), 55–70. <https://doi.org/10.1111/j.1540-627x.2010.00314.x>
- Neck, H. M., Greene, P. G., & Brush, C. G. (Eds), (2014). *Teaching entrepreneurship: A practice-based approach*. Edward Elgar Publishing.
- Newbery, R., Lean, J., & Moizer, J. (2016). Evaluating the impact of serious games: The effect of gaming on entrepreneurial intent. *Information Technology & People*, 29(4), 733–749. <https://doi.org/10.1108/itp-05-2015-0111>
- Padilla-Angulo, L. (2019). Student associations and entrepreneurial intentions. *Studies in Higher Education*, 44(1), 45–58. <https://doi.org/10.1080/03075079.2017.1336215>

- Passaro, R., Quinto, I., & Thomas, A. (2017). Start-up competitions as learning environment to foster the entrepreneurial process. *International Journal of Entrepreneurial Behavior & Research*, 23(3), 426–445. <https://doi.org/10.1108/ijebr-01-2016-0007>
- Passila, A., Oikarinen, T., & Vince, R. (2012). The role of reflection, reflection on roles: Practice-based innovation through theatre-based learning. *Practice-based innovation: Insights, applications and policy implications: Understanding practice-based innovation and its policy implications* (pp. 173–191).
- Pittaway, L., Brush, C., Corbett, A. C., & Tantawy, M. M. (2023). *Doctoral programs in entrepreneurship: Building cognitive apprenticeships*. Entrepreneurship Education and Pedagogy.
- Pittaway, L., & Cope, J. (2007). Simulating entrepreneurial learning: Integrating experiential and collaborative approaches to learning. *Management Learning*, 38(2), 211–233. <https://doi.org/10.1177/1350507607075776>
- Pittaway, L., & Edwards, C. (2012). Assessment: Examining practice in entrepreneurship education. *Education + Training*, 54(8), 778–800. <https://doi.org/10.1108/00400911211274882>
- Pittaway, L., Rodriguez-Falcon, E., Aiyegbayo, O., & King, A. (2011). The role of entrepreneurship clubs and societies in entrepreneurial learning. *International Small Business Journal: Researching Entrepreneurship*, 29(1), 37–57. <https://doi.org/10.1177/0266242610369876>
- Pittaway, L. A., Gazzard, J., Shore, A., & Williamson, T. (2015). Student clubs: Experiences in entrepreneurial learning. *Entrepreneurship & Regional Development*, 27(3–4), 127–153. <https://doi.org/10.1080/08985626.2015.1014865>
- Pocek, J., Politis, D., & Gabrielsson, J. (2021). Entrepreneurial learning in extra-curricular start-up programs for students. *International Journal of Entrepreneurial Behavior & Research*, 28(2), 325–345. <https://doi.org/10.1108/ijebr-04-2020-0206>
- Politis, D. (2005). The process of entrepreneurial learning: A conceptual framework. *Entrepreneurship theory and practice*, 29(4), 399–424. <https://doi.org/10.1111/j.1540-6520.2005.00091.x>
- Politis, D., Gabrielsson, J., Galan, N., & Abebe, S. A. (2019). *Entrepreneurial learning in venture acceleration programs*. The Learning Organization.
- Preedy, S., & Jones, P. (2015). An investigation into university extra-curricular enterprise support provision. *Education + Training*, 57(8/9), 992–1008. <https://doi.org/10.1108/et-04-2015-0025>
- Preedy, S., & Jones, P. (2017). Student-led enterprise groups and entrepreneurial learning: A UK perspective. *Industry and Higher Education*, 31(2), 101–112. <https://doi.org/10.1177/0950422216689349>
- Preedy, S., Jones, P., Maas, G., & Duckett, H. (2020). Examining the perceived value of extracurricular enterprise activities in relation to entrepreneurial learning processes. *Journal of Small Business and Enterprise Development*, 27(7), 1085–1105. <https://doi.org/10.1108/jsbed-12-2019-0408>

- QAA (2018). Enterprise and entrepreneurship: Guidance for UK higher education providers. [www.qaa.ac.uk/en/Publications/Documents/Enterprise-and-entrepreneurship-education-2018.pdf](http://www.qaa.ac.uk/en/Publications/Documents/Enterprise-and-entrepreneurship-education-2018.pdf)
- Rae, D. (2002). A narrative study of entrepreneurial learning in independently owned media businesses. *The International Journal of Entrepreneurship and Innovation*, 3(1), 53–59. <https://doi.org/10.5367/000000002101299042>
- Rae, D. (2007). Connecting enterprise and graduate employability: Challenges to the higher education culture and curriculum? *Education + Training*, 49(8/9), 605–619. <https://doi.org/10.1108/00400910710834049>
- Rae, D., & Carswell, M. (2000). Using a life-story approach in researching entrepreneurial learning: The development of a conceptual model and its implications in the design of learning experiences. *Education + Training*, 42(4/5), 220–228. <https://doi.org/10.1108/00400910010373660>
- Rae, D., Martin, L., Antcliff, V., & Hannon, P. (2012). Enterprise and entrepreneurship in English higher education: 2010 and beyond. *Journal of Small Business and Enterprise Development*, 19(3), 380–401. <https://doi.org/10.1108/14626001211250090>
- Reuber, A. R., & Fischer, E. (1999). Understanding the consequences of founders' experience. *Journal of Small Business Management*, 37(2), 30.
- Rice, P. L., & Ezzy, D. (1999). *Qualitative research methods: A health focus*.
- Rigg, C., & O'Dwyer, B. (2012). Becoming an entrepreneur: Researching the role of mentors in identity construction. *Education + Training*, 54(4), 319–329. <https://doi.org/10.1108/00400911211236181>
- Ritchie, J., & Spencer, L. (2002). Qualitative data analysis for applied policy research. *Analyzing qualitative data* (pp. 187–208). Routledge.
- Robinson, O. C. (2014). Sampling in interview-based qualitative research: A theoretical and practical guide. *Qualitative Research in Psychology*, 11(1), 25–41. <https://doi.org/10.1080/14780887.2013.801543>
- Robinson, S., Neergaard, H., Tanggaard, L., & Krueger, N. F. (2016). New horizons in entrepreneurship education: From teacher-led to student-centered learning. *Education + Training*, 58(7/8), 661–683. <https://doi.org/10.1108/et-03-2016-0048>
- Russell, R., Atchison, M., & Brooks, R. (2008). Business plan competitions in tertiary institutions: Encouraging entrepreneurship education. *Journal of Higher Education Policy and Management*, 30(2), 123–138. <https://doi.org/10.1080/13600800801938739>
- Schwartz, M., Goethner, M., Michelsen, C., & Waldmann, N. (2013). Start-up competitions as an instrument of entrepreneurship policy: The German experience. *European Planning Studies*, 21(10), 1578–1597. <https://doi.org/10.1080/09654313.2012.722960>
- Shirokova, G., Osiyevskyy, O., Morris, M. H., & Bogatyreva, K. (2017). Expertise, university infrastructure and approaches to new venture creation: Assessing students who start businesses. *Entrepreneurship & Regional Development*, 29(9–10), 912–944. <https://doi.org/10.1080/08985626.2017.1376516>
- Simons, L., Fehr, L., Blank, N., Connell, H., Georganas, D., Fernandez, D., & Peterson, V. (2012). Lessons learned from experiential learning: What do students learn from a

- practicum/internship? *International Journal of Teaching and Learning in Higher Education*, 24(3), 325–334.
- Smith, K. (2015). Measuring the impact of enterprise education and entrepreneurship support in higher education: Can routinely collected data be of use? *Industry and Higher Education*, 29(6), 493–503. <https://doi.org/10.5367/ihe.2015.0283>
- Souitaris, V., Zerbinati, S., & Al-Laham, A. (2007). Do entrepreneurship programmes raise entrepreneurial intention of science and engineering students? The effect of learning, inspiration and resources. *Journal of Business Venturing*, 22(4), 566–591. <https://doi.org/10.1016/j.jbusvent.2006.05.002>
- Spigel, B. (2017). The relational organization of entrepreneurial ecosystems. *Entrepreneurship theory and practice*, 41(1), 49–72. <https://doi.org/10.1111/etap.12167>
- Spinuzzi, C. (2012). Working alone together: Coworking as emergent collaborative activity. *Journal of Business and Technical Communication*, 26(4), 399–441. <https://doi.org/10.1177/1050651912444070>
- Stolz, L., & Sternberg, R. (2022). Do the winners really take it all? Exploring entrepreneurial learning in start-up competitions. *Entrepreneurship Education and Pedagogy*, 5(4), 599–626. <https://doi.org/10.1177/25151274211068191>
- Strauss, A. L., & Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (2nd ed.). London: Sage.
- Suri, H. (2011). Purposeful sampling in qualitative research synthesis. *Qualitative Research Journal*, 11(2), 63–75. <https://doi.org/10.3316/qrj1102063>
- Sykes, W. (1990). Validity and reliability in qualitative market research: A review of the literature. *Journal of the Market Research Society*, 32(3), 289–328.
- Szymanska, I., Sesti, T., Motley, H., & Puia, G. (2020). The effects of hackathons on the entrepreneurial skillset and perceived self-efficacy as factors shaping entrepreneurial intentions. *Administrative Sciences*, 10(3), 73. <https://doi.org/10.3390/admsci10030073>
- Toutain, O., Fayolle, A., Pittaway, L., & Politis, D. (2017). Role and impact of the environment on entrepreneurial learning. *Entrepreneurship & Regional Development*, 29(9–10), 869–888. <https://doi.org/10.1080/08985626.2017.1376517>
- Tunstall, R., & Neergaard, H. (2022). Flashmob: A heutagogical tool for social learning in entrepreneurship education. *Entrepreneurship Education and Pedagogy*, 5(3), 472–492. <https://doi.org/10.1177/25151274211017547>
- Vanevenhoven, J., & Drago, W. A. (2015). The structure and scope of entrepreneurship programs in higher education around the world. *Entrepreneurial learning* (pp. 117–133). Routledge.
- van Gelderen, M., Wiklund, J., & McMullen, J. S. (2021). Entrepreneurship in the future: A Delphi study of etp and JBV editorial board members. *Entrepreneurship Theory and Practice*, 45(5), 1239–1275. <https://doi.org/10.1177/10422587211010503>
- Walmsley, A., Thomas, R., & Jameson, S. (2006). Surprise and sense making: Undergraduate placement experiences in SMEs. *Education + Training*, 48(5), 360–372. <https://doi.org/10.1108/00400910610677063>
- Wenger, E. (1998). Communities of practice: Learning as a social system. *Systems thinker*, 9(5), 2–3.
- Wenger, E. (2011). *Communities of practice: A brief introduction*.

- Wenger, E. C. (1990). *Toward a theory of cultural transparency: Elements of a social discourse of the visible and the invisible*. University of California.
- Wenninger, H. (2019). Student assessment of venture creation courses in entrepreneurship higher education—an interdisciplinary literature review and practical case analysis. *Entrepreneurship Education and Pedagogy*, 2(1), 58–81. <https://doi.org/10.1177/2515127418816277>
- Williams Middleton, K., Padilla-Melendez, A., Lockett, N., Quesada-Pallarès, C., & Jack, S. (2020). The university as an entrepreneurial learning space: The role of socialized learning in developing entrepreneurial competence. *International Journal of Entrepreneurial Behavior & Research*, 26(5), 887–909. <https://doi.org/10.1108/ijebr-04-2018-0263>
- Wilson, K. E., Vyakarnam, S., Volkman, C., Mariotti, S., & Rabuzzi, D. (2009). Educating the next wave of entrepreneurs: Unlocking entrepreneurial capabilities to meet the global challenges of the 21st century. *World economic forum: A report of the global education initiative*.
- Winkler, C., Saltzman, E., & Yang, S. (2018). Improvement of practice in entrepreneurship education through action research: The case of coworking at a nonresidential college. *Entrepreneurship Education and Pedagogy*, 1(2), 139–165. <https://doi.org/10.1177/2515127418773410>
- Woiceshyn, J., & Daellenbach, U. (2018). Evaluating inductive vs deductive research in management studies: Implications for authors, editors, and reviewers. *Qualitative Research in Organizations and Management: An International Journal*, 13(2), 183–195. <https://doi.org/10.1108/qrom-06-2017-1538>
- Wraae, B., & Thomsen, J. (2019). Introducing a new framework for understanding learning in an entrepreneurship education ecosystem. *Journal of Higher Education Theory and Practice*, 19(2), 170–184.
- Yi, S., & Duval-Couetil, N. (2021). Interdisciplinary entrepreneurship education: Exploring 10-year trends in student enrollment, interest and motivation. *Entrepreneurship Education and Pedagogy*, 4(2), 100–118. <https://doi.org/10.1177/2515127420979195>
- Yin, R. K. (2015). *Qualitative research from start to finish*. Guilford publications.
- Zahra, S. A., Newey, L. R., & Shaver, J. M. (2011). Academic advisory boards' contributions to education and learning: Lessons from entrepreneurship centers. *Academy of Management Learning & Education*, 10(1), 113–129. <https://doi.org/10.5465/amle.10.1.zqr113>

**Publication II**

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## **The impact of educational technologies on entrepreneurial competencies: A systematic review of empirical evidence**

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**Abstract:** Researchers and educators have been exploring innovative methods in entrepreneurship education to address traditional approach failure at engaging students and developing their skills. Educational technology has shown promising results in early studies. Yet, there is a scarcity of reviews on their effectiveness in developing entrepreneurial competencies. This paper systematically reviews the empirical literature on the outcomes of educational technology used to teach entrepreneurship at higher education institutions. From an initial 316 search hits, 26 articles were selected for in-depth review. The learning outcomes were translated into entrepreneurial competencies, using the EntreComp Framework as a reference. Findings show that educational technologies, in general, positively impacted entrepreneurial competencies, especially financial & economic literacy, motivation & perseverance, and initiative taking. Gaming and simulations were the most researched, having an overall positive influence, while online learning and MOOCs showed limited and sometimes contradictory effects. The study fills the scholarly gap by connecting educational technology, entrepreneurship education, and entrepreneurial competencies. It provides a basic mapping linking each educational technology to the competencies it develops and advocates for a competency-based pedagogy in the delivery and assessment of entrepreneurship education. Educators can apply the findings and the mapping developed in this study to design and deliver entrepreneurship courses, incorporating educational technologies more insightfully and effectively in their pedagogies.

**Keywords:** Entrepreneurship education; Educational technology; Competency-based education; Systematic review; Entrepreneurial competency

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## 1. Introduction

Entrepreneurship and entrepreneurship education (EE) are linked to socio-economic development (Kuratko, 2011; Ligthelm, 2007; Mojica et al., 2010; Pacheco et al., 2010). EE delivered through higher education institutions (HEI) is valued for shaping students' entrepreneurial mindsets and behaviors (Ploum et al., 2018). However, traditional approaches to EE fail to engage students and nurture their practical skills to a satisfactory level (Gibb, 2002; Neck & Greene, 2011). Hence, in recent years, the use of more innovative methods based on experiential and practical approaches is increasingly being adopted as complementary tools (Ferreira et al., 2018). Researchers have thus called for more studies on reviewing the application and effectiveness of these new methods (Bonesso et al., 2018; Sirelkhatim & Gangi, 2015) to help guide educators work, with Fellnhofner (2019) suggesting that future research on EE pedagogies should focus on the "How?" rather than "What?".

Educational technologies (ET) are among those innovative methods. They refer to digital artefacts used in teaching to achieve desired learning outcomes (LO). They are regarded as a transformative impetus that can improve the effectiveness and efficiency of education (Papadakis et al., 2017). Their adoption was further hastened with the rapid shift to remote learning during COVID-19 (Ellyton et al., 2022) and the emergence of Generative AI as an educational tool (Hammada, 2024a), making learning more convenient to the digitally savvy generations (Ratten & Jones, 2023).

ET can enhance the practice-based aspects of EE (Hammada, 2024b; Schou et al., 2022; Winkler et al., 2023). Educators and researchers are trying, however, to find an effective approach to incorporate them into pedagogies (Ratten & Usmanij, 2021). This mapping exercise is becoming a necessity, as technology is expected to dominate EE in the near future (Ratten & Usmanij, 2021). A major obstacle is our limited understanding of how the LO can be identified as competencies (Harden, 2002), especially when applying ET in EE (Antonaci et al., 2015). The competency-based approach is indeed argued to be more suitable in assessing the effectiveness of EE, compared to socio-economic factors which predominate scholarly discussions (Nabi et al., 2017; Neck & Greene, 2011). Nonetheless, current reviews on this topic are scarce. Those available had either referred to it marginally as part of a wider pedagogical review (e.g., Rashid, 2019; Secundo et al., 2020), or focused on a narrow set of ET (e.g., Chen et al., 2021; Lin & Sekiguchi, 2020).

This paper fills our scholarly gap by reviewing empirical articles on the impact of the different types of ET when applied in EE within HEIs, using a systematic literature review methodology. It synthesizes the identified LO in those studies into entrepreneurial competencies (EC) using the EntreComp framework as a reference tool. EntreComp, which was developed by the European Commission in 2016, is a modular framework that exhibits essential EC and is widely adopted in entrepreneurship research and teaching (Bacigalupo et al., 2016). The following research question is pursued in this paper: How does the application of educational technologies in entrepreneurship education affect the development of entrepreneurial competencies among HEIs students?. Put simply, we aim to find whether educational technologies had a positive or negative impact on the development of the different entrepreneurial competencies of the students and to what extent.

The resultant map of the competencies developed by each ET is the main contribution of this study. It can be used as a basic model for EE researchers and educators to build upon in their studies and apply it in their classrooms for better integration of ET in

their curricula and to evaluate their students' progress. It hence contributes to advocating competency-based education as a suitable pedagogical approach in EE and contributes to the scarce research in this area. The paper is structured as follows: in the next section, we review relevant literature on entrepreneurship education and competencies, and educational technologies applications. We then explain the methodology of our systematic review. Afterwards, we report and discuss the descriptive findings and the competencies developed by each ET in the reviewed articles. Finally, we conclude by highlighting the implications, and limitations and indicate areas for future research focus.

## 2. Literature review

### 2.1. Entrepreneurship education

Entrepreneurship education can be defined as “*any pedagogical program or process of education for entrepreneurial attitudes and skills, which involve developing certain personal qualities.*” (Fayolle, 2006). In the last two decades, entrepreneurship courses have spread across most levels and disciplines at HEIs (Sousa et al., 2019), with pedagogical approaches and populations becoming highly diverse (Rideout & Gray, 2013). Hence, several scholars (e.g., Loi & Fayolle, 2021; Pittaway & Cope, 2007) argued for the need to review the fragmented literature on EE methods, with a special focus on their outcomes (Rashid, 2019).

EE methods can be classified into traditional, such as lectures and reading materials, which were found not suitable for the dynamic nature of entrepreneurship (Huebscher & Lendner, 2010; Mwasalwiba, 2010) and active/experiential approaches that use case studies, educational technologies, and extra-curricular activities (Kuratko & Morris, 2018). The latter has witnessed increasing adoption of HEIs to engage younger generations and operationalize EE (Fayolle et al., 2006; Kasurinen & Knutas, 2018). According to Jones and Colwill (2013), the choice of teaching style and method should relate to the nature of the learners. Given that the newer generations are naturally digitally savvy, using ET can elicit better adoption, facilitate EE delivery, and improve LO (Neergaard & Christensen, 2017). Moreover, ET which involves active learning techniques can help instill core entrepreneurial and business skills in students (Klapper & Tegmeier, 2010).

### 2.2. Educational technology

Technology has become a constant in every aspect of life (Vorbach et al., 2019), and the education sector is no different, with technology becoming a core component of educational reforms (Mavlutova et al., 2020; Papadakis et al., 2017). These reforms can incrementally improve the quality and feasibility of education (Hammoda, 2024; Papadakis et al., 2017), with wide-spread digitalization expected to offer unlimited opportunities to improve the educational and learning process (Mavlutova et al., 2020). Educational technology is defined as the facilitation of learning by the application of technology (Januszewski & Molenda, 2013). Their propagated application in recent years has increased the attractiveness of the education system as it improved students' engagement and allowed them to have better access and flexibility in their learning journey (Gianesini et al., 2018; Qureshi et al., 2021; Winter & Hammoda, 2024). ET is particularly relevant to new generations who are adept at technology and hence brings a sense of familiarity to

them and contributes to a student-centered approach (Oyelere et al., 2016), which was proven to better develop learners' competencies (Wu et al., 2018). Tretyakova et al. (2021) predict that HEIs will become heavily reliant on ET in the near future.

Educational technology can play a key role in the evolution and promotion of EE towards stronger economic and societal impact (Ratten & Jones, 2021). They are introduced in EE curricula to augment the learning experience of the students, increase the appeal of EE especially among younger generations, and improve the learning outcomes. Indeed, ET is argued to improve entrepreneurial competencies and mindset (Chen et al., 2021; Fayolle, 2013), with recent years witnessing an increasing use of various ET in business and entrepreneurship education (Chen et al., 2021). These include gaming and simulations (Chaudhary, 2008), virtual and augmented reality (Papadakis et al., 2020), multimedia (Wu et al., 2018), big data and related technologies (Mavlutova et al., 2020). Moreover, they allow for more efficient student-centered learning through personalization of content and the learning process. Hence, enhancing its convenience and the engagement of the students (Cooper, 2007; Wu et al., 2018; Tretyakova et al., 2021). However, there are several challenges hindering the propagation of ET in EE. These include institutional support, financial costs, training of entrepreneurship educators, application among larger classes, educational oversights, and required technological and physical infrastructure (Hammada, 2024).

However, research on the application of ET in EE is still in its infancy (Lin & Sekiguchi, 2020; Rashid, 2019), with scholars calling for better exploration of this nexus (Ratten & Jones, 2021). This can provide a better understanding of the intricacies of applying innovative technologies in EE (Fellnhofner, 2019), and propagate best practices (Nixon et al., 2018). In addition, there is a lack of reviews on the outcomes of the different technology-based methods in EE (Chen et al., 2021).

### *2.2.1. Previous reviews of educational technology in entrepreneurship education*

A few reviews have examined the intersection of ET and EE. Two of these reviews marginally touched on the application of ET in EE as part of a wider scope, yet their conclusions support the argument for conducting this study. The first is Secundo et al. (2020), who explored the ascending role of ET in academic entrepreneurship. In their review, they mention examples of technologies such as augmented reality, additive manufacturing, and social networks that are revolutionizing several aspects of the educational process. They put the applications of ET in EE as a top avenue for future research in this field. Moreover, Rashid (2019) in his review of the role of EE in promoting sustainable development goals, argues that some of the available technologies (e.g., learning management systems (LMS), mobile platforms, and serious games) can help develop certain EC that traditional EE methods fell short of addressing such as creativity, problem-solving skills, cooperation, and teamwork.

Two other reviews were more focused on the role of ET in EE. The first is Lin and Sekiguchi's systematic review of e-learning in EE (2020). Although they only reviewed EE in online settings, their findings and conclusions warrant attention. Their most salient remark is the clear insufficiency of research in this area, as they identified 41 articles only over a 20-year period (2000-2020). The second review was conducted by Chen et al. (2021). They covered a broader scope of ET used in online and blended EE settings and organized the 38 articles they reviewed into three categories: games, social media, and MOOCs. They stated that each technology has its merits and its challenges, thus it is up to the educator to

decide which technology to use and for what purpose. Both studies called for more reviews on the utilization and effectiveness of ET in EE, which aligns with Fayolle’s earlier remarks (2013) on the absence of systematic reviews in this area.

### 2.3. Competency-based entrepreneurship education

Competency-based education is an outcome-based approach that orchestrates the different pedagogical approaches and activities to equip students with the intended skills, knowledge, and attitudes to achieve the desired LO (Gervais, 2016; Morris et al., 2013). Entrepreneurs need to acquire and apply a set of competencies in their quest to transform opportunities into viable businesses (Vestergaard et al., 2012), with EE regarded as a key enabler in developing them (Morris et al., 2013).

Identifying a concrete set of EC, however, has been difficult due to the variety of settings, types, and understandings of the field of entrepreneurship. Hence, in recent years an EU-commissioned team of researchers managed to identify a set essential EC through a rigorous review of literature and a series of experts’ consultations. They developed the Entrepreneurship Competency Framework, also known as EntreComp, as a basic framework that can be adapted and leveraged by individuals and organizations for skills development, innovation, and venture creation (Bacigalupo et al., 2016). The EntreComp is made up of three competency areas: ‘*Ideas and opportunities*’, ‘*Resources*’ and ‘*Into action*’ (see Fig. 1), with a total of 15 competencies across them (ibid). In recent years, it has become the most established competency framework in entrepreneurship research, education, and its assessment (López-Núñez et al., 2022; Morselli & Gorenc, 2022). It is especially relevant in educational settings as a measure of the generic LO (European Commission, 2016).

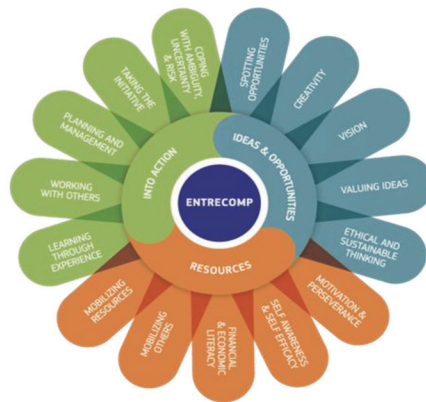


Fig. 1. EntreComp framework, Adapted from Bacigalupo et al. (2016)

Several scholars called for the adoption of more formative measures to assess EE outcomes, rather than socio-economic factors such as startup rates, with EC regarded as more suitable for a comprehensive assessment of EE contributions (Glackin & Phelan, 2020; Nabi et al., 2017; Neergaard & Christensen, 2017). This aligns with ongoing reforms to promote competency-based approaches in HEIs, especially in EE programmes (Glackin & Phelan, 2020), as it equips students with transformative skills and competencies that they can use in different personal, career, and social contexts (Bacigalupo et al., 2016; Fayolle et al., 2006).

### **3. Methods**

The study employed a systematic literature review which is typically used to analyse state-of-the-art research on a given topic (Massaro et al., 2016; Petticrew & Roberts, 2006; Rauch, 2020). It is often conducted in entrepreneurship research (Tranfield et al., 2003) and helps guide future research efforts (Denyer & Tranfield, 2009). We followed Jesson et al. (2011) six steps approach to systematic reviews, which are: 1) Mapping the field through a scoping review, 2) Comprehensive search, 3) Quality assessment, by reading and selecting qualified papers, 4) Data extraction, by collecting needed data from reviewed papers and storing them in an excel sheet with predetermined columns, 5) Synthesis of the extracted data to show the known and to provide the basis for establishing the unknown, and 6) Write-up.

The author, together with a research assistant, first discussed and agreed upon the database, search keywords, inclusion, and exclusion criteria. These were selected to fulfill the purpose of the study in critically assessing the empirical literature investigating the impact of ET on LO when used for EE at HEIs. An Excel sheet was produced and used in analysing the articles with specific criteria (columns) mirroring our research interests. We primarily relied on the Scopus database as it has the largest coverage in social sciences (Mishra et al., 2017; Rew, 2020; Thelwall, 2018; Waltman, 2016). The search keywords were synthesized from previous literature reviews in this area (e.g., Chen et al., 2021; Lin & Sekiguchi, 2020) and expanded to include more educational technologies (Hammada, 2024).

The initial search generated 316 hits. These were articles published anytime until 30 June 2023. A review of the title, abstract and in some cases in-depth reading of other sections was needed to keep only articles that are relevant to the purpose of our study. The inclusion criteria were empirical journal articles, that went through a peer review process as it assures quality and validity (Podsakoff et al., 2005), with the sample being students in HEIs across any discipline, educational level, or geography, and a focus on reporting LO of applying ET in EE. We excluded conference publications, book chapters, and conceptual and review papers. We also excluded papers with a different focus beyond the purpose of this research, such as those addressing established entrepreneurs or investigating the impact on educators and the institution; focusing on the technology design or adoption rates and not the learning outcomes; or reporting on nonspecific learning outcomes. After incorporating the inclusion and exclusion criteria, a final count of 26 scientific articles was chosen for the in-depth analysis. The search string and the search process are depicted in Fig. 2.

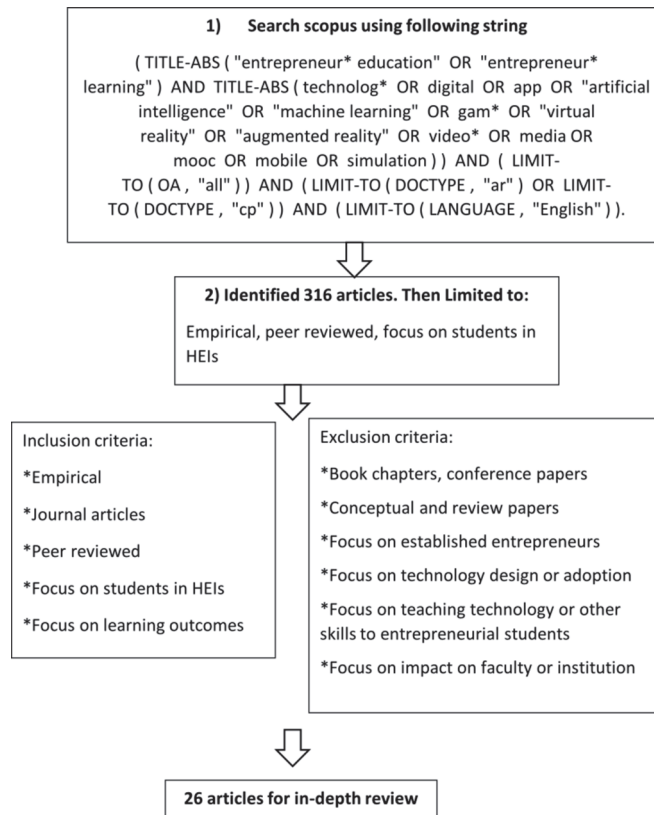


Fig. 2. Systematic review stages

We collected descriptive data on the geography, journals, publication years, theories, research methods, and technologies. The focus of the analysis, however, was on the reported learning outcomes to answer our main research question. These were extracted from the findings and discussion sections in those papers and translated into the corresponding competencies as exhibited in the EntreComp framework (Bacigalupo et al., 2016). This was done by the author and reviewed by the research assistant, following a thematic analysis approach (Neuendorf, 2018). The similarity was 92.6% (150 out of 162 translations) and for the debated translations (N = 12), we discussed between us and reached a consensus. The above-mentioned methodology allowed us to review and present the state of the art on ET (Levy & Ellis, 2006) and their entrepreneurial learning outcomes, and develop a body of validated knowledge to guide EE research and practice.



## 4. Results

In the descriptive part of our findings (see Table 1), we provide details with regard to the name of the journals, including their primary focus, the year of publication, and the geographical location of the study. We also account for the used theories, methodological approaches, and the ET investigated in each of them. We then expound on ET outcomes by mapping the technologies in those articles to the entrepreneurial competencies they influenced, as the main contribution of this paper.

### 4.1. Descriptive findings

The empirical research on the role of ET in developing EC among HEI entrepreneurial students is clearly fragmented with the 26 articles spread across 20 different journals in various fields. Surprisingly, the most popular outlets were *Frontiers in Psychology* ( $N = 5$ ) and *Sustainability* ( $N = 3$ ), which are not primarily focused on entrepreneurship or education. The field of study is a nascent one indeed, with most studies appearing in the last 5 years only (22 out of 26 articles). Moreover, to address the specific research question, we limited our sample to those articles that reported clearly on the learning outcomes of applied educational technologies. Hence, the relatively small number of articles in our sample which is not uncommon in this niche (see Chen et al., 2021; Lin & Sekiguchi, 2020; Secundo et al., 2020) or in specific phenomena in education (Bendermacher et al., 2017). However, a few pioneering studies emerged more than 10 years ago (Cooper, 2007; Huebscher & Lendner, 2010), although their work was based on desktop-based technologies that were the standard then. The 26 investigated articles were conducted in 19 different countries: 11 in Europe, 6 in Asia and 2 in North America. Only one research (Mavlutova et al., 2020), was conducted across several countries: Lithuania, Latvia, Italy, Belgium, and Portugal.

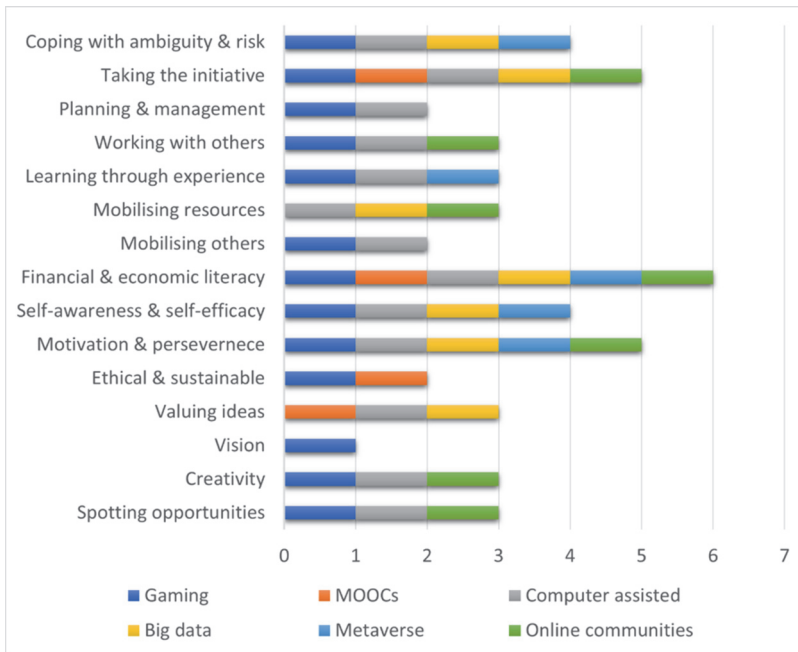
The most utilized theoretical framework was that of the planned behavior of Ajzen (1991). It was used in several studies including Bandera et al. (2018); Dabbous and Boustani (2023); Dong and Tu (2021); Isabelle (2020); and Newbery et al. (2016). Other theories were applied seldomly such as uses and gratification, experiential learning, constructivist learning, and UTAUT. Several studies, however, did not rely on an established theoretical model. Most of the reviewed papers adopted a quantitative approach via closed-ended questionnaires (19 out of 26), with multiple studies applying an experimental approach with pre- and post-test questionnaires. A few articles employed a mixed-method approach or qualitative-only methods.

### 4.2. Educational technologies and their impact on learning outcomes and entrepreneurial competencies

Through the studied papers, several technologies were used to enhance the delivery of EE to students. We grouped them into seven categories based on the nature and the use of each of them (gaming and simulation, big data such as Artificial Intelligence and machine learning, massive open online courses, computer-assisted tools, virtual and augmented realities, and online communities). Although some studies combined multiple modalities, we assigned them to the technology group that chiefly impacted students' competencies. We then reviewed the LO in the findings and discussion sections of each of the articles and mapped them against the EC and their description as listed on the *EntreComp* (Bacigalupo et al., 2016). The EC impacted by each of the ETs is demonstrated in Fig. 3.

**Table 1**  
Overview of the reviewed articles

Articles	Journal	Geography	Main theoretical model	Main technology group
Ahsan and Faletehan (2021)	Cakrawala Pendidikan	Indonesia	N/A	Simulation & gaming
Bandera et al. (2018)	International Journal of Management Education	US	Theory of Planned Behavior	Online communities & online education
Chen and Yu (2020)	Frontiers in Psychology	China	Personality Development Theory	AI & ML
Chen et al. (2022)	Frontiers in Psychology	China	N/A	Simulation & gaming
Cooper (2007)	Active Learning in Higher Education	UK	N/A	Computer-assisted & multimedia
Dabbous and Boustani (2023)	Journal of Risk and Financial Management	Lebanon	Theory of Planned Behavior	AI & ML
Dong and Tu (2021)	Mathematical Problems in Engineering	Thailand	Theory of Planned Behavior	Virtual & augmented realities
Grivokostopoulou et al. (2019)	Sustainability	Greece	Self-determination Theory	Simulation & gaming; Virtual & augmented realities
Huebscher and Lendner (2010)	Journal of Small Business and Entrepreneurship	Germany	Constructivist Learning	Simulation & gaming
Isabelle (2020)	Decision Sciences Journal of Innovative Education	Canada	Theory of Planned Behavior	Simulation & gaming
Kang and Lee (2020)	Education and Information Technologies	Korea	Project-based Learning	Computer assisted & multimedia
Kriz and Auchter (2016)	Simulation and Gaming	Germany	Logic Model	Simulation & gaming
Lyons et al. (2023)	Education + Training	Ireland	N/A	Simulation & gaming
Mavlutova et al. (2020)	WSEAS Transactions on Environment and Development	Latvia, Lithuania, Belgium, Italy and Portugal	N/A	AI & ML
Newbery et al. (2016)	Information Technology and People	UK	Theory of Planned Behaviour	Simulation & gaming
Oliver and Oliver (2022)	Industry & Higher Education	UK	Experiential Learning	Online education
Park and Kim (2023)	Sustainability	Korea	N/A	Simulation & gaming
Pratikto et al. (2021)	International Journal of Interactive Mobile Technologies	Indonesia	Design thinking	Simulation & gaming
Samašonok et al. (2020)	Entrepreneurship and Sustainability Issues	Lithuania	N/A	Simulation & gaming
Vorbach et al. (2019)	International Journal of Engineering Pedagogy	Switzerland	N/A	MOOCs
Widjaja et al. (2022)	Entrepreneurial Business and Economics Review	Indonesia	UTAUT	Online education
Wu et al. (2018)	Sustainability	Taiwan	N/A	Computer assisted & multimedia
Wu et al. (2019)	Frontiers in Psychology	Taiwan	Affective domain	MOOCs
Wu and Song (2019)	Frontiers in Psychology	China	Uses and gratification theory	Online communities
Yang et al. (2022)	Frontiers in Psychology	China	Learning Process 3P model <sup>9</sup>	Simulation & gaming
Zuo et al. (2021)	International Journal of Emerging Technologies in Learning	Russia	N/A	MOOCs



**Fig. 3.** Entrepreneurial competencies that educational technologies helped develop

#### 4.2.1. Gaming and simulations

In our analysis, gaming and simulation were the most studied technology group (12 out of 26 articles), with some delivered on desktops and centrally administered (e.g., Huebscher & Lendner, 2010), while the rest delivered through mobile platforms (e.g., Pratikto et al., 2021) or virtual reality environment (e.g., Grivokostopoulou et al., 2019). Simulations were found to have the most positive impact on developing most of the ECs, especially “*planning & management*”, “*financial & economic literacy*” and “*working with others*”.

For example, Huebscher & Lendner (2010) surveyed more than 2,000 entrepreneurship students involved in gaming seminars over 5 years in Germany and found that it helped them understand economics, strategy and marketing, work in a team, and practice business planning and management. Ahsan & Faletehan (2021) found coinciding results when surveying hundreds of undergraduate university students over 9 years. Game-based EE helped them acquire entrepreneurial knowledge, better communicate with others, and perform business processes. In the same vein, Lyons et al. (2023) conducted two separate case studies using a digital enterprise module among first-year students and found it to significantly improve their engagement and motivation. It also helped them understand different entrepreneurial topics, and improve their digital, innovation, and communication skills. Grivokostopoulou et al., (2019) found that game-based learning helped students acquire financial and management concepts in their experiment with 86 university students. Pratikto et al. (2021) ran a posttest among vocational students, after using a design thinking

approach to develop serious game requirements. They found that it helped them understand business concepts such as market analysis, operating costs, pricing, and profitability. Chen et al. (2022) conducted a quasi-experimental study with the TOP-BOSS simulation software and found it to positively influence entrepreneurial orientation and self-efficacy. Similarly, Park and Kim (2023), ran an experiment with 30 students and reported that the gaming experience improved their intention, self-determination, and self-efficacy. Yang et al. (2022) surveyed students after an entrepreneurship course at Zhongshan Institute, China and found that simulations helped students develop self-efficacy and teamwork skills. Furthermore, Samašonok et al. (2020) surveyed university students to investigate the efficiency conditions and possibilities of using business simulations in EE and found that it helped them with spotting opportunities to start a business, perform tasks creatively, get acquainted with enterprise operations, and learn through practical environments.

However, business simulations were shown by some other authors to have contradictory impacts on “*motivation*” and “*self-efficacy*”, which coincides with similar findings in the literature on game-based learning (El Mawas et al., 2022). Newbery et al. (2016) ran a quasi-experiment with questionnaires distributed to 263 first-year university students from business and management discipline. They found it to negatively impact their entrepreneurial intentions, although not significantly. Also, Kriz and Aucher (2016) carried out an online survey to measure the long-term effects of simulation-based startup seminars (EXIST priME Cup) in Germany. Although it had a positive impact on business knowledge and planning competencies, it showed conflicting results when it came to motivation and entrepreneurial intent.

#### 4.2.2. Artificial intelligence and machine learning

Big data technologies such as Artificial Intelligence (AI) and Machine Learning (ML), were of special value in testing students’ entrepreneurial ideas, providing recommendations for partners’ and investors’ selection, performing market analysis and evaluating business plans. Thus, helping to-be entrepreneurs develop several competencies including “*self-awareness & self-efficacy*”, “*valuing ideas*”, “*financial & economic literacy*” and “*mobilizing resources*”. Mavlutova et al. (2020) surveyed 947 undergraduate and master’s students from five European countries mainly, after using AI-supported software to assess and improve their startup ideas. They found that it helped assess the innovativeness, viability, and competitiveness of business ideas; analyse students’ personal characteristics and abilities as potential entrepreneurs; examine their business plans; and recommend resources, partnerships; provide incorporation advice; and assess risks and potential mitigation plans. Additionally, Chen and Yu (2020) ran an experiment with 518 entrepreneurship psychology university students leveraging deep neural networks and found it to improve intentions, resilience, optimism, and mental strength. Moreover, Dabbous and Boustani (2023), surveyed 233 postgraduate business students in a university in Lebanon, and found AI to have a positive impact, although indirect, on entrepreneurial intention and self-efficacy.

#### 4.2.3. MOOCs

Learning through MOOCs was convenient to the students and helped develop knowledge-based competencies such as “*financial & economic literacy*” and “*ethical and sustainable thinking*”, “*motivations*”, and “*initiative taking*”. For example, Zuo et al. (2021) surveyed

205 undergraduate students, in the pre and post-implementation of MOOC courses in EE and found it to improve intentions and rates of starting a business. Wu et al. (2019) ran a thematic content analysis of MOOC course feedback and used it to compare the learning performance of students participating in a 9-week blended social entrepreneurship program. They found that students made improved ethical judgements and understood basic business concepts and operations better. Vorbach et al. (2019) surveyed 40 university students from engineering majors and found that it impacted their ability to work in teams, communicate and mobilize others. MOOCs were shown, however, to have a limited impact on developing practice-based EC among students, in comparison to other modes of learning. Also, by missing the opportunity to interact with other students, their social skills and their motivation were negatively impacted.

#### *4.2.4. Computer-assisted tools and multimedia*

Computer-assisted tools such as videos and animations, were shown to improve a broad range of skills and competency in a supportive role (e.g., Cooper, 2007; Kang & Lee, 2020; Wu et al., 2018). Cooper (2007) used mixed methods with students enrolled in entrepreneurship courses across multiple university levels, to compare their preferences and effectiveness of using text versus multimedia. He found it to provoke thinking and learning by doing. Kang and Lee (2020) surveyed and interviewed undergraduate students to assess the impact of using computer-assisted technology (Arduino and Raspberry Pi) in entrepreneurship capstone courses. They found it to improve inquisitive, imaginative, interpersonal, technical, and critical thinking skills, among others. Wu et al. (2018) combined a peer-evaluated quasi-experiment with a qualitative analysis of reflective learning reports from MBA students, to examine the effects of animated presentations on procuring entrepreneurial investments. They found it to be helpful in developing new ideas and conveying them in a simpler and more interesting way, developing proof of concepts rapidly, and engaging and persuading investors.

#### *4.2.5. Virtual and augmented realities*

Virtual and augmented realities were used to provide entrepreneurship students with immersive and near-life practical experiences (Dong & Tu, 2021; Hammada, 2023; Grivokostopoulou et al., 2019). They were shown to develop several competencies, including “*self-awareness*” and “*coping with ambiguity, uncertainty and risk*”. Dong and Tu (2021) surveyed 400 university students, to understand the influence of VR-aided EE on entrepreneurial intentions. They reported that students improved their willingness and motivation, developed entrepreneurial character and awareness, experienced real situations, and learned to deal with unexpected situations and problems.

#### *4.2.6. Online communities*

Participating in online entrepreneurship communities by students influenced the development of most ECs, especially “*spotting opportunities*”, “*creativity*”, “*taking initiative*”, and “*working with others*”. Bandera et al. (2018) surveyed tens of undergraduate and MBA university students in entrepreneurship courses and found it to improve opportunity recognition, intention and motivation, and willingness to take on tasks. Wu and Song (2019) used a mixed-method approach through focus groups, interviews and a survey distributed to hundreds of university students, to explore the uses and

gratifications of social media in entrepreneurship courses. They reported that it helped students think about opportunities to generate income, improve their knowledge of business concepts, expand their network among like-minded and supportive people, and take the first step in promoting and selling their products and services through online communities.

#### 4.2.7. Online education

On the contrary, to previously mentioned findings, which are mostly positive, online EE was shown to have minimal impact on competency development. This came as no surprise given the practical nature of EE. Among the competencies that were slightly improved is “*motivation*” in Widjaja et al. (2022) study. In addition, Oliver and Oliver’s (2022), case study with postgraduate students found that certain features of online learning platforms such as breakout rooms and discussion boards could be beneficial to develop negotiation skills in a safe public judgement environment and sharing knowledge among learning circles, respectively.

In summation, ET applied for teaching entrepreneurship had to varying degrees a positive impact on the development of the majority of EC, with simulations receiving the main scholarly attention and proving to have the most profound impact. It is worth noting however that across all the studies, a few competencies were minimally affected. These are “*vision*”, “*ethical & sustainable thinking*”, and “*mobilizing others*”. Hence, we have a limited understanding of how ET can help develop those competencies in entrepreneurial settings.

## 5. Discussion

The recent technological advances and the expansion in technology utilization in education warrant a rising scholarly attention (Hammoda & Foli, 2024). Within the entrepreneurship context, our understanding is still nascent with regard to their application and effectiveness towards developing EC (Gervais, 2016; Morris et al., 2013). Entrepreneurship educators are still conceptualizing possible ways to integrate them into existing pedagogies (Mavlutova et al., 2020). This study systematically reviewed empirical work that reported directly on LO of applying ET in EE and translated those findings into corresponding EC. In comparison to previous reviews, it provides a more concrete understanding of the utility of ET in EE across a more comprehensive set of technologies, that can be promptly applied by entrepreneurship educators.

Indeed, it became more evident from this review that research on the role of technologies in EE is a rather recent one and is clearly fragmented. Moreover, there are geographical discrepancies between our practice of entrepreneurship education and the scholarly efforts investigating the application of technologies in it. Despite the United States pioneering the introduction of entrepreneurship courses in its HEIs (Katz, 2003; Kuratko, 2005), only two studies in our sample were conducted in North America. Comparable findings were also reported in reviews in this niche. Rashid’s review (2019), which referred to ET’s role in EE, found that only 16% of the total articles had a North American focus. Also, Chen et al. (2021) found only four out of 38 papers emerged from the U.S. (approximately 10%). This might be attributed to either a lag in incorporating ET in entrepreneurship pedagogies or specific challenges in conducting research in this niche.

Additionally, a significant number of the reviewed articles lack sufficient theoretical and methodological rigor (Nabi et al., 2017; Zainuddin et al., 2020). We hence support scholarly calls (e.g., Kuratko, 2011) to further investigate this area, adopting sound theoretical foundations. On the other hand, the predominance of the theory of planned behavior of Ajzen (1991) supports the observations of Liñán et al. (2010) and Nabi et al. (2017) that entrepreneurial intentions are the single most used factor to study EE outcomes, as it is arguably a well-founded construct (Bae et al. 2014).

Across the identified technologies, gaming and simulation were the most popular in research as they have been witnessing a growing adoption in EE (Samašonok et al., 2020). We argue that their widespread impact stems from their ability to provide realistic entrepreneurial experiences (Bellotti et al., 2014), through combining active participation in learning with enjoyable moments (Fonseca et al., 2014). They project a virtual environment that simulates real-life entrepreneurial scenarios (Dong & Tu, 2021; Hammoda, 2023; Grivokostopoulou et al., 2019). Students immersed in game-based environments learn through semi-factual hands-on experiences and then reflect on them to update their knowledge base and cognitive structures (Kolb & Kolb, 2005; Neck & Greene, 2011). Hence, they are regarded as key tools in experiential EE (Antonaci et al., 2015). As to online communities, we argue that their demonstrable impact is derived from their role in promoting entrepreneurial orientation, establishing mutual trust, a sense of belonging, peer support, knowledge sharing, and access to resources among participants along their learning journey (Kew & Tasir, 2021; Troise et al., 2021). They are also positioned as convenient mediums for today's mobile and remote learners (Wu & Song, 2019), as they are not limited by time, space, or social class (Autio et al., 2013).

Given the complexity and dynamism of entrepreneurship, the application of AI & ML in EE appears as a natural extension to their growing utilization in education as they help make sense of the exponentially growing knowledge (Winkler et al., 2023). They are also able to reach larger groups of students through personalized support (Ma et al., 2020). However, there is still a scarcity of research on their applications, which can be attributed to the technical intricacies and theoretical and methodological obscurities associated with their implementation (Ma et al., 2020). With regards to virtual and augmented realities, the literature showed that they can enhance learners' knowledge acquisition and synthesis by exposing them to various sensory stimuli (Radosavljevic et al., 2020), through experiential occurrences. Hence, they are most beneficial for developing practical entrepreneurial skills. Moreover, as modern virtual and augmented reality applications are delivered essentially through mobile devices, they can be conveniently utilized for EE environments both inside and outside the classroom (Papadakis et al., 2020).

The employment of multimedia and computer-assisted tools improves educational message clarity and communication, especially theory-laden content (O'Flaherty & Phillips, 2015). They are also rather convenient for students and easy to integrate with existing EE pedagogies (Liguori et al., 2021). On the other hand, MOOCs can improve the convenience and accessibility of education. However, they have a limited impact on developing social and communication skills, which are essential in entrepreneurship. This is a critical impasse in their adoption of EE. Developing EC is argued as the outcome educators should pursue when teaching entrepreneurship (Fayolle et al., 2006; Neergaard & Christensen, 2017).

### 5.1. Research and practical implications

Literature reviews in the entrepreneurship field provide important contributions that help progress theoretical foundations and practices and direct future research (Rauch, 2020). This review contributes to the limited validated knowledge at the nexus of technology, education, and competency development within an entrepreneurship context. It establishes a basic tool that maps the competencies developed by each potential technology when applied in EE.

Moreover, this study contributes to the long-standing arguments for adopting a competency-based approach in teaching and assessing entrepreneurship (Bird, 2019; Morris et al., 2013), by addressing an important challenge that Morris et al. (2013) highlighted, as its lack of a standard tool. Given the divergence in competency-based assessment methods, notwithstanding that the reliability and generalizability of any competency-based method is debatable (Bird, 2019), our approach provides a path that can guide scholars in implementing a more reliable measure. Moreover, we extend the applications of our reference tool; EntreComp framework (Bacigalupo et al., 2016) into a new pedagogical delivery method, i.e., educational technologies.

Entrepreneurship educators and program designers can utilize the developed mapping to better integrate technologies in their pedagogies, along with other teaching methods and tools. Hence, achieving better outcomes and improving students' learning experiences. Moreover, they can use it as a basic tool for assessing the effectiveness of applying ET in EE, following a competency-based approach. The mapping exercise can be replicated and adapted to assess the outcomes of other methods and tools used in EE and other business and management disciplines. The results of this study can also support educators and administrators' efforts in building the business case for adopting ET in entrepreneurship and business education, knowing that some of the main barriers to doing so are the lack of awareness of their possible applications and potential benefits (Cooper, 2007; Hammuda, 2024; Secundo et al., 2020).

### 5.2. Limitations

The correlation of a specific pedagogical intervention to learning outcomes is a complicated endeavor. As Young et al. (2003) argue, "*There is a multitude of instructional factors that produce a joint effect on learning, thereby limiting the usefulness of the reported effects of a specific instructional technology examined in isolation*". These factors can include technology quality (Limbu & Pham, 2023), compatibility and interoperability (Abbate et al., 2023), perceived safety and security (Borycki & Kushniruk, 2021), context, content and course structure, geographical location (Phan, 2023), student characteristics, including gender (Kusuma, 2023), among others. This is true for this study as well. In addition, the role of the teacher needs to be factored in when investigating the learning outcomes of ET in the EE context. The qualities of the entrepreneurship educator contribute to his ability to utilize the different teaching modalities, and thus influence message delivery and success (Oksanen et al., 2022).

Also, studies investigating new technologies typically lack the required methodological and theoretical rigorousness for journal publication (Béchar & Grégoire, 2005; Nabi et al., 2017). Hence, eliminating them might have reduced the number of results available for analysis. Additionally, our educational context is set to students at HEIs. Future research can look at studies outside universities, such as in incubators, enterprises,



and schools, as these are more adept at testing innovative pedagogical approaches in EE (Miles et al., 2017).

### 5.3. *Future research*

To build on this study and its results, we suggest a few areas that researchers can focus on 1) More empirical studies are needed to examine the effects of ET application in EE, especially for newer and more advanced technologies such as virtual worlds and artificial intelligence. 2) Researchers can use our mapping to conduct similar exercises that assess the competencies developed using other pedagogical tools in entrepreneurship and business courses. 3) Competency-based approach in EE outcomes assessment is rather subjective (Morris et al., 2013), and hence further studies validating the developed mapping tool are needed 4) Most importantly, research garnering the views of entrepreneurship educators, managers, and educational technology experts is required, given that the majority of the studies rely on students' feedback. These perspectives can provide valuable insights that help with ET adoption and their effective implementation.

## 6. Conclusion

Adopting a competency-based view of EE, this paper conducted a systematic literature review through an in-depth investigation of 26 articles. The reported learning outcomes were translated to entrepreneurial competencies and mapped against utilized technologies, relying on the EntreComp framework as a reference tool. We identified several groups of technologies that impacted the entrepreneurial competencies of students and reported on their effectiveness. The identified categories are simulation and gaming, AI and ML, online education, MOOCs, computer-assisted and multimedia software, virtual and augmented reality, and online communities. The study advanced scholarly understanding at the nexus of technology, education, and entrepreneurial competencies. It provides a basic map that can be applied to conduct similar outcome-assessment studies as well as aiding educators in integrating technologies into their entrepreneurship and management curricula. The study contributes to and advocates for a competency-based approach by providing a standard tool for its adoption. It also lowers the barriers to adopting ET in EE and business education more generally, by offering more clarity on their potential applications and benefits. In conclusion, we urge scholars to work closely with educators and practitioners to develop more comprehensive competency-based frameworks for EE, incorporating the findings of this review, to coalesce digital and non-digital methods for improved entrepreneurial learning outcomes.

## Author Statement

The author declares that there is no conflict of interest.

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## References

- Abbate, S., Centobelli, P., Cerchione, R., Oropallo, E., & Riccio, E. (2023). Kick-start your scientific journey into the metaverse. *Knowledge Management & E-Learning*, 15(1), 103–114. <https://doi.org/10.34105/j.kmel.2023.15.006>
- \*Ahsan, M., & Faletahan, A. F. (2021). What do they like and dislike from game-based entrepreneurship learning? A qualitative study. *Jurnal Cakrawala Pendidikan*, 40(2), 495–507. <https://doi.org/10.21831/cp.v40i2.38858>
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-t](https://doi.org/10.1016/0749-5978(91)90020-t)
- Antonaci, A., Dagnino, F. M., Ott, M., Bellotti, F., Berta, R., De Gloria, A., ... Mayer, I. (2015). A gamified collaborative course in entrepreneurship: Focus on objectives and tools. *Computers in Human Behavior*, 51(Part B), 1276–1283. <https://doi.org/10.1016/j.chb.2014.11.082>
- Autio, E., Dahlander, L., & Frederiksen, L. (2013). Information exposure, opportunity evaluation, and entrepreneurial action: An investigation of an online user community. *Academy of Management Journal*, 56(5), 1348–1371. <https://doi.org/10.5465/amj.2010.0328>
- Bacigalupo, M., Kamyli, P., Punie, Y., & Van den Brande, G. (2016). *EntreComp: The entrepreneurship competency framework*. European Commission. Retrieved from <https://eige.europa.eu/resources/lfna27939enn.pdf>
- Bae, T. J., Qian, S., Miao, C., & Fiet, J. O. (2014). The relationship between entrepreneurship education and entrepreneurial intentions: A meta-analytic review. *Entrepreneurship Theory and Practice*, 38(2), 217–254. <https://doi.org/10.1111/etap.12095>
- \*Bandera, C., Collins, R., & Passerini, K. (2018). Risky business: Experiential learning, information and communications technology, and risk-taking attitudes in entrepreneurship education. *The International Journal of Management Education*, 16(2), 224–238. <https://doi.org/10.1016/j.ijme.2018.02.006>
- Béchar, J. P., & Grégoire, D. (2005). Entrepreneurship education research revisited: The case of higher education. *Academy of management learning & education*, 4(1), 22–43. <https://doi.org/10.5465/amle.2005.16132536>
- Bellotti, F., Berta, R., De Gloria, A., Lavagnino, E., Antonaci, A., Dagnino, F., ... Mayer, I. S. (2014). Serious games and the development of an entrepreneurial mindset in higher education engineering students. *Entertainment Computing*, 5(4), 357–366. <https://doi.org/10.1016/j.entcom.2014.07.003>
- Bendermacher, G. W. G., oude Egbrink, M. G. A., Wolfhagen, I. H. A. P., & Dolmans, D. H. J. M. (2017). Unravelling quality culture in higher education: A realist review. *Higher Education*, 73, 39–60. <https://doi.org/10.1007/s10734-015-9979-2>
- Bird, B. (2019). Toward a theory of entrepreneurial competency. In J. A. Katz & A. C. Corbet (Eds.), *Seminal Ideas for the Next Twenty-Five Years of Advances* (pp. 115–131). Emerald Publishing Limited. <https://doi.org/10.1108/s1074-754020190000021011>
- Bonesso, S., Gerli, F., Pizzi, C., & Cortellazzo, L. (2018). Students' entrepreneurial intentions: The role of prior learning experiences and emotional, social, and cognitive competencies. *Journal of Small Business Management*, 56(S1), 215–242. <https://doi.org/10.1111/jsbm.12399>
- Borycki, E. M., & Kushniruk, A. W. (2021). Editorial: Knowledge management and e-learning: Improving the safety of technologies and devices. *Knowledge Management & E-Learning*, 13(4), 390–394. <https://doi.org/10.34105/j.kmel.2021.13.020>

- Chaudhary, A. G. (2008). Digital game-based learning – Future of education? *Pranjana: The Journal of Management Awareness*, 11(2). Retrieved from <https://www.indianjournals.com/ijor.aspx?target=ijor:pr&volume=11&issue=2&article=001>
- \*Chen, J., Chen, Y., Ou, R., Wang, J., & Chen, Q. (2022). How to use artificial intelligence to improve entrepreneurial attitude in business simulation games: Implications from a quasi-experiment. *Frontiers in Psychology*, 13: 856085. <https://doi.org/10.3389/fpsyg.2022.856085>
- Chen, L., Ifenthaler, D., & Yau, J. Y. K. (2021). Online and blended entrepreneurship education: A systematic review of applied educational technologies. *Entrepreneurship Education*, 4, 191–232. <https://doi.org/10.1007/s41959-021-00047-7>
- \*Chen, Z., & Yu, X. (2020). Adoption of human personality development theory combined with deep neural network in entrepreneurship education of college students. *Frontiers in Psychology*, 11: 1346. <https://doi.org/10.3389/fpsyg.2020.01346>
- \*Cooper, B. (2007). Central issues in the use of computer-based materials for high volume entrepreneurship education. *Active Learning in Higher Education*, 8(3), 201–217. <https://doi.org/10.1177/1469787407081887>
- \*Dabbous, A., & Boustani, N. M. (2023). Digital explosion and entrepreneurship education: Impact on promoting entrepreneurial intention for business students. *Journal of Risk and Financial Management*, 16(1): 27. <https://doi.org/10.3390/jrfm16010027>
- Denyer, D., & Tranfield, D. (2009). Producing a systematic review. In D. A. Buchanan & A. Bryman (Eds.), *The Sage Handbook of Organizational Research Methods* (pp. 671–689). Sage. Retrieved from <https://psycnet.apa.org/record/2010-00924-039>
- \*Dong, P., & Tu, C. C. (2021). Research on the impact of university innovation and entrepreneurship education on university students' entrepreneurship willingness based on virtual reality technology. *Mathematical Problems in Engineering*, 2021: 9730705. <https://doi.org/10.1155/2021/9730705>
- Ellyton, F., E., Foli, F., Hammada, B., Mallarge, J., Durst, S., & Rothenberger, S. (2022). *Reference framework for inclusive digital education*. Zenodo. <https://doi.org/10.5281/zenodo.7215856>
- El Mawas, N., Trúchly, P., Podhradský, P., Medvecký, M., & Muntean, C. H. (2022). Impact of game-based learning on STEM learning and motivation: Two case studies in Europe. *Knowledge Management & E-Learning*, 14(4), 360–394. <https://doi.org/10.34105/j.kmel.2022.14.020>
- European Commission. (2016). *A new skills agenda for Europe. Working together to strengthen human capital, employability and competitiveness*. European Commission. Retrieved from <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52016DC0381>
- Fayolle, A., Gailly, B., & Lassas-Clerc, N. (2006). Assessing the impact of entrepreneurship education programmes: A new methodology. *Journal of European Industrial Training*, 30(9), 701–720. <https://doi.org/10.1108/03090590610715022>
- Fayolle, A. (2006). *International entrepreneurship education: Issues and newness*. Edward Elgar. <https://doi.org/10.4337/9781847201652>
- Fayolle, A. (2013). Personal views on the future of entrepreneurship education. *Entrepreneurship & Regional Development*, 25(7/8), 692–701. <https://doi.org/10.1080/08985626.2013.821318>
- Fellnhofner, K. (2019). Toward a taxonomy of entrepreneurship education research literature: A bibliometric mapping and visualization. *Educational Research Review*, 27, 28–55. <https://doi.org/10.1016/j.edurev.2018.10.002>
- Ferreira, J. J., Fayolle, A., Ratten, V., & Raposo, M. (2018). *Entrepreneurial universities:*

- Collaboration, education and policies*. Edward Elgar. Retrieved from <https://www.e-elgar.com/shop/gbp/entrepreneurial-universities-9781786432452.html>
- Fonseca, B., Gonçalves, R., Nunes, R. R., Teixeira, M. S., Paredes, H., Morgado, L., & Martins, P. (2014, June). BIZZY – A social game for entrepreneurship education. In *Proceedings of the International Conference on Learning and Collaboration Technologies (LCT 2014)* (pp. 33–41). Springer. [https://doi.org/10.1007/978-3-319-07485-6\\_4](https://doi.org/10.1007/978-3-319-07485-6_4)
- Gervais, J. (2016). The operational definition of competency-based education. *The Journal of Competency-Based Education*, 1(2), 98–106. <https://doi.org/10.1002/cbe2.1011>
- Gianesini, G., Cubico, S., Favretto, G., & Leitão, J. (2018). Entrepreneurial competencies: Comparing and contrasting models and taxonomies. In S. Cubico, G. Favretto, J. Leitão & U. Cantner (Eds.), *Entrepreneurship and the Industry Life Cycle: The Changing Role of Human Capital and Competencies* (pp. 13–32). Springer.
- Gibb, A. (2002). In pursuit of a new ‘enterprise’ and ‘entrepreneurship’ paradigm for learning: Creative destruction, new values, new ways of doing things and new combinations of knowledge. *International Journal of Management Reviews*, 4(3), 233–269. <https://doi.org/10.1111/1468-2370.00086>
- Glackin, C. E., & Phelan, S. E. (2020). Improving entrepreneurial competencies in the classroom: An extension and in-study replication. *New England Journal of Entrepreneurship*, 23(2), 79–96. <https://doi.org/10.1108/neje-04-2020-0005>
- \*Grivokostopoulou, F., Kovas, K., & Perikos, I. (2019). Examining the impact of a gamified entrepreneurship education framework in higher education. *Sustainability*, 11(20): 5623. <https://doi.org/10.3390/su11205623>
- Hammoda, B. (2023). Extracurricular activities for entrepreneurial learning: A typology based on learning theories. *Entrepreneurship Education and Pedagogy*. <https://doi.org/10.1177/25151274231218212>
- Hammoda, B. & Foli, S. (2024). A digital competency framework for learners (DCFL): A conceptual framework for digital literacy. *Knowledge Management & E-Learning*, 16(3).
- Hammoda, B. (2024a). ChatGPT for founding teams: An entrepreneurial pedagogical innovation. *International Journal of Technology in Education*, 7(1), 154–173. <https://doi.org/10.46328/ijte.530>
- Hammoda, B. (2024b). Digital technology in entrepreneurship education: An overview of the status quo. In S. Durst & A. Pevkur (Eds.), *Digital Transformation for Entrepreneurship* (pp. 71–93). World Scientific. [https://doi.org/10.1142/9789811270178\\_0006](https://doi.org/10.1142/9789811270178_0006)
- Harden, R. M. (2002). Developments in outcome-based education. *Medical Teacher*, 24(2), 117–120. <https://doi.org/10.1080/01421590220120669>
- \*Huebscher, J., & Lendner, C. (2010). Effects of entrepreneurship simulation game seminars on entrepreneurs’ and students’ learning. *Journal of Small Business & Entrepreneurship*, 23(4), 543–554. <https://doi.org/10.1080/08276331.2010.10593500>
- \*Isabelle, D. A. (2020). Gamification of entrepreneurship education. *Decision Sciences Journal of Innovative Education*, 18(2), 203–223. <https://doi.org/10.1111/dsji.12203>
- Januszewski, A., & Molenda, M. (2013). *Educational technology: A definition with commentary*. Routledge. <https://doi.org/10.4324/9780203054000>
- Jesson, J., Matheson, L., & Lacey, F. M. (2011). *Doing your literature review: Traditional and systematic techniques*. Sage.
- Jones, P., & Colwill, A. (2013). Entrepreneurship education: An evaluation of the Young Enterprise Wales Initiative. *Education + Training*, 55(8/9), 911–925.

- <https://doi.org/10.1108/et-04-2013-0052>
- \*Kang, Y., & Lee, K. (2020). Designing technology entrepreneurship education using computational thinking. *Education and Information Technologies*, 25, 5357–5377. <https://doi.org/10.1007/s10639-020-10231-2>
- Kasurinen, J., & Knutas, A. (2018). Publication trends in gamification: A systematic mapping study. *Computer Science Review*, 27, 33–44. <https://doi.org/10.1016/j.cosrev.2017.10.003>
- Katz, J. A. (2003). The chronology and intellectual trajectory of American entrepreneurship education: 1876–1999. *Journal of business venturing*, 18(2), 283–300. [https://doi.org/10.1016/s0883-9026\(02\)00098-8](https://doi.org/10.1016/s0883-9026(02)00098-8)
- Kew, S. N., & Tasir, Z. (2021). Analysing students' cognitive engagement in e-learning discussion forums through content analysis. *Knowledge Management & E-Learning*, 13(1), 39–57. <https://doi.org/10.34105/j.kmel.2021.13.003>
- Klapper, R., & Tegtmeier, S. (2010). Innovating entrepreneurial pedagogy: Examples from France and Germany. *Journal of Small Business and Enterprise Development*, 17(4), 552–568. <https://doi.org/10.1108/14626001011088723>
- Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of Management Learning & Education*, 4(2), 193–212. <https://doi.org/10.5465/amle.2005.17268566>
- \*Kriz, W. C., & Aucther, E. (2016). 10 years of evaluation research into gaming simulation for German entrepreneurship and a new study on its long-term effects. *Simulation & Gaming*, 47(2), 179–205. <https://doi.org/10.1177/1046878116633972>
- Kuratko, D. F. (2005). The emergence of entrepreneurship education: Development, trends, and challenges. *Entrepreneurship Theory and Practice*, 29(5), 577–597. <https://doi.org/10.1111/j.1540-6520.2005.00099.x>
- Kuratko, D. F. (2011). Entrepreneurship theory, process, and practice in the 21st century. *International Journal of Entrepreneurship and Small Business*, 13(1), 8–17. <https://doi.org/10.1504/ijesb.2011.040412>
- Kuratko, D. F., & Morris, M. H. (2018). Examining the future trajectory of entrepreneurship. *Journal of Small Business Management*, 56(1), 11–23. <https://doi.org/10.1111/jsbm.12364>
- Kusuma, I. P. I. (2023). The role of gender in student teachers' technology integration in teaching English speaking skills during the Covid-19 pandemic. *Knowledge Management & E-Learning*, 15(3), 487–505. <https://doi.org/10.34105/j.kmel.2023.15.028>
- Levy, Y., & Ellis, T. J. (2006). A systems approach to conduct an effective literature review in support of information systems research. *Informing Science*, 9, 181–212. <https://doi.org/10.28945/479>
- Ligthelm, A. (2007). Survival analysis of small informal businesses in South Africa 2007–2010. *Eurasian Business Review*, 1, 160–179. <https://doi.org/10.14208/bf03353804>
- Liguori, E. W., Winkler, C., Zane, L. J., Muldoon, J., & Winkel, D. (2021). COVID-19 and necessity-based online entrepreneurship education at US community colleges. *Journal of Small Business and Enterprise Development*, 28(6), 821–830. <https://doi.org/10.1108/jsbed-09-2020-0340>
- Limbu, Y. B., & Pham, L. (2023). Impact of e-learning service quality on student satisfaction during the Covid-19 pandemic: A systematic review. *Knowledge Management & E-Learning*, 15(4), 523–538. <https://doi.org/10.34105/j.kmel.2023.15.030>
- Lin, J., & Sekiguchi, T. (2020, March). E-learning in entrepreneurship education: A systematic literature review. In *Proceedings of the 2020 IEEE International Conference*

- on Teaching, Assessment, and Learning for Engineering (TALE) (pp. 83–90). IEEE. <https://doi.org/10.1109/tale48869.2020.9368412>
- Liñán, F., Rodríguez-Cohard, J. C., & Rueda-Cantuche, J. M. (2010). Factors affecting entrepreneurial intention levels: A role for education. *International Entrepreneurship and Management Journal*, 7(2), 195–218. <https://doi.org/10.1007/s11365-010-0154-z>
- Loi, M., & Fayolle, A. (2021). Impact of entrepreneurship education: A review of the past, overview of the present, and a glimpse of future trends. In C. H. Matthews & E. W. Liguori (Eds.), *Annals of Entrepreneurship Education and Pedagogy – 2021* (pp. 170–193). Edward Elgar. <https://doi.org/10.4337/9781789904468.00018>
- López-Núñez, M. I., Rubio-Valdehita, S., Armuña, C., & Pérez-Urria, E. (2022). EntreComp questionnaire: A self-assessment tool for entrepreneurship competencies. *Sustainability*, 14(5): 2983. <https://doi.org/10.3390/su14052983>
- \*Lyons, R. M., Fox, G., & Stephens, S. (2023). Gamification to enhance engagement and higher order learning in entrepreneurial education. *Education + Training*, 65(3), 416–432. <https://doi.org/10.1108/et-05-2022-0204>
- Massaro, M., Dumay, J., & Guthrie, J. (2016). On the shoulders of giants: Undertaking a structured literature review in accounting. *Accounting, Auditing & Accountability Journal*, 29(5), 767–801. <https://doi.org/10.1108/aaaj-01-2015-1939>
- \*Mavlutova, I., Lesinskis, K., Liogys, M., & Hermanis, J. (2020). Innovative teaching techniques for entrepreneurship education in the era of digitalisation. *WSEAS Transactions on Environment and Development*, 16(1), 725–733. <https://doi.org/10.37394/232015.2020.16.75>
- Ma, H., Lang, C., Liu, Y., & Gao, Y. (2020). Constructing a hierarchical framework for assessing the application of big data technology in entrepreneurship education. *Frontiers in Psychology*, 11: 551389. <https://doi.org/10.3389/fpsyg.2020.551389>
- Miles, M. P., de Vries, H., Harrison, G., Bliemel, M., De Klerk, S., & Kasouf, C. J. (2017). Accelerators as authentic training experiences for nascent entrepreneurs. *Education + Training*, 59(7/8), 811–824. <https://doi.org/10.1108/et-01-2017-0007>
- Mishra, D., Gunasekaran, A., Papadopoulos, T., & Hazen, B. (2017). Green supply chain performance measures: A review and bibliometric analysis. *Sustainable Production and Consumption*, 10, 85–99. <https://doi.org/10.1016/j.spc.2017.01.003>
- Mojica, M. N., Gebremedhin, T. J., & Schaeffer, P. V. (2010). A county-level assessment of entrepreneurship and economic development in Appalachia using simultaneous equations. *Journal of Developmental Entrepreneurship*, 15, 3–18. <https://doi.org/10.1142/s1084946710001452>
- Morris, M. H., Webb, J. W., Fu, J., & Singhal, S. (2013). A competency-based perspective on entrepreneurship education: Conceptual and empirical insights. *Journal of Small Business Management*, 51(3), 352–369. <https://doi.org/10.1111/jsbm.12023>
- Morselli, D., & Gorenc, J. (2022). Using the EntreComp framework to evaluate two entrepreneurship education courses based on the Korda Method. *The International Journal of Management Education*, 20(1): 100591. <https://doi.org/10.1016/j.ijme.2021.100591>
- Mwasalwiba, E. S. (2010). Entrepreneurship education: A review of its objectives, teaching methods, and impact indicators. *Education + Training*, 52(1), 20–47. <https://doi.org/10.1108/00400911011017663>
- Nabi, G., Linan, F., & Fayolle, A. (2017). The impact of entrepreneurship education in higher education: A systematic review and research agenda. *Academy of Management Learning & Education*, 16(2), 277–300. <https://doi.org/10.5465/amlle.2015.0026>
- Neck, H. M., & Greene, P. G. (2011). Entrepreneurship education: Known worlds and new

- frontiers. *Journal of Small Business Management*, 49(1), 55–71. <https://doi.org/10.1111/j.1540-627x.2010.00314.x>
- Neergaard, H., & Christensen, D. R. (2017). Breaking the waves: Routines and rituals in entrepreneurship education. *Industry and Higher Education*, 31(2), 90–100. <https://doi.org/10.1177/0950422217692479>
- Neuendorf, K. A. (2018). Content analysis and thematic analysis. In P. Brough (Ed.), *Advanced Research Methods for Applied Psychology* (pp. 211–223). Routledge.
- \*Newbery, R., Lean, J., & Moizer, J. (2016). Evaluating the impact of serious games: The effect of gaming on entrepreneurial intent. *Information Technology & People*, 29(4), 733–749. <https://doi.org/10.1108/itp-05-2015-0111>
- Nixon, E., Scullion, R., & Hearn, R. (2018). Her majesty the student: Marketised higher education and the narcissistic (dis)satisfactions of the student-consumer. *Studies in Higher Education*, 43(6), 927–943. <https://doi.org/10.1080/03075079.2016.1196353>
- Oksanen, L., Oikkonen, E., & Pihkala, T. (2022). Adopting entrepreneurship education – Teachers’ professional development. *Entrepreneurship Education and Pedagogy*, 6(2), 276–298. <https://doi.org/10.1177/25151274221091698>
- \*Oliver, P. G., & Oliver, S. (2022). Innovative online learning in entrepreneurship education: The impact of embedding real-life industry practice in the virtual learning environment. *Industry and Higher Education*, 36(6), 756–767. <https://doi.org/10.1177/09504222221121283>
- Oyelere, S. S., Suhonen, J., Shonola, S. A., & Joy, M. S. (2016, October). Discovering students mobile learning experiences in higher education in Nigeria. In *Proceedings of the 2016 IEEE Frontiers in Education Conference (FIE)* (pp. 1–7). IEEE. <https://doi.org/10.1109/fie.2016.7757541>
- O’Flaherty, J., & Phillips, C. (2015). The use of flipped classrooms in higher education: A scoping review. *The Internet and Higher Education*, 25, 85–95. <https://doi.org/10.1016/j.iheduc.2015.02.002>
- Pacheco, D. F., Dean, T. J., & Payne, D. S. (2010). Escaping the green prison: Entrepreneurship and the creation of opportunities for sustainable development. *Journal of Business Venturing*, 25(5), 464–480. <https://doi.org/10.1016/j.jbusvent.2009.07.006>
- Papadakis, S., Kalogiannakis, M., & Zaranis, N. (2017). Designing and creating an educational app rubric for preschool teachers. *Education and Information Technologies*, 22(6), 3147–3165. <https://doi.org/10.1007/s10639-017-9579-0>
- Papadakis, S., Vaiopoulou, J., Kalogiannakis, M., & Stamovlasis, D. (2020). Developing and exploring an evaluation tool for educational apps (ETEA) targeting kindergarten children. *Sustainability*, 12(10): 4201. <https://doi.org/10.3390/su12104201>
- \*Park, S., & Kim, S. (2023). The avaritia: Entrepreneurship practice to understand the problem of information control through gamification. *Sustainability*, 15(8): 6738. <https://doi.org/10.3390/su15086738>
- Petticrew, M., & Roberts, H. (2006). *Systematic reviews in the social sciences: A practical guide*. John Wiley & Sons. <https://doi.org/10.1002/9780470754887>
- Phan, N. T. T. (2023). Self-efficacy in a MOOC environment: A comparative study of engineering students in Taiwan and Vietnam. *Knowledge Management & E-Learning*, 15(1), 64–84. <https://doi.org/10.34105/j.kmel.2023.15.004>
- Pittaway, L., & Cope, J. (2007). Entrepreneurship education: A systematic review of the evidence. *International Small Business Journal*, 25(5), 479–510. <https://doi.org/10.1177/0266242607080656>
- Ploum, L., Blok, V., Lans, T., & Omta, O. (2018). Toward a validated competency framework for sustainable entrepreneurship. *Organization & Environment*, 31(2), 113–

132. <https://doi.org/10.1177/1086026617697039>
- Podsakoff, P. M., MacKenzie, S. B., Bachrach, D. G., & Podsakoff, N. P. (2005). The influence of management journals in the 1980s and 1990s. *Strategic Management Journal*, 26(5), 473–488. <https://doi.org/10.1002/smj.454>
- \*Pratikto, H., Hanafiya, R., Ashar, M., Akbar, M. I., & Harsono, Y. T. (2021). Entrepreneurship game apps to enhancement student skill thinking analytic in class online. *International Journal of Interactive Mobile Technologies*, 15(8), 155–162. <https://doi.org/10.3991/ijim.v15i08.21575>
- Qureshi, M. I., Khan, N., Raza, H., Imran, A., & Ismail, F. (2021). Digital technologies in education 4.0. Does it enhance the effectiveness of learning? A Systematic literature review. *International Journal of Interactive Mobile Technologies*, 15(4), 31–47. <https://doi.org/10.3991/ijim.v15i04.20291>
- Radosavljevic, S., Radosavljevic, V., & Grgurovic, B. (2020). The potential of implementing augmented reality into vocational higher education through mobile learning. *Interactive Learning Environments*, 28(4), 404–418. <https://doi.org/10.1080/10494820.2018.1528286>
- Rashid, L. (2019). Entrepreneurship education and sustainable development goals: A literature review and a closer look at fragile states and technology-enabled approaches. *Sustainability*, 11(19): 5344. <https://doi.org/10.3390/su11195343>
- Ratten, V., & Jones, P. (2021). Covid-19 and entrepreneurship education: Implications for advancing research and practice. *The International Journal of Management Education*, 19(1): 100433. <https://doi.org/10.1016/j.ijme.2020.100432>
- Ratten, V., & Jones, P. (2023). Generative artificial intelligence (ChatGPT): Implications for management educators. *The International Journal of Management Education*, 21(3): 100857. <https://doi.org/10.1016/j.ijme.2023.100857>
- Ratten, V., & Usmanij, P. (2021). Entrepreneurship education: Time for a change in research direction? *The International Journal of Management Education*, 19(1): 100368. <https://doi.org/10.1016/j.ijme.2020.100367>
- Rauch, A. (2020). Opportunities and threats in reviewing entrepreneurship theory and practice. *Entrepreneurship Theory and Practice*, 44(5), 847–860. <https://doi.org/10.1177/1042258719879635>
- Rew, D. A. (2020). The development of high impact national and regional journals in medicine and the health sciences. *Science Editor and Publisher*, 5(2), 113–122. <https://doi.org/10.24069/2542-0267-2020-2-113-122>
- Rideout, E. C., & Gray, D. O. (2013). Does entrepreneurship education really work? A review and methodological critique of the empirical literature on the effects of university-based entrepreneurship education. *Journal of Small Business Management*, 51(3), 329–351. <https://doi.org/10.1111/jsbm.12021>
- \*Samašonok, K., Isoraitè, M., & Žirnelè, L. (2020). Education of entrepreneurship by participation in a business simulation enterprise activities: Conditions of effectiveness and opportunities for improvement. *Entrepreneurship and Sustainability Issues*, 7(4): 3122–3144. [https://doi.org/10.9770/jesi.2020.7.4\(36\)](https://doi.org/10.9770/jesi.2020.7.4(36))
- Schou, P. K., Bucher, E., & Waldkirch, M. (2022). Entrepreneurial learning in online communities. *Small Business Economics*, 58(4), 2087–2108. <https://doi.org/10.1007/s11187-021-00502-8>
- Secundo, G., Del Vecchio, P., & Mele, G. (2020). Social media for entrepreneurship: Myth or reality? A structured literature review and a future research agenda. *International Journal of Entrepreneurial Behavior & Research*, 27(1), 149–177. <https://doi.org/10.1108/ijeb-07-2020-0453>



- Sirelkhatim, F., & Gangi, Y. (2015). Entrepreneurship education: A systematic literature review of curricula contents and teaching methods. *Cogent Business & Management*, 2(1): 1052034. <https://doi.org/10.1080/23311975.2015.1052034>
- Sousa, M. J., Carmo, M., Gonçalves, A. C., Cruz, R., & Martins, J. M. (2019). Creating knowledge and entrepreneurial capacity for HE students with digital education methodologies: Differences in the perceptions of students and entrepreneurs. *Journal of Business Research*, 94, 227–240. <https://doi.org/10.1016/j.jbusres.2018.02.005>
- Thelwall, M. (2018). Dimensions: A competitor to Scopus and the Web of Science? *Journal of Informetrics*, 12(2), 430–435. <https://doi.org/10.1016/j.joi.2018.03.006>
- Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management*, 14, 207–222. <https://doi.org/10.1111/1467-8551.00375>
- Tranfield, D., Denyer, D., Marcos, J., & Burr, M. (2004). Co-producing management knowledge. *Management Decision*, 42(3/4), 375–386. <https://doi.org/10.1108/00251740410518895>
- Tretyakova, N., Lyzhin, A., Chubarkova, E., Uandykova, M., & Lukyanova, M. (2021). Mobile-learning platform for the development of entrepreneurial competencies of the students. *International Journal of Interactive Mobile Technologies*, 15(9), 118–135. <https://doi.org/10.3991/ijim.v15i09.20225>
- Troise, C., Dana, L. P., Tani, M., & Lee, K. Y. (2022). Social media and entrepreneurship: Exploring the impact of social media use of start-ups on their entrepreneurial orientation and opportunities. *Journal of Small Business and Enterprise Development*, 29(1), 47–73. <https://doi.org/10.1108/jsbed-01-2021-0041>
- Vestergaard, L., Moberg, K., & Jørgensen, C. (2012). *Impact of entrepreneurship education in Denmark - 2011*. Fonden for Entreprenørskab – Young Enterprise Denmark. Retrieved from <https://www.yumpu.com/en/document/view/26460251/impact-of-entrepreneurship-education-in-denmark-2011>
- \*Vorbach, S., Poandl, E. M., & Korajman, I. (2019). Digital entrepreneurship education – The role of MOOCs. *International Journal of Engineering Pedagogy*, 9(3), 99–111. <https://doi.org/10.3991/ijep.v9i3.10149>
- Waltman, L. (2016). A review of the literature on citation impact indicators. *Journal of Informetrics*, 10(2), 365–391. <https://doi.org/10.1016/j.joi.2016.02.007>
- \*Widjaja, S. U. M., Wibowo, A., Narmaditya, B. S., Wardoyo, C., & Saptono, A. (2022). Identifying factors affecting entrepreneurship education and entrepreneurial intention among Indonesian university students. *Entrepreneurial Business and Economics Review*, 10(3), 89–104. <https://doi.org/10.15678/eber.2022.100306>
- Winkler, C., Hammoda, B., Noyes, E., & Van Gelderen, M. (2023). Entrepreneurship education at the dawn of generative artificial intelligence. *Entrepreneurship Education and Pedagogy*, 6(4), 579–589. <https://doi.org/10.1177/25151274231198799>
- Winter, M., & Hammoda, B. (2024). Digital skills platform from Silicon Valley: Training new generations using experiential learning principles. In B. Hammoda & S. Durst (Eds.), *Contemporary Entrepreneurship: Global Perspectives and Cases*. Routledge. <https://doi.org/10.4324/9781003371403-7>
- \*Wu, W. H., Kao, H. Y., Wu, S. H., & Wei, C. W. (2019). Development and evaluation of affective domain using student’s feedback in entrepreneurial massive open online courses. *Frontiers in Psychology*, 10: 1109. <https://doi.org/10.3389/fpsyg.2019.01109>
- \*Wu, Y., & Song, D. (2019). Gratifications for social media use in entrepreneurship courses: Learners’ perspective. *Frontiers in Psychology*, 10: 1270. <https://doi.org/10.3389/fpsyg.2019.01270>

- \*Wu, Y. J., Yuan, C. H., & Pan, C. I. (2018). Entrepreneurship education: An experimental study with information and communication technology. *Sustainability*, 10(3): 691. <https://doi.org/10.3390/su10030691>
- \*Yang, Q., Zhang, Y., & Lin, Y. (2022). Study on the influence mechanism of virtual simulation game learning experience on student engagement and entrepreneurial skill development. *Frontiers in Psychology*, 12: 772157. <https://doi.org/10.3389/fpsyg.2021.772157>
- Young, M. R., Klemz, B. R., & Murphy, J. W. (2003). Enhancing learning outcomes: The effects of instructional technology, learning styles, instructional methods, and student behavior. *Journal of Marketing Education*, 25(2), 130–142. <https://doi.org/10.1177/0273475303254004>
- Zainuddin, Z., Chu, S. K. W., Shujahat, M., & Perera, C. J. (2020). The impact of gamification on learning and instruction: A systematic review of empirical evidence. *Educational Research Review*, 30: 100326. <https://doi.org/10.1016/j.edurev.2020.100326>
- \*Zuo, L., Shestak, V., Vlasova, S., & Islamov, A. (2021). Efficiency of outsourcing and outstaffing mechanisms based on MOOCs in the market of entrepreneurial education services. *International Journal of Emerging Technologies in Learning*, 16(2), 135–148. <https://doi.org/10.3991/ijet.v16i02.18821>



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# Active methods in Entrepreneurship Education: a case study with engineering students

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## ABSTRACT

Future engineers are labelled entrepreneurial engineers, possessing business skills that enable them to perform effectively in various contexts. Entrepreneurship education is a key avenue for equipping engineering students with these skills, with a growing propagation in their curricula in recent years. Still, scholarly efforts are limited in this domain, particularly regarding the application of active and experiential learning methods, despite early studies highlighting their effectiveness in developing entrepreneurial competencies. This case study presents a course for engineering undergraduates based on active learning theories and methods. We offer a comprehensive view of their perceived usefulness, opportunities, and challenges from the perspectives of the students, educator, and entrepreneurship education experts. This study advances the discussion on the intricacies of active learning applications in entrepreneurship, contributes to the limited literature on engineering entrepreneurship education, and provide insights to educators and pedagogical designers to effectively incorporate active methods into their curricula.

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## Introduction

Engineering graduates are highly innovative and entrepreneurial, providing valuable economic contributions to society (Duval-Couetil, Shartrand, and Reed 2016). The future engineer is indeed labelled an entrepreneurial one, requiring a set of business-oriented skills to adjust to dynamic markets, rapid advancements in science and technology, and find suitable career opportunities (Hagvall Svensson 2023; Stenard 2023; Täks, Tynjälä, and Kukemelk 2016). Hence, there has been a greater interest in supporting the development of their entrepreneurial competencies (ECs) through relevant education and programmes.

Entrepreneurship education (EE) is broadly defined as ‘any pedagogical program or process of education for entrepreneurial attitudes and skills’ (Fayolle, Gailly, and Lassas-Clerc 2006, 702). This seminal definition by Fayolle had probably anticipated its propagation in the following years to multiple settings and disciplines (Mawson, Casulli, and Simmons 2023; Nabi et al. 2017), including engineering. EE is regarded as ‘the’ approach to developing those skills and is being increasingly introduced in engineering education (Aadland and Aaboen 2020; Huang-Saad and Celis 2017; Täks et al. 2014; Zappe, Cutler, and Gase 2023). Following a similar trend in broader EE, recent years have witnessed a propagated application of active and experiential approaches in engineering entrepreneurship education (EEE), such as projects, casework, and group activities. Several scholars have supported this active teaching approach and are even calling for accelerating its

implementation (Duval-Couetil, Shartrand, and Reed 2016; Fernandes et al. 2017; Hagvall Svensson et al. 2020; Mäkimurto-Koivumaa and Belt 2016; Winkler et al. 2015).

Active pedagogies comprise a *learning-by-doing* approach. Students apply reasoning, critical thinking, and problem-solving skills to mental or physical tasks that result in acquiring specific knowledge and skills while updating their cognitive and behavioural capabilities in the process. However, the introduction of active pedagogies in EEE has proven difficult, which could be attributed to the nature of engineering and STEM curricula often emphasizing a mechanistic approach to learning with little exposure to real-life interactions (Ferreira et al. 2021; Hagvall Svensson 2023; Täks et al. 2014). Research on EEE, more generally, also lacks momentum (Ferreira et al. 2021). Like the criticism often directed at EE (Fayolle 2018; Kakouris, Morselli, and Pittaway 2023; Neck and Corbett 2018), the applied pedagogies lack sufficient theoretical grounding. Moreover, there is a dearth of studies investigating the applications of the different active approaches, the perceptions of the students towards them, and their impact (Arranz et al. 2017; Duval-Couetil, Shartrand, and Reed 2016; Fernandes et al. 2017). Even the limited literature available often produced inconclusive results about their applicability and usefulness (Duval-Couetil, Shartrand, and Reed 2016; Täks et al. 2014, 2016).

This study aims to address the scarcity of literature on EEE. It provides an account of an EE course for undergraduate engineering students in a higher education institution (HEI). The active methods deployed in this course were based on the principles of active learning theories (Dewey 1974; Kolb 1984; Piaget 1970; Vygotsky 1978). It employs a case study approach, which is a common lens for exploratory investigations in the field of EEE (e.g. Fernandes et al. 2017; Kalkani, Boussiakou, and Boussiakou 2004; Martín-Lara 2020; Papayannakis et al. 2008). The study aims to provide a holistic view of the usefulness and applicability of different active methods from the perspectives of students, educators, and EE experts. The data sources include post-course interviews with the students, educator observations, and feedback from an entrepreneurship educators' workshop. The course applied eight active methods: guest speaking, pitching, group work, case studies, reflective assignments, online search, multimedia and social media, and mentoring sessions. Our findings provide a comprehensive view of these active methods, exploring the intricacies of applying them in EEE. It thus provides entrepreneurship educators with valuable insights to enact active learning theories in their pedagogies and incorporate active methods in their curricula.

The paper is structured as follows: We start by expounding on the EE literature, especially that relevant to engineering contexts and active learning approaches. We then explain the case study methodology and the course design and report our findings from the different sources, thematically grouped against the eight applied active methods. Lastly, we discuss our findings and contributions of our study and highlight its potential limitations and future research directions to build on it.

## Literature review

### *Entrepreneurship education*

Entrepreneurship and EE is a driving force for economic development (Kuratko 2011). Indeed, EE was proven to have tangible socio-economic contributions such as venture creation, job creation, and firm growth (Nabi et al. 2017). It also increased affective entrepreneurial outcomes, including entrepreneurial intentions, orientation, mindset, and competencies development (Ilonen and Heinonen 2018; Martín-Lara 2020; Zhang and Cain 2017).

EE is defined as 'any pedagogical program or process of education for entrepreneurial attitudes and skills' (Fayolle, Gailly, and Lassas-Clerc 2006, 702). It has become a staple in HEIs in recent years, particularly in business education, STEM, and other educational disciplines (Morselli 2018; Stenard 2023). Its expansion beyond business school remits aligns with a radiant approach to EE that is decentralised, i.e. coordinated and delivered in other departments and colleges across HEIs (Katz et al. 2013; Morris, Kuratko, and Pryor 2013; Streeter, Jaquette, and Hovis 2002). Subsequently, the

attention of scholars has started shifting from pedagogical content to modes of delivery (Fayolle 2018; Fellnhofer 2019), which can be primarily attributed to the widening of the EE student base and their diverse characteristics and readiness levels (Blenker et al. 2012; Mwasalwiba 2010). Hence, there is a need to adjust our methods to more distinctive student profiles.

The pedagogical approaches to EE are commonly organised into ‘about’, ‘for’, and ‘through’ along with an increasing practical and experiential inclination (Neergaard and Christensen 2017; Pittaway and Edwards 2012). They can also be classified as ‘traditional’ and ‘active’ / ‘modern’ / ‘progressive’ approaches (Blenker et al. 2012; Lackéus, Lundqvist, and Middleton 2016; Mwasalwiba 2010). Traditional approaches rely on imparting knowledge to students through theory-laden lectures and case studies. They were shown to insufficiently engage students or develop their practical skills. More active approaches are thus receiving growing scholarly attention and progressive application in entrepreneurship courses, as they were proven to overcome traditional methods shortcomings and contribute effectively to EE’s behavioural and affective outcomes (Fayolle 2018; Lackéus, Lundqvist, and Middleton 2016).

### **Active learning theories**

Active pedagogies in education stem from the work of several scholars, most notably John Dewey (1974), Jean Piaget (1970; 1995), Lev Vygotsky (1978; 1987), and David Kolb (1984). Dewey established the principles of active learning in 1903, criticising the prevailing knowledge-imparting mechanistic approaches at that time and advocating for progressive education. He posited the educator as a maestro who orchestrated knowledge transmission and exchange in the classroom, with students actively acquiring and processing knowledge through problem-solving-based activities (Dewey 1974). Hence, cognition can be viewed as active doing emanating from learners’ experiences rather than passive knowledge ingestion. The former can be achieved through mental and physical project-based learning activities.

Piaget also rejected traditional education methods, highlighting the potential dissonance between teachers’ communicated knowledge and students’ understanding and assimilation of it (Piaget 1970; 1995). Hence, he posited that learning occurs through a constructive process of adaptation and configuration of knowledge available to the learner through his surrounding environment. Consequently, based on these stimuli, the learner reflects on and updates his mental models and structures, resulting in a continuous cognitive development and advancement process.

Vygotsky’s perspectives on learning are inclined towards and shaped by social interactive views. These were communicated through his main theories, the sociocultural development and zone of proximal development (ZPD). In Vygotsky’s philosophy, learning happens through actively interacting with the surrounding artifacts in a developmental process. Hence, the roles of context (learning environment), peers (classmates), and pedagogue (teacher) are crucial in shaping the cognitive structures of the learner, in contrast to the focus on the individual learner as the centrum of knowledge assimilation and adaptation in Dewey’s and Piaget’s views. This is reflected more explicitly in his ZPD, which highlights the role of the guidance a child (learner) receives from a more knowledgeable educator or peer. As such, the learner moves from a peripheral zone of incomplete knowledge attainment when relying on only a more competent position supported by his educator (Vygotsky 1978, 1987).

Kolb’s (1984) experiential learning model centres on experiences as the initiator of learning and the source of knowledge. Thus, learning is a ‘process by which knowledge is created through the transformation of experience’ (Kolb 1984, 41). His views were largely influenced by the work of Dewey and Piaget on active and constructivist learning, respectively. He depicted his views in the Experiential Learning Cycle, which posits that learning follows a cyclical process (Kolb and Kolb 2005). It is initiated by a concrete experience the learner goes through, followed by a reflective observation stage on the experience and sense-making. The learner subsequently conceptualises the new knowledge and updates their cognitive structure to initiate active experimentation by



implementing the new or adapted behaviours. A central critique of Kolb's experiential model is that it depicts the learning process in a rather sequential form, which may contradict the active learning principle of learning 'through' doing and thus insufficiently explain entrepreneurial learning (Fust, Jenert, and Winkler 2017).

The constructivist views of Piaget form the basis for current active learning processes, which aim at developing reasoning, problem-solving, critical thinking, and experiential learning skills (Hu and Driscoll 2013; Kirschner, Sweller, and Clark 2006). In a constructivist approach, the learner builds and updates his knowledge structures as they get exposed to and interact with artefacts in his surrounding environment (Piaget 1995). Reflection and conceptualisation, two constructs of Kolb's (1984) experiential learning, are essential elements in knowledge assimilation and cognitive and behavioural adaptation processes. These resonate with Vygotsky's (1978) premise that the surrounding context and artifacts facilitate learning and occur through social, interactive, and collaborative transactions. Hence, the learner plays an active role in acquiring and processing knowledge and updating cognitive and behavioural processes (Dewey 1974).

### ***Active pedagogies in entrepreneurship education***

Following an active learning approach in EE, the teacher's role is transformed into orchestration and facilitation (Fiet 2001; Kyrö 2015) rather than controlling the learning process through unidirectional knowledge transfer as in behaviouristic models (Kyrö 2015). Students learn by doing and reflecting on what they do (Robinson et al. 2016). Hence, they translate their experiences into acquired knowledge through interactive practices (Kolb and Kolb 2005). Experiential learning is thus congruent with active and constructivist learning, in which entrepreneurial students participate in learning episodes and practice synthesising information by reflecting on their lived entrepreneurial practical experiences (Neck and Greene 2011). Although accumulating entrepreneurial experiences does not necessarily guarantee the success of an entrepreneurial project or even pursuing one (Winkler, Fust, and Jenert 2023a), it equips learners with essential business skills, coinciding with the changing objectives of EE towards competency development. Grounding EE pedagogies in these constructs have been shown to effectively engage students and enhance their ECs by connecting knowledge and theory with their applications in a scaffolded learning approach (Fayolle 2018; Neck and Corbett 2018; Pittaway et al. 2023).

Active learning methods in EE have grown expediently in recent years (Hammoda 2023; Neck and Corbett 2018), especially with business schools and universities focusing on equipping their students with practical ECs to narrow the gap with market requirements (Aguinis et al. 2019; Pittaway et al. 2023). These include activities such as group work and presentations, student clubs (Pittaway et al. 2015), venture creation programmes (Pocek, Politis, and Gabrielsson 2021), and digital technologies such as serious games (Grivokostopoulou, Kovas, and Perikos 2019). The introduction of active methods thus contributes and aligns with a competency-based approach in EE (Morris et al. 2013), which has received more attention from scholars, educators, and policymakers in recent years (Neergaard, Robinson, and Jones 2021; QAA 2018). A competency-based approach promotes the development ECs, as a broader skill set among student entrepreneurs that connects knowledge to behavioural and affective outcomes and can be deployed in a variety of career options (Glackin and Phelan 2020; Morris et al. 2013; Nabi et al. 2017; Neergaard and Christensen 2017; QAA 2018). The competency-based view corresponds to the broader definition of EE as 'the application of enterprise behaviors, attributes and competencies into the creation of cultural, social or economic value. This can, but does not exclusively, lead to venture creation' (QAA 2018, 7). Moreover, Neck and Corbett (2018) define EE as 'developing the mindset, skill set, and practice necessary for starting new ventures, yet acknowledging the outcomes of such education are far reaching' (8).

EE delivered to engineering students has followed suit, with a growing application of active and experiential methods to develop engineering students ECs (Duval-Couetil, Shartrand, and Reed 2016). However, research on EEE is lagging practice and the wider EE scholarly field (Ferreira et al. 2021; Mäkimurto-Koivumaa and Belt 2016). More specifically, little is known about the intricacies and

impact of active methods when applied to engineering students (Duval-Couetil, Shartrand, and Reed 2016).

### ***Engineering entrepreneurship education (EEE)***

Engineering graduates are regarded as innovation beacons. Their entrepreneurial pursuits and innovative contributions drive economic development and solve pressing systematic and societal problems (Hagvall Svensson et al. 2020; Huang-Saad, Bodnar, and Carberry 2020; Siegel and Wright 2015). In the current dynamic markets, however, they are constantly prompted to assemble knowledge and develop skills beyond their specific technical domain (Aadland and Aaboen 2020; Hagvall Svensson 2023; Winkler et al. 2015; Zappe, Cutler, and Gase 2023). They are thus expected to emanate a spectrum of social and entrepreneurial competencies such as teamwork and communication abilities (Creed, Suuberg, and Crawford 2002; Täks et al. 2014), opportunity exploitation, creativity, and risk management (Hagvall Svensson et al. 2020; Nichols and Armstrong 2003).

EE is posited as an effective medium for developing these competencies (Hammoda 2023; Huang-Saad and Celis 2017; Nichols and Armstrong 2003; Täks et al. 2014, 2016). Moreover, teaching entrepreneurship in engineering curricula has grown significantly recently (Huang-Saad, Bodnar, and Carberry 2020; Zappe, Cutler, and Gase 2023). This direction is heavily supported at the policy level, recognising the valuable contribution of innovative entrepreneurial engineering graduates to national and regional economies (Commission of the European Communities 2006; National Science Foundation 2011). Several private and community organisations have also launched initiatives supporting engineering entrepreneurship (e.g. Engineering Unleashed n.d.; VentureWell 2024). In addition to the expected economic and societal impact from augmenting the innovation and entrepreneurial capacity of engineers through EE, Ferreira et al. (2021) and Paço, Ferreira, and Raposo (2017) argue that entrepreneurship is a viable alternative to the diminishing job opportunities for engineering and STEM graduates. Similarly, Duval-Couetil, Reed-Rhoads, and Haghighi (2012) reported that engineering students appreciated the broader career options provided by EE.

Several motivations can raise engineering students' interest in EE, such as a desire to create an innovative venture, self-development, or financial success (Täks et al. 2014; Yi and Duval-Couetil 2018). However, engaging them in entrepreneurial learning has proven to be a difficult task (Täks et al. 2014, 2016), which also holds for other disciplines, due to the conflict between traditional behaviouristic and modern active and socio-constructivist approaches (Günzel-Jensen and Robinson 2017; Lackéus 2015; Neergaard and Christensen 2017). Engineering education mostly follows a systematic logic that ingrains linear causal thinking among the students (Mäkimurto-Koivumaa and Belt 2016). This contradicts entrepreneurship's complex and dynamic nature (Mäkimurto-Koivumaa and Belt 2016; Sarasvathy 2001). Creed, Suuberg, and Crawford (2002) elaborated on this, saying that although engineering education does include experiential activities, these usually have a narrow scope, pre-determined goals, and take the form of small-scale design or development projects. Hence, students fail to acquire broader business and non-technical competencies. Additionally, engineering students lack the space and time resources to engage in extracurricular entrepreneurial activities, as these typically do not count towards their academic credits (Duval-Couetil, Shartrand, and Reed 2016).

Therefore, there have been growing calls to accelerate the investigation and application of active methods in EEE (e.g. Duval-Couetil, Shartrand, and Reed 2016; Herman and Stefanescu 2017; Mäkimurto-Koivumaa and Belt 2016). This rhymes with modern views of entrepreneurial learning as a continuum of socially situated interactions and aligns with a competency-based view of EE. However, there is limited research on EE pedagogies among engineering and STEM students, especially those of active and experiential nature (Duval-Couetil, Shartrand, and Reed 2016; Ferreira et al. 2021), with little known about the intricacies of their application and the impact and reception of these practices among students (Hagvall Svensson 2023; Zappe, Cutler, and Gase 2023). In the subsequent section, we discuss some of the notable work on EEE, which has sometimes been

discussed within the context of innovation and creativity (See Lemaître 2018 on developing the innovation capability among engineering students).

Creed, Suuberg, and Crawford (2002) initially investigated the impact of an entrepreneurship course delivered in conjunction with enterprises on engineering students. The students were tasked with developing an innovative idea into a viable business or product and, thus, experientially applying the knowledge and skills learned during the lectures. Students commented that the course was very valuable and helped them develop entrepreneurial and employability skills and grasp the basics of enterprise collaboration. Some notable recent scholarly work includes the study of Duval-Couetil, Shartrand, and Reed (2016), who surveyed senior-year engineering students involved in different entrepreneurship programmes across three HEIs. They found that students perceived that their levels of entrepreneurial knowledge, self-efficacy, and skills increased when engaged in active learning practices, albeit not singling out a particular method as the primary contributor. Täks et al. (2014; 2016) recorded final-year engineering students' feedback on an entrepreneurship course developed using active learning principles. The course included problem-solving challenges, role play, presentations, and peer feedback, among others. Those active methods helped nurture their interest and knowledge of entrepreneurship and develop their social and business skills. The students recognised the value that an active approach to EE can bring along four dimensions: applying it to develop engineering ideas, acquiring entrepreneurial knowledge, developing better self-awareness through group work, and adopting activity-based self-development tasks. Moreover, Mäkimurto-Koivumaa and Belt (2016) proposed a conceptual framework for teaching entrepreneurship among engineering students relying on active and constructivist principles, similar to this study. By presenting their framework, they argued that applying various active methods can yield better results and that EEE should aim first at developing students' entrepreneurial interest, creativity, and mindset through interactive and enjoyable activities.

As Brunhaver et al. (2018) and Huang-Saad, Bodnar, and Carberry (2020) concluded, our understanding of EE in engineering and its theoretical and axiological connections remains nascent, lagging broader entrepreneurship and EE research. It is not a surprise that several scholars, including Aadland and Aaboen (2020), Huang-Saad, Bodnar, and Carberry (2020), and Zappe, Cutler, and Gase (2023) argued that the EE community lacks clarity on possible approaches to teaching entrepreneurship to engineering students, which warrants further research on the topic. Hence, researchers called for advancing EE research in engineering, as to other STEM fields (Hagvall Svensson 2023; Hagvall Svensson et al. 2020; Herman and Stefanescu 2017). Especially deserving is the work that focuses on investigating active methods and the application of multiple of them in conjunction (Duval-Couetil, Shartrand, and Reed 2016; Herman and Stefanescu 2017; Huang-Saad and Celis 2017), linking them with theory and outcomes (Huang-Saad, Morton, and Libarkin 2018; Zappe, Cutler, and Gase 2023), and reporting on students' interactions and perceptions (Huang-Saad, Morton, and Libarkin 2018; Täks, Tynjälä, and Kukemelk 2016).

To follow these calls, this study investigates those previously highlighted focus areas that can offer a sizable contribution to EEE. In doing so, we report on a course that applied different active methods and aim to answer the following research questions:

- How could active learning principles emanate teaching practices within the context of a EEE course?
- How do students, educators, and EE experts perceive the impact, challenges, and opportunities of active learning methods in EEE?

## **Methodology**

### **Case context**

The study was conducted at the business school of Tallinn University of Technology (Taltech) in Estonia. In recent years, Estonia has positioned itself as an entrepreneurship hub, especially in

technology, engineering, and science. The culture in Estonia is rather pro-entrepreneurship, as it exhibits the highest number of startups per capita in Europe. The country hosts over 1,500 startups, employing nearly 10,000 people, over half from a technology background. Technology and advanced engineering startups are also vital contributors to the national economy (Startup Estonia 2023). Taltech is a university of technology that has put a strategy in place to equip its students, regardless of their field of study, with the required entrepreneurial skills. The university's vision for its graduates is to become '... able to solve complex real-world problems with an evidence-based mindset, practical engineering skills, good self-management and cooperation skills, as well as an entrepreneurial drive' (Taltech 2021, 3). This stems from its 5-year plan to position itself as an innovative and entrepreneurial university, leading the pack in engineering, technology, science, and business.

The course described in this study, titled 'Basics of Entrepreneurship', is considered one of the levers to enact this strategy. It is a compulsory course for baccalaureate students from engineering and technology disciplines and aims to create awareness and raise their interest in entrepreneurship. The course, conducted in 2022, included 18 first-year undergraduate students in engineering and information technology disciplines without previous exposure to entrepreneurship education, training, or startup activities. Fourteen (14) of the students (approximately 80%) were above 20 years of age, with over half of them (10 out of 18) having work experience. The higher age groups with bachelor's degrees and students working while/ before studying are common phenomena in Estonia (Beerkens, Mägi, and Lill 2011). Out of the 18 students, only four were females, highlighting the existing gender disparity and underrepresentation of women in the tech and engineering fields, which also extends to educational choices (Bix 2022; Paravastu and Paravastu 2023).

### **Course design**

The course design was informed by Mäkimurto-Koivumaa and Belt (2016) framework for teaching entrepreneurship to engineering students, which aims to develop the entrepreneurial mindset and equip year 1 and 2 students with basic entrepreneurial and business knowledge, which corresponds to our sample. Their model leans heavily on active learning methods, complemented by traditional approaches, such as lectures. Combining both approaches, the course design yielded a 12-week course for first-year undergraduate students from engineering and technology backgrounds. The utilisation of active and experiential approaches is considered a cornerstone to the delivery of EE among young generations in engineering disciplines (Duval-Couetil, Shartrand, and Reed 2016). The following learning objectives were planned accordingly to fulfil the course aim, following the revised Bloom's taxonomy by Anderson et al. (2001):

1. Understand the basic definitions and topics of entrepreneurship
2. Use the different frameworks and methodologies for business idea development
3. Analyse the different entrepreneurial and business models and their contexts
4. Evaluate the entrepreneurial outputs produced during the course by yourself and your peers
5. Present the different models and ideas created during the courses

The course was delivered through a series of four theory-focused lectures and 12 seminars, which provided an opportunity to enhance the understanding and application of entrepreneurial knowledge and skills through active methods. A similar approach was followed by Creed, Suuberg, and Crawford (2002) and Täks et al. (2014; 2016), when active and experiential methods were utilised to supplement and effectuate learnt knowledge. Although, Mäkimurto-Koivumaa and Belt (2016) suggested that systematic business knowledge should be delayed to a later stage of the EE course among younger engineering students, their justification that those students might lack self-efficacy to search for and recognise opportunities is primarily purposed for venture creation EE and was not supported by empirical evidence.

The active methods implemented in the course and examined in this study leveraged the active learning principles. It promoted collaborative problem-solving through project-based activities, provided learning and reflection space for the students to assimilate and update their cognitive structures, and emphasized the assistive role of the classroom environment, students, and the educator in the constructive learning process. The course structure, including the description of the activities and the applied active methods, is provided in Appendix 1. For this research, we report specifically on the active methods followed during the course.

### ***Approach***

The study relies on a single case, using the different active methods applied as our analysis unit. Case studies are used widely in education as they provide valuable insights into understanding different methods and perceptions (Yazan 2015) and are commonly used in EEE studies (e.g. Fernandes et al. 2017; Kalkani, Boussiakou, and Boussiakou 2004; Martín-Lara 2020; Papayannakis et al. 2008). Yet, applying multiple active methods among engineering students has seldom been investigated in the literature, thus representing a unique instance worthy of examination (Tellis 1997; Yin 1994). We hence followed an exploratory approach (Yin 1994) as it allows answering questions of ‘how’ and ‘why’ (Leonard-Barton 1990) and explains connections among multiple elements that cannot always be controlled by the investigator (Eisenhardt 1989). This is true for our case, which features several modalities in an interactive classroom environment.

Although statistical sampling is not an essential element of a case study design (Mitchell 1983), we relied on multiple data sources to further strengthen the validity of our analysis and findings (Meyer 2001; Tellis 1997; Yin 2003). Our data sources included semi-structured interviews, as well as educator observations to corroborate and improve our understanding of the data (Meyer 2001; Yin 1994) and highlight its nuances (Sykes 1990). Furthermore, we conducted a workshop with eight experienced entrepreneurship educators (experts) at the conclusion of the course. It was essential to examine their viewpoints concerning the possible challenges, benefits, and experiences in further applying those methods in EE. Integrating data from the different sources helped supplement our understanding of the case from various perspectives (Bergman 2008) and develop a comprehensive view (Hafiz 2008).

### ***Data sources and collection***

In this part, we provide further details on the data collection for each source: semi-structured interviews, educator observations, and expert workshops.

#### ***Semi-structured interviews***

The interviews were conducted face to face, and a voice recorder was used, to which students consented. They were carried out as flexible dialogues to improve the quality of collected responses and the strength of the research (Sykes 1990). Interviews were all performed during the week of the final seminar after all teaching and grading activities were concluded. The interviews aimed to understand the students’ reception of the different teaching methods used during the course regarding their suitability and perceived usefulness. Each interview lasted, on average, 30 min, and students were asked to share their thoughts and feedback freely without any restrictions while anonymity and confidentiality were ensured. The data from the interviews and observations was thematically grouped under each active method, representing our analysis units.

#### ***Observations and informal conversations***

The educator is a previous entrepreneur and has experience in teaching entrepreneurship and mentoring startups and entrepreneurs for several years in different regions and settings, which played a role in reducing teacher bias (Childs and Wooten 2023). The educator (participant) observations

implied the cognitive processing and reflection on students' interactions among themselves and with the educator, their engagement with the different teaching activities applied, and their level of enthusiasm and commitment in performing the required activities and assignments. Observational notes were taken during the seminars or at a later time and kept throughout the course. In addition, notes on the informal conversations and student comments during the sessions were also noted (O'Leary 2020). The data from observations were used to provide deeper explanations and fill the gaps in our understanding of the application and reception of the different active methods included in the course.

### ***Expert workshop***

A workshop was conducted with eight entrepreneurship education experts, each with at least five (5) years of experience teaching entrepreneurship at the university level. The experts represented HEIs from six (6) European countries (Denmark, England, France, Italy, Netherlands, and Spain). The workshop was conducted following the conclusion of the course during an entrepreneurship event and lasted for 2 h without students' involvement. The case context was explained, and the active methods applied in the course were highlighted without mentioning the findings from the interviews or observations. Responses were written on a large whiteboard. Each expert was asked to provide their input on the benefits and challenges of using each of the eight active methods based on their experience of applying them in the classroom. Each expert was provided with sticky notes, with two colours signalling benefits and challenges. The experts were asked to write one specific benefit or challenge on each sticky note and pin it against the corresponding active method on the whiteboard. Subsequently, all experts engaged in a discussion on their proposed views. Experts' accounts from the sticky notes and feedback from the ensuing discussion were collected. These accounts were refined to ensure alignment with active methods and incorporated into our analysis.

### ***Data analysis***

We followed Yin's (1994) and Miles and Huberman's (1994) suggested guidelines for data analysis. The data collected from the different sources was refined, reduced, and analysed, following a mainly inductive and iterative process (Strauss and Corbin 1998). The data was manually coded and thematically categorised against the different active methods as our espoused lens and unit of analysis (Tellis 1997). Hence, including an element of hybridity by integrating the codes driven from multiple sources with those from active methods and foundational learning theories (Creswell 2013; Fereday and Muir-Cochrane 2006).

The data was then exposed for further analysis to satisfy the purpose of the study in exploring the opportunities, challenges, and suitability and usefulness of active methods in EEE. Concerning the latter, we relied on a competency-based view on assessing the outcomes of the EE interventions (active methods) towards the development of the students' ECs (Hammoda 2024b; Morris et al. 2013). Conclusions were later deduced from the findings, and the results were discussed and validated against extant literature (Eisenhardt 1989).

Yin (2009) confirms that the four criteria that assure the validity and reliability of research projects must be established in case studies as well. These are construct validity, internal validity, external validity (generalizability), and reliability. Construct validity can be assured by using multiple data sources. In our study, we relied on three: interviews, observations/ informal discussions, and experts' feedback. Internal validity refers to the strength of connections among the study elements and the theoretical discourse. We built course propositions by drawing from relevant literature on EEE and the theoretical constructs of active, constructive, and experiential learning. Moreover, we ensured a clear identification of our unit of analysis and built linkages between the findings from different data sources. To overcome the generalizability (external validity) barrier in our single case (Yin 1994), we reckon that the readers, who are primarily scholars and educators in the field

of entrepreneurship and engineering, will be able to internalise the case narrative and draw correlations with their field of research/ work (Maxwell 1992; Miles and Huberman 1994). A process that Stake (1995) calls 'naturalistic' generalizability. In our case, this proposition was validated during the expert workshop. Moreover, we enhanced the reliability of the study by providing a detailed account of the case study context, data collection and analysis, and findings.

## **Findings**

In this section, we report on the findings of our study. We first highlight salient general observations. Then, we expound on the findings against each active method applied in this course as the units of analysis based on data from different sources.

### ***General findings***

Initially, students thought it would be 'the most boring course in the semester'. They expected it to be theory-laden and unidirectional, with the teacher instructing them to 'do this and do not do that'. They declared they were 'originally biased against social sciences and management studies'. Thus, introducing active teaching methods was well appreciated and contributed towards developing 'a positive vibe' among them. Students found active approaches essential in learning entrepreneurship as an unknown topic, providing sufficient theoretical knowledge while allowing them to practice it simultaneously. This was especially important as they reported that they were not exposed to business education before and that baccalaureate programmes are 'heavily theory focused without many engaging activities'.

Through the activities and interactions, which emulated real-life entrepreneurial environments, they became more confident in their abilities as potential entrepreneurs, and some even started considering the possibility of launching their businesses based on some ideas developed during the course. However, they also became more aware of their strengths, weaknesses, and the challenges they might face as entrepreneurs, and thus, the specific competencies they might need to develop further.

### ***Pitching and presenting***

Pitching and presenting were the most valued activities by students. It was primarily included to ingrain a learning-by-doing approach when the students practice operationalising the theories and knowledge they acquired (Dewey 1974). It spurred their motivation and helped them become more creative and self-confident. It also improved their communication skills and taught them better planning and management by putting theoretical knowledge into application. Students presented in front of the class five times during the course, including the final pitch event. The lecturer generally observed no correlation between classroom engagement in active learning methods and the quality of students' presentations or their confidence while presenting.

Students were nervous at the beginning, as most of them never had the chance to speak publicly or present their work before. They agreed that they lacked basic skills in this area, and the activity proved to be a great learning opportunity for them, even if they would not pursue an entrepreneurial career. As a secondary effect, presentations enhanced their English language proficiency, and they became more attentive to their work, knowing that it would be scrutinised by their colleagues publicly. This helped them learn how to handle criticism and accommodate audience reactions. Some highlighted its importance as a transferable professional competency they will need in many corporate settings. They further realised that the way they communicate their message is equally important to the knowledge they possess. As one student said: 'Doing a task is one thing, but presenting it to others is another different experience'. Some students recommended adding dedicated pitch training to help them 'learn the basics'.

EE experts believe that pitching activates students and improves their motivation and confidence. It also helps them develop and continuously improve their knowledge and skills through direct feedback from the audience. However, they also pointed out that it could be challenging with larger groups and shy students. It might also fail to achieve the desired outcomes if theoretical concepts are prioritised in their slides. Students might also become more results-oriented, 'pitching to impress', thus reducing the desired activity learning outcomes.

### ***Mentoring sessions***

The mentoring sessions were scheduled with the educator, a long-serving startup mentor, as optional opt-in activities towards the end of the course. These sessions were used to advise students on their business model canvas, pitch deck, and the final pitch event. Additionally, some students managed to schedule a mentoring session with an external mentor to advise them on their startup idea as part of the 'ask' activity, where students were asked to reach out to external startup ecosystem advisors. These 1-on-1 sessions were viewed as 'quite helpful' in improving the material they are working on and receiving tailored feedback (Vygotsky 1978), which is difficult to achieve in the classroom due to time constraints. The activity was regarded as one of the most valuable methods as students became more aware of their capabilities. The sessions also helped improve their self-confidence and helped them become more able to transform theory into valuable professional, communicative artifacts (e.g. business model canvas). Students used it to raise any 'embarrassing questions they might not feel comfortable asking in the classroom'. EE experts commented that students feel more engaged, secure, and better understood during 1-on-1 discussions with their educator, especially if the educator possesses entrepreneurial experience and can deliver personalised feedback to each student. However, mentoring sessions are seen as resource-consuming activities, requiring much of the educator's time and effort, which cannot always be accommodated.

### ***Guest speakers***

Throughout the course, eight guest speakers participated in seven guest speaking sessions. Only three guest speakers were locals and attended in person, while the rest were internationals and participated online. It was an 'exciting experience' for students to meet with people who actually 'did it' and are 'doing it for a living'. They found it interesting to learn 'first-hand' about what worked, what did not, the challenges, and best practices. Interacting with guest speakers helped them better understand contemporary entrepreneurship business models and their potential future entrepreneurial choices. Hence, they relied on guest speakers as a source of knowledge and experience that they assembled and adapted to transform their cognitive maps and behavioural aptitude (Piaget 1970). Moreover, it allowed them to expand their cultural and social learning horizons and learn about the language of entrepreneurship from the guest speakers (Vygotsky 1978). It improved their motivation to continue learning and their willingness to become entrepreneurs. Students rated guest speakers highly as an activity that helped them better identify opportunities, stay motivated, become more creative, and shape their entrepreneurial aspirations. The educator noticed that although students were mainly attentive during all guest speaker sessions, they were more engaged when guests showed up in person. Also, in a few instances when the guest speaker drifted into less relevant topics, they lost interest.

Experts commented that involving guest speakers makes the students more inspired and engaged as they hear from their entrepreneurial role models. They can provide insightful real-life examples, especially when they include the failure parts. However, reaping the full benefits can be clouded due to a lack of message clarity, inconsistency among guest speakers' reflections, and difficulties aligning their discussions with the topics being taught. It is also daunting to recruit relevant guest speakers and organise their sessions. They might also create a 'Superhero complex' among students if they focus only on moments of success in their entrepreneurial journeys (Wraae and Nybye 2024).



### **Case studies**

Short case studies were used a few times during the course to illuminate topics such as ethical issues in entrepreneurship, challenges of born globals, and growth hacking tactics. Case studies represented mental active learning exercises. Students analysed case narratives and extracted relevant knowledge. They leveraged those in conjunction with theoretical material to enhance their understanding of theory and its various real-life applications. They then acted upon the presented case information and their developed knowledge to propose solutions (Dewey 1974). Their recommendations for each case study were openly discussed within the class rather than in writing or presentations. This was aimed to improve their debating and oral communication skills further. They appreciated working on cases as they helped ‘widen their borders’ and ‘get a look under the hood’. It allowed them to better understand the issues a startup can face and how companies respond to those challenges.

The educator noticed that case studies ignited students’ critical thinking and problem-solving skills. It helped them revisit their learned theories and apply them in a practical context by analysing ‘something real’. They built cognitive scenarios as potential business leaders and managers. They reckoned that its value would extend beyond their university studies, as they could always return to their analysis to help them with future work scenarios. During the workshop, experts argued that using case studies can provide concrete and practical illustrations of how the theories and models taught can help startups through their entire lifecycle. However, one of the main shortcomings of available cases is that they demonstrate stories of famous startups and unicorns, excluding everyday entrepreneurship. They can also be tedious, ritualistic, and challenging to connect with the curriculum.

### **Groupwork**

Students worked in groups on different activities throughout the course. The aim was to develop and support their ability to learn from peers and social interactions (Vygotsky 1978). In addition, groups primarily worked on assignments and in-class activities akin to project-based active learning (Dewey 1974). The educator observed that the students seemed slightly reluctant whenever a group activity was initiated. They perceived group work as ‘mildly useful’. The educator initially attributed this to their lack of preparedness. However, later, during the interviews, some students reported wanting to work with different people every time. Thus, they recommended shuffling the groups more frequently. Still, they believed that working in teams is one of the most essential skills for entrepreneurs and discovered that it helped build more cohesive social connections with their colleagues and learn how to influence them. They also realised that they must adapt to their coworkers’ style and develop interdependent and collective attitudes.

Experts affirmed that working in groups resembles real-world professional environments, so students learn to exchange opinions effectively, work together as a team, and manage conflicts. The benefits are further emphasized in interdisciplinary teams (Volkman and Audretsch 2017). However, it can prove challenging for the educator and the students to get them all to contribute equally or agree on common goals, especially for less experienced students.

### **Reflective assignments**

Students had to produce an essay reflecting on their entrepreneurial competencies and what could have contributed to shaping them and, consequently, developing self-improvement action plans (Kolb 1984). This activity received mixed feedback from the students. Most of the students valued this activity with some stating that it was ‘the first time I take time to think about my skills’. They recognised that understanding their strengths and weaknesses is an essential first step in personal and professional development. It helped them focus their (future) efforts on improving their

weaknesses. Moreover, it encouraged them to seek new knowledge and experiences to fill their cognitive and behavioural gaps and 'view things from different perspectives'. However, some students felt they 'could have made a better use of their time', while others preferred to be offered the possibility to present or discuss their development plans. Entrepreneurship educators argued that reflective assignments can help activate students and provide a reliable tool for assessing their skills and progress when conducted over time. However, some students might view it as a duty or a punishment, especially if it fails to link with practical applications or other parts of the course.

### **Online search**

Asking students to search for specific information online was frequently used throughout the course. More essentially, at the beginning of the course, they were asked to report on a startup or an entrepreneur they liked. The educator guided this activity, following the zone of proximal development premise of Vygotsky (1987). The educator introduced the students to the relevant sources for the different types of information and explained how to perform the search in an organised and iterative approach rather than a random Google search (Vygotsky 1978). Although most students confirmed that it was not a new skill, they regarded it as an essential tool to master in today's online-driven business. They found it helpful when searching for relevant company information and performing thorough market and competitor analyses. Moreover, students learned 'what sources to go for and for which type of information' and that 'Google might not always be the best source'.

Experts call it 'Googling' and assert that it is a beneficial skill that improves students' knowledge and overall competencies. It also improves their access and exposure to previously unknown and unattainable resources and information. Although online search is becoming a favoured learning mode by young students belonging to Generation Z, to the experts' surprise, many of their students were 'bad at conducting it effectively'. They also warned that it can impede students' creativity as it does not provide personalised knowledge.

### **Multimedia and social media**

The course included displaying videos played during the seminars, or students were asked to watch them at home as supplementary material. They were used to provide complementary explanations to some topics and provided examples of contemporary entrepreneurial phenomena. Images were extensively used to bring the meaning closer and sometimes to promote students' thinking. Students reported that multimedia made comprehending specific topics easier through animated demonstrations. Moreover, it improved the course's message clarity, quality, and appeal.

Social media platforms were leveraged for reasons beyond their dominant use in literature as a communication medium. Students were asked to use Instagram, LinkedIn, and Facebook to analyse publicly available information and interpret implicit cues from startups and entrepreneurs. Multimedia and social media typify a sociocultural developmental perspective on learning. These activities raised the students' awareness of the social and cultural aspects of established and emerging entrepreneurial phenomena and the language and symbols applied in contemporary business practices (Vygotsky 1978).

The students were aware that social media plays a vital role in today's business and that all companies rely on them. They believed it could help them identify and respond to market trends and spot opportunities better as future entrepreneurs. Understanding how companies connect with their customers and brand affiliates was an enjoyable and insightful learning experience. They also found it helpful in providing up-to-date information about specific events within the entrepreneurial ecosystem. A student concluded that 'everyone is on social media and every business is on social media. So, we have to learn how to deal with it'.

Experts recounted that using multimedia and social media in EE aligns with 'modern-day students' native way of learning', as it is more related to their daily lives. Thus, it engages students by providing

them with more contemporary perspectives on the business world. However, they do not provide detailed information about most of the topics they feature. It also takes time to search for relevant information, and they might not be helpful in specific contexts such as business-to-business models.

## Discussion and implications

The development of entrepreneurship pedagogies is often insufficiently grounded in educational theories and constructs (Bécharde and Grégoire 2005; Fayolle 2013; Hammoda 2023; Kyrö 2015). Recently, it became more 'felt' as a pressing issue with the diffusion of 'for' and 'through' pedagogical thinking among entrepreneurship educators (Fayolle 2018; Hammoda 2023; Winkler et al. 2015), which rely primarily on active methods. This study aimed to fill part of this gap. It employed the principles of active learning theories based on the perspectives of John Dewey (1974), David Kolb (1984), Jean Piaget (1995), and Lev Vygotsky (1978) in designing and delivering several active methods during an entrepreneurship course for engineering undergraduate students.

The propagation of active methods in EE in recent years was shared across the board, with EEE emulating this direction (Duval-Couetil, Shartrand, and Reed 2016; Huang-Saad, Morton, and Libarkin 2018). However, little attention was given to exploring the intricacies of their application, especially in EEE settings (Duval-Couetil, Shartrand, and Reed 2016; Täks et al. 2014, 2016), beyond the causal EE outcome studies (Alakaleek, Harb, and Harb 2023; Matlay 2008). The findings of this study provided a comprehensive account of the perceptions, opportunities, and challenges of applying active methods in EEE. Moreover, it employed ECs as a lens to analyse the benefits of their application, following a competency-based view (Morris et al. 2013). It embraced the different perspectives of the students, educator, and EE experts towards active methods to provide a more holistic view, in comparison to the majority of previous studies which focused on a single actor (group) of EE only, such as the educator (e.g. Nikou, Brush, and Wraae 2023) or the students (e.g. Koropogui, St-Jean, and Zakariya 2024).

Active methods deployed through this study have proven to enhance students' ECs by engaging them in educational activities that resemble real-life settings (Neck and Corbett 2018). In engineering education, teaching entrepreneurship is argued to become more effective and efficient when active methods are utilised, especially when several of them are implemented (Mäkimurto-Koivumaa and Belt 2016; Martín-Lara 2020). They help develop broader competencies beyond technical know-how, improving entrepreneurial orientation and widening the career prospects of students, thus preparing them to become the engineers of the future or what is coined as the 'entrepreneurial engineer' (Hagvall Svensson 2023; Zappe, Cutler, and Gase 2023).

However, it is often a challenge to deliver EE to engineering students. Raising their interest in a non-technical topic and adjusting their linearly developed cognitive process (Mäkimurto-Koivumaa and Belt 2016) to a more effectual one (Saravathy 2009) could become a demanding endeavour. This was implicitly and explicitly signified while expounding on the views of the students, educator, and EE experts involved in this case. The application of several active methods in this study aimed to overcome this barrier to learning entrepreneurship among engineering students.

Regarding the individual active methods and ensuing implications, our findings confirm the premise of pitching in initiating immediate reflective learning experiences among presenters and audiences (Chang and Rieple 2013; Ulijn, Duill, and Robertson 2004), helping them develop several ECs. Hence, educators might want to repurpose the customary pitch at the end of an entrepreneurship course to repetitive, active learning experiences that extend throughout the duration of the course. They could also guide their students to alternative forms of presenting their ideas to achieve higher returns on this activity by developing additional skills, rather than confining it to a traditional representation of their theoretical knowledge. These forms can include storytelling, which is more engaging and can be promptly personalised (Haloub, Houry, and Masri 2022), or video pitching, which reaches a larger audience and provides lasting information about the venture idea (Kolbe, Mansouri, and Momtaz 2022).

Mentoring sessions were viewed as a safe space for students to discuss ideas and receive constructive feedback privately. Hence, they can be employed to improve students' self-confidence (Kuratko, Neubert, and Marvel 2021; Robinson et al. 2016; Vygotsky 1978) and provide them with more tailored guidance to enhance their ECs and propel their venture idea (Kuratko, Neubert, and Marvel 2021). Mentors can also provide their aspiring entrepreneurial students with access to a network of resources and connections, that can help validate and realise their startup potential (Rigg and O'Dwyer 2012).

In terms of guest speaking and case studies, it is crucial that educators recognise the potential negative impact of promoting famous and successful entrepreneurial exemplars on their students' morale and self-efficacy. This undesirable impact is what Bandera, Santos, and Liguori (2021) and Wraae and Nybye (2024) referred to as the 'dark side of entrepreneurship education'. Thus, examples should portray a broader spectrum of everyday entrepreneurship, including failure stories (e.g. Welter et al. 2017). Additionally, educators should be transparent with their students about the challenging realities of entrepreneurship and the potential negative psychological, social, and economic impacts (Bandera, Santos, and Liguori 2021). It is worth noting that the influence of guest speakers as experienced role models is amplified when they physically attend the class and interact personally with the students (Rigg and O'Dwyer 2012), as confirmed through our findings.

Moreover, case studies were found to help students revise, update, and apply their learned theoretical concepts to develop their critical thinking skills (Heinonen and Poikkijoki 2006), following the active and constructivist hypotheses of learning (Dewey 1974; Piaget 1995). However, their widely applied traditional (tedious) written forms could benefit from more engaging delivery modes. We urge entrepreneurship educators to try contemporary case formats, including video-based cases, which can provide memorable accounts of the desired concepts in an entertaining manner (De Beule et al. 2019), or mini-case studies which usually have shorter span with a limited number of questions aiming to address a single topic (Carloye 2017). Hence, these contemporary case formats can help overcome the attention, time, and logistical constraints with traditional case studies.

Working in groups, in the views of the students and EE experts, is an essential skill in modern professional working environments and new ventures. While research is split on the merits and contingencies of homophily versus heterogeneity (Ruef, Aldrich, and Carter 2003; Shepherd, Souitaris, and Gruber 2021), interdisciplinary teams that incorporate students from different backgrounds can improve students' aptitudes as well as the affective and socio-economic outcomes of EE (Volkman and Audretsch 2017). The student views communicated through this study confirm this direction. Hence, we join the calls of Rippa et al. (2022) and Pittaway et al. (2023) for multidisciplinary approaches to promote EE among engineering students. Indeed, HEIs and educators concerned with engineering and STEM education should focus on designing and delivering integrative active learning pedagogies that are interdisciplinary/transdisciplinary to leverage efficiencies and improve effectiveness (Klaassen 2018).

Reflective activities are a projection of existential learning (De Fillippi 2001). They allow students to understand their capabilities better, revisit their convictions, and update them as a core element of experiential and active pedagogies for effective entrepreneurial learning (Cope 2003; Kolb 1984; Neck, Greene, and Brush 2014). Learning activities of an existential nature are, however, difficult to incorporate in curricular EE due to time and space constraints (Neck and Greene 2011). Thus, there is a need to develop reflective tools that facilitate capturing students' progression throughout the learning process via more interactive and spontaneous tools. We posit that recent advances in generative artificial intelligence (AI) applications could provide a fertile ground for transforming and enriching the reflective practices in EE (Winkler et al. 2023b). Entrepreneurship educators can guide their students to utilising those heutagogical tools (Hammoda 2024a) to provide them with conversational feedback and guidance on their reflections, observations on their learning progress, and tailored assistance towards their self-development plans.

The merits of generative AI applications could extend to mitigate a limitation of another active method investigated in this study, namely, online search. Although online search is an essential

skill to master in any business context (Hammoda and Foli 2024; McGrew et al. 2018), experts pointed to search engines' 'one-size fits all' logic as a limitation to implementing them widely in active pedagogies. Indeed, it is difficult for students to conduct effective online search and evaluate digital content (McGrew and Byrne 2020). Generative AI, alternatively, can provide personalised and contextually relevant information specific to the respective student needs and entrepreneurial ideas (Hammoda 2024a).

Lastly, given that the newer generations are naturally digitally savvy, multimedia can elicit better adoption, facilitate EE delivery, and improve its outcomes (Hammoda 2024c; Neergaard and Christensen 2017). We posit that wider yet purposeful adoption of multimedia and social media beyond their communicative axiology can enhance students' understanding of the different concepts and help acquaint them with contemporary business and entrepreneurial phenomena (Hammoda 2024b). Companies in general, and entrepreneurial firms more specifically, are devoting expansive consciousness to using social media to bond with and rally their customers and supporters (Kemp et al. 2021). Hence, social media platforms are becoming a facade for relaying their social, cultural, and identity narratives (Burnell, Neubert, and Fisher 2023), which students can learn from, emanating from a sociocultural developmental learning path (Vygotsky 1978).

### ***Limitations and future research***

The study is not without its limitations. We acknowledge that a single case design limits the generalizability of our findings to other populations and contexts. To address this limitation, we triangulated our data by using multiple sources. Moreover, we provided a detailed account of the methodology and findings and discussed them against pertinent literature (Tellis 1997; Yin 2003), strengthening the study's validity and reliability (Yin 1994). Additionally, we are aware that the educator bias could have played a role in the misinterpretation of students questions (Childs and Wooten 2023), which could have resulted in filtering out or emphasizing certain observations and comments made by the students. However, as a case study design was followed versus action research (Bergmark 2020), the researcher did not project himself as a research object and his observations and notes were not used to alter the course design and delivery, as it was set beforehand.

The study provides a much-needed detailed empirical account of several active methods of EEE from the viewpoints of the students, educator, and EE experts. Future researchers might want to explore additional or alternative active methods. The study focuses primarily on undergraduate engineering students. Other scholars could replicate the study among various educational levels and disciplines. Moreover, the course was delivered within a business school, which rhymes with the magnet approach to EE (Katz et al. 2013; Streeter, Jaquette, and Hovis 2002). In the future, EE educators and scholars might want to conduct and report on active entrepreneurship pedagogical interventions delivered in cross-disciplinary manner, involving non-business educators (Morris, Kuratko, and Pryor 2013; Pittaway et al. 2023). Similarly, they can also deploy and report on them in alternative settings to HEIs, such as accelerators or intra-corporate training, where the sample comprises entrepreneurs and experienced professionals as well.

While we tried incorporating external experts' views towards EE, they mostly represented entrepreneurship educators active in other HEIs nonetheless. Their views were guided towards unveiling their experience and perspectives towards classroom-based active methods. Hence, we advocate for more inclusive research that garners the inputs of experts from the wider entrepreneurship ecosystem and industry (Bischoff, Volkman, and Audretsch 2018) and extends to active methods that eventuate outside HEIs boundaries, such as extracurricular activities (Hammoda 2023). This is especially important given that ecosystem and industry experts have specific expertise towards more active and experiential approaches to competencies development (Ahmed et al. 2020; Carbone et al. 2020), with their involvement posited as especially beneficial in engineering education (Craps et al. 2021; Valentine, Marinelli, and Male 2021).

Although the study aimed to investigate the application of several active methods in conjunction, as called for in literature (Duval-Couetil, Shartrand, and Reed 2016; Herman and Stefanescu 2017; Huang-Saad and Celis 2017), additional work might prove useful in understanding their quintessential combination for improved EE outcomes. Additionally, researchers willing to validate and propagate the findings should follow a quantitative approach through experimental designs with larger samples. Finally, with the growing adoption of online and digital pedagogies, we urge researchers to investigate the applicability and effectiveness of those active methods in tech-enabled and online EE environments (Liguori and Winkler 2020).

## Conclusion

This case study reports on an entrepreneurship education course designed and delivered to engineering baccalaureate students with no previous entrepreneurship experience or exposure to business education. Building on the principles of Dewey, Piaget, Vygotsky, and Kolb, it applied several active learning methods to improve the acceptance and effectiveness of the course. We recounted on active learning methods deployed in this course by triangulating data from students interviews, educator observations, and feedback from entrepreneurship education experts. The case study provides a comprehensive view of the opportunities and challenges for applying active methods in EEE and further establishes the grounding of EE in learning theories. It also advances the limited literature on the application of active pedagogies in EEE. Practically, it offers new and valuable insights for educators and pedagogical designers to incorporate active methods more effectively in their EEE curricula.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

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## References

Aadland, T., and L. Aaboen. 2020. "An Entrepreneurship Education Taxonomy Based on Authenticity." *European Journal of Engineering Education* 45 (5): 711–728. <https://doi.org/10.1080/03043797.2020.1732305>.

- Aguinis, H., R. S. Ramani, N. Alabduljader, J. R. Bailey, and J. Lee. 2019. "A Pluralist Conceptualization of Scholarly Impact in Management Education: Students as Stakeholders." *Academy of Management Learning & Education* 18 (1): 11–42. <https://doi.org/10.5465/amle.2017.0488>.
- Ahmed, T., V. G. R. Chandran, J. E. Klobas, F. Liñ'an, and P. Kokkalis. 2020. "Entrepreneurship Education Programmes: How Learning, Inspiration and Resources Affect Intentions for new Venture Creation in a Developing Economy." *The International Journal of Management Education* 18 (1): 100327. <https://doi.org/10.1016/j.ijme.2019.100327>.
- Alakaleek, W., Y. Harb, and A. A. Harb. 2023. "The Impact of Entrepreneurship Education: A Study of Entrepreneurial Outcomes." *The International Journal of Management Education* 21 (2): 100800. <https://doi.org/10.1016/j.ijme.2023.100800>.
- Anderson, L. W., D. R. Krathwohl, P. W. Airasian, K. A. Cruikshank, R. E. Mayer, P. R. Pintrich, J. Raths, and M. C. Wittrock. 2001. *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. New York: Longman.
- Arranz, N., F. Ubierna, M. F. Arroyabe, C. Perez, and J. C. Fdezde Arroyabe. 2017. "The Effect of Curricular and Extracurricular Activities on University Students' Entrepreneurial Intention and Competences." *Studies in Higher Education* 42 (11): 1979–2008. <https://doi.org/10.1080/03075079.2015.1130030>.
- Bandera, C., S. C. Santos, and E. W. Liguori. 2021. "The Dark Side of Entrepreneurship Education: A Delphi Study on Dangers and Unintended Consequences." *Entrepreneurship Education and Pedagogy* 4 (4): 609–636. <https://doi.org/10.1177/2515127420944592>.
- Béchar, J. P., and D. Grégoire. 2005. "Entrepreneurship Education Research Revisited: The Case of Higher Education." *Academy of Management Learning & Education* 4 (1): 22–43. <https://doi.org/10.5465/amle.2005.16132536>.
- Beerens, M., E. Mägi, and L. Lill. 2011. "University Studies as a Side Job: Causes and Consequences of Massive Student Employment in Estonia." *Higher Education* 61 (6): 679–692. <https://doi.org/10.1007/s10734-010-9356-0>.
- Bergman, M. M. 2008. "Advances in Mixed Methods Research: Theories and Applications." *Advances in Mixed Methods Research*, 1–200. <https://doi.org/10.4135/9780857024329>.
- Bergmark, U. 2020. "Rethinking Researcher–Teacher Roles and Relationships in Educational Action Research Through the use of Nel Noddings' Ethics of Care." *Educational Action Research* 28 (3): 331–344. <https://doi.org/10.1080/09650792.2019.1567367>.
- Bischoff, K., C. K. Volkmann, and D. B. Audretsch. 2018. "Stakeholder Collaboration in Entrepreneurship Education: An Analysis of the Entrepreneurial Ecosystems of European Higher Educational Institutions." *The Journal of Technology Transfer* 43 (1): 20–46. <https://doi.org/10.1007/s10961-017-9581-0>.
- Bix, A. S. 2022. *Girls Coming to Tech!: A History of American Engineering Education for Women*. MIT Press. <https://doi.org/10.7551/mitpress/9101.001.0001>
- Blenker, P., S. H. Frederiksen, S. Korsgaard, S. Müller, H. Neergaard, and C. Thrane. 2012. "Entrepreneurship as Everyday Practice: Towards a Personalized Pedagogy of Enterprise Education." *Industry and Higher Education* 26 (6): 417–430. <https://doi.org/10.5367/ihe.2012.0126>.
- Brunhaver, S. R., J. M. Bekki, A. R. Carberry, J. S. London, and A. F. McKenna. 2018. "Development of the Engineering Student Entrepreneurial Mindset Assessment (ESEMA)." *Advances in Engineering Education* 7 (1): n1.
- Burnell, D., E. Neubert, and G. Fisher. 2023. "Venture Tales: Practical Storytelling Strategies Underpinning Entrepreneurial Narratives." *Business Horizons* 66 (3): 325–346. <https://doi.org/10.1016/j.bushor.2023.01.003>.
- Carbone, A., G. M. Rayner, J. Ye, and Y. Durandet. 2020. "Connecting Curricula Content with Career Context: The Value of Engineering Industry Site Visits to Students, Academics and Industry." *European Journal of Engineering Education* 45 (6): 971–984. <https://doi.org/10.1080/03043797.2020.1806787>.
- Carloye, L. 2017. "Case Study: Mini-Case Studies: Small Infusions of Active Learning for Large-Lecture Courses." *Journal of College Science Teaching* 46 (06): 63. [https://doi.org/10.2505/4/jcst17\\_046\\_06\\_63](https://doi.org/10.2505/4/jcst17_046_06_63).
- Chang, J., and A. Rieple. 2013. "Assessing Students' Entrepreneurial Skills Development in Live Projects." *Journal of Small Business and Enterprise Development* 20 (1): 225–241. <https://doi.org/10.1108/14626001311298501>.
- Childs, T. M., and N. R. Wooten. 2023. "Teacher Bias Matters: An Integrative Review of Correlates, Mechanisms, and Consequences." *Race Ethnicity and Education* 26 (3): 368–397. <https://doi.org/10.1080/13613324.2022.2122425>.
- Commission of the European communities. 2006. *Implementing the Partnership for Growth and Jobs: Making Europe a Pole of Excellence on Corporate Social Responsibility*. <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0136:FIN:en:PDF>.
- Cope, J. 2003. "Entrepreneurial Learning and Critical Reflection: Discontinuous Events as Triggers for 'Higher-Level' Learning." *Management Learning* 34 (4): 429–450. <https://doi.org/10.1177/1350507603039067>.
- Craps, S., M. Pinxten, H. Knipprath, and G. Langie. 2021. "Different Roles, Different Demands. A Competency-Based Professional Roles Model for Early Career Engineers, Validated in Industry and Higher Education." *European Journal of Engineering Education* 47 (1): 144–163. <https://doi.org/10.1080/03043797.2021.1889468>.
- Creed, C. J., E. M. Suuberg, and G. P. Crawford. 2002. "Engineering Entrepreneurship: An Example of a Paradigm Shift in Engineering Education." *Journal of Engineering Education* 91 (2): 185–195. <https://doi.org/10.1002/j.2168-9830.2002.tb00691.x>.
- Creswell, J. W. 2013. *Steps in Conducting a Scholarly Mixed Methods Study*.

- De Beule, F., A. Jaklič, A. Kania, K. Mroczek-Dąbrowska, N. Vardar, and H. Voss. 2019. "Video Case Studies in IB Teaching: An Empirical Comparison of Academic and Student Perceptions and Expectations." *Journal of Teaching in International Business* 30 (2): 175–195. <https://doi.org/10.1080/08975930.2019.1663777>.
- De Fillippi, R. J. 2001. "Introduction: Project-Based Learning, Reflective Practices and Learning." *Management Learning* 32 (1): 5–10. <https://doi.org/10.1177/1350507601321001>.
- Dewey, J. 1903. "Democracy in Education." *The Elementary School Teacher* 4 (4): 193–204. <https://doi.org/10.1086/453309>.
- Dewey, J. 1974. John Dewey on Education: Selected Writings.
- Duval-Couetil, N., T. Reed-Rhoads, and S. Haghighi. 2012. "Engineering Students and Entrepreneurship Education: Involvement, Attitudes and Outcomes." *International Journal of Engineering Education* 28 (2): 425.
- Duval-Couetil, N., A. Shartrand, and T. Reed. 2016. "The Role of Entrepreneurship Program Models and Experiential Activities on Engineering Student Outcomes." *Advances in Engineering Education* 5 (1): n1.
- Eisenhardt, K. M. 1989. "Building Theories from Case Study Research." *The Academy of Management Review* 14 (4): 532–550. <https://doi.org/10.2307/258557>.
- Engineering Unleashed. n.d. <https://engineeringunleashed.com/>.
- Fayolle, A. 2013. "Personal Views on the Future of Entrepreneurship Education." *Entrepreneurship & Regional Development* 25 (7-8): 692–701. <https://doi.org/10.1080/08985626.2013.821318>.
- Fayolle, A., ed. 2018. *A Research Agenda for Entrepreneurship Education*. <https://doi.org/10.4337/9781786432919>
- Fayolle, A., B. Gailly, and N. Lassas-Clerc. 2006. "Assessing the Impact of Entrepreneurship Education Programmes: A new Methodology." *Journal of European Industrial Training* 30 (9): 701–720. <https://doi.org/10.1108/03090590610715022>.
- Fellnhöfer, K. 2019. "Toward a Taxonomy of Entrepreneurship Education Research Literature: A Bibliometric Mapping and Visualization." *Educational Research Review* 27:28–55. <https://doi.org/10.1016/j.edurev.2018.10.002>.
- Fereday, J., and E. Muir-Cochrane. 2006. "Demonstrating Rigor Using Thematic Analysis: A Hybrid Approach of Inductive and Deductive Coding and Theme Development." *International Journal of Qualitative Methods* 5 (1): 80–92. <https://doi.org/10.1177/160940690600500107>.
- Fernandes, J. M., P. Afonso, V. Fonte, V. Alves, and A. N. Ribeiro. 2017. "Promoting Entrepreneurship among Informatics Engineering Students: Insights from a Case Study." *European Journal of Engineering Education* 42 (1): 91–108. <https://doi.org/10.1080/03043797.2016.1197891>.
- Ferreira, J., A. Paço, M. Raposo, C. Hadjichristodoulou, and D. Marouchou. 2021. "International Entrepreneurship Education: Barriers Versus Support Mechanisms to STEM Students." *Journal of International Entrepreneurship* 19 (1): 130–147. <https://doi.org/10.1007/s10843-020-00274-4>.
- Fiet, J. O. 2001. "The Theoretical Side of Teaching Entrepreneurship." *Journal of Business Venturing* 16 (1): 1–24. [https://doi.org/10.1016/S0883-9026\(99\)00041-5](https://doi.org/10.1016/S0883-9026(99)00041-5).
- Fust, A. P., T. Jenert, and C. Winkler. 2017. "Experiential or Self-Regulated Learning: A Critical Reflection of Entrepreneurial Learning Processes." *Entrepreneurship Research Journal* 8 (2): 20170098. <https://doi.org/10.1515/erj-2017-0098>.
- Glackin, C. E., and S. E. Phelan. 2020. "Improving Entrepreneurial Competencies in the Classroom: An Extension and In-Study Replication." *New England Journal of Entrepreneurship* 23 (2): 79–96. <https://doi.org/10.1108/NEJE-04-2020-0005>.
- Grivokostopoulou, F., K. Kovas, and I. Perikos. 2019. "Examining the Impact of a Gamified Entrepreneurship Education Framework in Higher Education." *Sustainability* 11 (20): 5623. <https://doi.org/10.3390/su11205623>.
- Günzel-Jensen, F., and S. Robinson. 2017. "Effectuation in the Undergraduate Classroom: Three Barriers to Entrepreneurial Learning." *Education + Training* 59 (7/8): 780–796. <https://doi.org/10.1108/ET-03-2016-0049>.
- Hafiz, K. 2008. "Case Study Example." *The Qualitative Report* 13 (4): 544–559.
- Hagvall Svensson, O. 2023. "What Makes Entrepreneurial Learning Difficult: Cognitive Conflicts or Cultural Clashes?" *European Journal of Engineering Education* 48 (3): 391–406. <https://doi.org/10.1080/03043797.2022.2154196>.
- Hagvall Svensson, O., T. Adawi, M. Lundqvist, and K. Williams Middleton. 2020. "Entrepreneurial Engineering Pedagogy: Models, Tradeoffs and Discourses." *European Journal of Engineering Education* 45 (5): 691–710. <https://doi.org/10.1080/03043797.2019.1671811>.
- Haloub, R., G. Khoury, and A. Masri. 2022. "Resilience Through Entrepreneurial Storytelling in Extreme Contexts: A Case Study of a Pharmaceutical Company in the Palestinian Territory." *The International Journal of Entrepreneurship and Innovation* 23 (2): 111–127. <https://doi.org/10.1177/14657503221074576>.
- Hammoda, B. 2023. "Extracurricular Activities for Entrepreneurial Learning: A Typology Based on Learning Theories." *Entrepreneurship Education and Pedagogy*. <https://doi.org/10.1177/25151274231218212>.
- Hammoda, B. 2024a. "ChatGPT for Founding Teams: An Entrepreneurial Pedagogical Innovation." *International Journal of Technology in Education* 7 (1): 154–173. <https://doi.org/10.46328/ijte.530>.
- Hammoda, B. 2024b. "The Impact of Educational Technologies on Entrepreneurial Competencies: A Systematic Review of Empirical Evidence." *Knowledge Management & E-Learning: An International Journal* 16 (2): 309–333. <https://doi.org/10.34105/j.kmel.2024.16.015>.
- Hammoda, B. 2024c. "Digital Technology in Entrepreneurship Education: An Overview of the Status Quo." In *Digital Transformation for Entrepreneurship. Digital Transformation: Accelerating Organizational Intelligence*, edited by S. Durst and A. Pevkur, 71–93. World Scientific Publishing Company. [https://doi.org/10.1142/9789811270178\\_0006](https://doi.org/10.1142/9789811270178_0006).



- Hammoda, B., and S. Foli. 2024. "A Digital Competence Framework for Learners (DCFL): A Conceptual Framework for Digital Literacy." *Knowledge Management & E-Learning* 16 (3).
- Heinonen, J., and S. A. Poikkijoki. 2006. "An Entrepreneurial-Directed Approach to Entrepreneurship Education: Mission Impossible?" *Journal of Management Development* 25 (1): 80–94. <https://doi.org/10.1108/02621710610637981>.
- Herman, E., and D. Stefanescu. 2017. "Can Higher Education Stimulate Entrepreneurial Intentions among Engineering and Business Students?" *Educational Studies* 43 (3): 312–327. <https://doi.org/10.1080/03055698.2016.1277134>.
- Hu, H., and M. P. Driscoll. 2013. "Self-regulation in e-Learning Environments: A Remedy for Community College?" *Journal of Educational Technology & Society* 16 (4): 171–184.
- Huang-Saad, A., C. Bodnar, and A. Carberry. 2020. "Examining Current Practice in Engineering Entrepreneurship Education." *Entrepreneurship Education and Pedagogy* 3 (1): 4–13. <https://doi.org/10.1177/2515127419890828>.
- Huang-Saad, A., and S. Celis. 2017. "Examining Current Practice in Engineering Entrepreneurship Education." *Entrepreneurship Education and Pedagogy* 3 (2): 4–13. <https://doi.org/10.1177/2515127419890828>.
- Huang-Saad, A. Y., C. S. Morton, and J. C. Libarkin. 2018. "Entrepreneurship Assessment in Higher Education: A Research Review for Engineering Education Researchers." *Journal of Engineering Education* 107 (2): 263–290. <https://doi.org/10.1002/jee.20197>.
- Ilonen, S., and J. Heinonen. 2018. "Understanding Affective Learning Outcomes in Entrepreneurship Education." *Industry and Higher Education* 32 (6): 391–404. <https://doi.org/10.1177/0950422218805177>.
- Kakouris, A., D. Morselli, and C. Pittaway. 2023. "Editorial: Educational Theory Driven Teaching in Entrepreneurship." *The International Journal of Management Education* 21 (2), <https://doi.org/10.1016/j.ijme.2023.100814>.
- Kalkani, E. C., I. K. Boussiakou, and L. G. Boussiakou. 2004. "Application of Educational Theories in Restructuring an Introductory Course in Renewable Energy Engineering." *European Journal of Engineering Education* 29 (3): 401–413. <https://doi.org/10.1080/0304379032000157286>.
- Katz, J. A., J. Roberts, R. Strom, and A. Freilich. 2013. "Perspectives on the Development of Cross Campus Entrepreneurship Education." *Entrepreneurship Research Journal* 4 (1): 13–44. <https://doi.org/10.1515/erj-2013-0062>.
- Kemp, E., M. Porter III, N. A. Anaza, and D. J. Min. 2021. "The Impact of Storytelling in Creating Firm and Customer Connections in Online Environments." *Journal of Research in Interactive Marketing* 15 (1): 104–124. <https://doi.org/10.1108/JRIM-06-2020-0136>.
- Kirschner, P. A., J. Sweller, and R. E. Clark. 2006. "Why Minimal Guidance During Instruction Does not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching." *Educational Psychologist* 41 (2): 75–86. [https://doi.org/10.1207/s15326985ep4102\\_1](https://doi.org/10.1207/s15326985ep4102_1).
- Klaassen, R. G. 2018. "Interdisciplinary Education: A Case Study." *European Journal of Engineering Education* 43 (6): 842–859. <https://doi.org/10.1080/03043797.2018.1442417>.
- Kolb, D. A. 1984. *Experiential Learning*. Eaglewood Cliffs, NJ: Prentice Hall.
- Kolb, A. Y., and D. A. Kolb. 2005. "Learning Styles and Learning Spaces: Enhancing Experiential Learning in Higher Education." *Academy of Management Learning & Education* 4 (2): 193–212. <https://doi.org/10.5465/amle.2005.17268566>.
- Kolbe, M., S. Mansouri, and P. P. Momtaz. 2022. "Why do Video Pitches Matter in Crowdfunding?" *Journal of Economics and Business* 122:106081. <https://doi.org/10.1016/j.jeconbus.2022.106081>.
- Koropogui, S. T., É St-Jean, and S. Zakariya. 2024. "Usefulness of Practice-Based Pedagogical Approaches for Nascent Student Entrepreneurs." *Entrepreneurship Education and Pedagogy* 7 (1): 22–61. <https://doi.org/10.1177/25151274231207047>.
- Kuratko, D. F. 2011. "Entrepreneurship Theory, Process, and Practice in the 21st Century." *International Journal of Entrepreneurship and Small Business* 13 (1): 8–17. <https://doi.org/10.1504/IJESB.2011.040412>.
- Kuratko, D. F., E. Neubert, and M. R. Marvel. 2021. "Insights on the Mentorship and Coachability of Entrepreneurs." *Business Horizons* 64 (2): 199–209. <https://doi.org/10.1016/j.bushor.2020.11.001>.
- Kyrö, P. 2015. "The Conceptual Contribution of Education to Research on Entrepreneurship Education." *Entrepreneurship & Regional Development* 27 (9–10): 599–618. <https://doi.org/10.1080/08985626.2015.1085726>.
- Lackéus, M. 2015. *Entrepreneurship in Education: What, When, Why, How*. OECD. [https://www.oecd.org/cfe/leed/BGP\\_Entrepreneurship-in-Education.pdf](https://www.oecd.org/cfe/leed/BGP_Entrepreneurship-in-Education.pdf).
- Lackéus, M., M. Lundqvist, and K. W. Middleton. 2016. "Bridging the Traditional-Progressive Education Rift Through Entrepreneurship." *International Journal of Entrepreneurial Behavior & Research* 22 (6): 777–803. <https://doi.org/10.1108/IJEBR-03-2016-0072>.
- Lemaître, D., ed. 2018. *Training Engineers for Innovation*. John Wiley & Sons. <https://doi.org/10.1002/9781119563938>
- Leonard-Barton, D. 1990. "A Dual Methodology for Case Studies: Synergistic use of a Longitudinal Single Site with Replicated Multiple Sites." *Organization Science* 1 (3): 248–266. <https://doi.org/10.1287/orsc.1.3.248>.
- Liguori, E., and C. Winkler. 2020. "From Offline to Online: Challenges and Opportunities for Entrepreneurship Education Following the COVID-19 Pandemic." *Entrepreneurship Education and Pedagogy* 3 (4): 346–351. <https://doi.org/10.1177/2515127420916738>.
- Mäkimurto-Koivumaa, S., and P. Belt. 2016. "About, for, in or Through Entrepreneurship in Engineering Education." *European Journal of Engineering Education* 41 (5): 512–529. <https://doi.org/10.1080/03043797.2015.1095163>.

- Martín-Lara, M. A. 2020. "Integrating Entrepreneurial Activities in Chemical Engineering Education: A Case Study on Solid Waste Management." *European Journal of Engineering Education* 45 (5): 758–779. <https://doi.org/10.1080/03043797.2019.1691155>.
- Matlay, H. 2008. "The Impact of Entrepreneurship Education on Entrepreneurial Outcomes." *Journal of Small Business and Enterprise Development* 15 (2): 382–396. <https://doi.org/10.1108/14626000810871745>.
- Mawson, S., L. Casulli, and E. L. Simmons. 2023. "A Competence Development Approach for Entrepreneurial Mindset in Entrepreneurship Education." *Entrepreneurship Education and Pedagogy* 6 (3): 481–501. <https://doi.org/10.1177/25151274221143146>.
- Maxwell, J. 1992. "Understanding and Validity in Qualitative Research." *Harvard Educational Review* 62 (3): 279–301. <https://doi.org/10.17763/haer.62.3.8323320856251826>.
- McGrew, S., J. Breakstone, T. Ortega, M. Smith, and S. Wineburg. 2018. "Can Students Evaluate Online Sources? Learning from Assessments of Civic Online Reasoning." *Theory & Research in Social Education* 46 (2): 165–193. <https://doi.org/10.1080/00933104.2017.1416320>.
- McGrew, S., and V. L. Byrne. 2020. "Who Is Behind This? Preparing High School Students to Evaluate Online Content." *Journal of Research on Technology in Education* 53 (4): 457–475. <https://doi.org/10.1080/15391523.2020.1795956>.
- Meyer, C. B. 2001. "A Case in Case Study Methodology." *Field Methods* 13 (4): 329–352. <https://doi.org/10.1177/1525822X0101300402>.
- Miles, M. B., and A. M. Huberman. 1994. *Qualitative Data Analysis: An Expanded Sourcebook*. Thousand Oaks, CA: Sage.
- Mitchell, J. C. 1983. "Case and Situation Analysis 1." *The Sociological Review* 31 (2): 187–211. <https://doi.org/10.1111/j.1467-954x.1983.tb00387.x>.
- Morris, N. M., D. F. Kuratko, and C. G. Pryor. 2013. "Building Blocks for the Development of University-Wide Entrepreneurship." *Entrepreneurship Research Journal* 4 (1): 45–68. <https://doi.org/10.1515/erj-2013-0047>.
- Morris, M. H., J. W. Webb, J. Fu, and S. Singhal. 2013. "A Competency-Based Perspective on Entrepreneurship Education: Conceptual and Empirical Insights." *Journal of Small Business Management* 51 (3): 352–369. <https://doi.org/10.1111/jsbm.12023>.
- Morselli, D. 2018. "Teaching a Sense of Initiative and Entrepreneurship with Constructive Alignment in Tertiary non-Business Contexts." *Education+ Training* 60 (2): 122–138. <https://doi.org/10.1108/ET-06-2017-0093>.
- Mwasalwiba, E. S. 2010. "Entrepreneurship Education: A Review of its Objectives, Teaching Methods, and Impact Indicators." *Education+ Training* 52 (1): 20–47. <https://doi.org/10.1108/00400911011017663>.
- Nabi, G., F. Liñán, A. Fayolle, N. Krueger, and A. Walmsley. 2017. "The Impact of Entrepreneurship Education in Higher Education: A Systematic Review and Research Agenda." *Academy of Management Learning & Education* 16 (2): 277–299. <https://doi.org/10.5465/amle.2015.0026>.
- National Science Foundation. 2011. *Report to the National Science Board on the National Science Foundation's Merit Review Process*. (No. NSB-11-41). <https://www.nsf.gov/nsb/publications/2011/nsb1141.pdf>.
- Neck, H. M., and A. C. Corbett. 2018. "The Scholarship of Teaching and Learning Entrepreneurship." *Entrepreneurship Education and Pedagogy* 1 (1): 8–41. <https://doi.org/10.1177/2515127417737286>.
- Neck, H. M., and P. G. Greene. 2011. "Entrepreneurship Education: Known Worlds and New Frontiers." *Journal of Small Business Management* 49 (1): 55–70. <https://doi.org/10.1111/j.1540-627X.2010.00314.x>.
- Neck, H. M., O. G. Greene, and C. G. Brush. 2014. "Practice-based Entrepreneurship Education Using Actionable Theory." *Annals of Entrepreneurship Education and Pedagogy* \_ 2014 1. <https://doi.org/10.4337/9781783471454.00008>.
- Neergaard, H., and D. R. Christensen. 2017. "Breaking the Waves: Routines and Rituals in Entrepreneurship Education." *Industry and Higher Education* 31 (2): 90–100. <https://doi.org/10.1177/0950422217692479>.
- Neergaard, H., S. Robinson, and S. Jones. 2021. "Transformative Learning in the Entrepreneurship Education Process: The Role of Pedagogical Nudging and Reflection." *International Journal of Entrepreneurial Behavior & Research* 27 (1): 251–277. <https://doi.org/10.1108/IJEBR-04-2020-0235>.
- Nichols, S. P., and N. E. Armstrong. 2003. "Engineering Entrepreneurship: Does Entrepreneurship Have a Role in Engineering Education?" *IEEE Antennas and Propagation Magazine* 45 (1): 134–138. <https://doi.org/10.1109/MAP.2003.1189659>.
- Nikou, S., C. Brush, and B. Wraae. 2023. "Entrepreneurship Educators: A Configurational Analysis of Factors Influencing Pedagogical Choices." *International Journal of Entrepreneurial Behavior & Research* 29 (11): 81–108. <https://doi.org/10.1108/IJEBR-08-2022-0760>.
- O'Leary, M. 2020. *Classroom Observation: A Guide to the Effective Observation of Teaching and Learning*. Routledge. <https://doi.org/10.4324/9781315630243>
- Paço, A., J. Ferreira, and M. Raposo. 2017. "How to Foster Young Scientists' Entrepreneurial Spirit?" *International Journal of Entrepreneurship* 21 (1): 47–60.
- Papayannakis, L., I. Kastelli, D. Damigos, and G. Mavrotas. 2008. "Fostering Entrepreneurship Education in Engineering Curricula in Greece. Experience and Challenges for a Technical University." *European Journal of Engineering Education* 33 (2): 199–210. <https://doi.org/10.1080/03043790801980086>.
- Paravastu, S., and N. S. Paravastu. 2023. "Women Inclusivity in Entrepreneurial and STEM Related Education—A Case Study." *Entrepreneurship Education and Pedagogy* 6 (1): 135–147. <https://doi.org/10.1177/25151274211033163>.

- Piaget, J. 1970. "Piaget's Theory." In *Carmichaels' Manual of Child Psychology*, edited by P. Mussen, 3rd ed., vol. I, 703–732. New York: Wiley.
- Piaget, L. 1995. *Sociological Studies*, 2nd ed. Edited by I. Smith. Translated by Smith, et al. London, New York: Routledge (Original work published 1977).
- Pittaway, L., C. Brush, A. C. Corbett, and M. M. Tantawy. 2023. "Doctoral Programs in Entrepreneurship: Building Cognitive Apprenticeships." *Entrepreneurship Education and Pedagogy* 6 (4): 608–642. <https://doi.org/10.1177/25151274231153487>.
- Pittaway, L., and C. Edwards. 2012. "Assessment: Examining Practice in Entrepreneurship Education." *Education+ Training* 54 (8/9): 778–800. <https://doi.org/10.1108/00400911211274882>.
- Pittaway, L. A., J. Gazzard, A. Shore, and T. Williamson. 2015. "Student Clubs: Experiences in Entrepreneurial Learning." *Entrepreneurship & Regional Development* 27 (3-4): 127–153. <https://doi.org/10.1080/08985626.2015.1014865>.
- Poczek, J., D. Politis, and J. Gabriellsson. 2021. "Entrepreneurial Learning in Extra-Curricular Startup Programs for Students." *International Journal of Entrepreneurial Behavior & Research* 28 (2): 325–345. <https://doi.org/10.1108/IJEBR-04-2020-0206>.
- Quality Assurance Agency (QAA). 2018. *Enterprise and Entrepreneurship Education: Guidance for UK Higher Education Providers*. London: The Quality Assurance Agency for Higher Education. [https://www.qaa.ac.uk/docs/qaas/enhancement-anddevelopment/enterprise-and-entrepreneurship-education-2018.pdf?sfvrsn=15f1f981\\_8](https://www.qaa.ac.uk/docs/qaas/enhancement-anddevelopment/enterprise-and-entrepreneurship-education-2018.pdf?sfvrsn=15f1f981_8)
- Rigg, C., and B. O'Dwyer. 2012. "Becoming an Entrepreneur: Researching the Role of Mentors in Identity Construction." *Education+ Training* 54 (4): 319–329. <https://doi.org/10.1108/00400911211236181>.
- Rippa, P., G. Landi, S. Cosimato, L. Turriziani, and M. Gheith. 2022. "Embedding Entrepreneurship in Doctoral Students: The Impact of a T-Shaped Educational Approach." *European Journal of Innovation Management* 25 (1): 249–270. <https://doi.org/10.1108/EJIM-07-2020-0289>.
- Robinson, S., H. Neergaard, L. Tanggaard, and N. F. Krueger. 2016. "New Horizons in Entrepreneurship Education: From Teacher-led to Student-Centered Learning." *Education+ Training* 58 (7/8): 661–683. <https://doi.org/10.1108/ET-03-2016-0048>.
- Ruef, M., H. E. Aldrich, and N. M. Carter. 2003. "The Structure of Founding Teams: Homophily, Strong Ties, and Isolation among US Entrepreneurs." *American Sociological Review* 68:195–222. <https://doi.org/10.1177/000312240306800202>.
- Sarasvathy, S. D. 2001. "Causation and Effectuation: Toward a Theoretical Shift from Economic Inevitability to Entrepreneurial Contingency." *The Academy of Management Review* 26 (2): 243–263. <https://doi.org/10.2307/259121>.
- Sarasvathy, S. D. 2009. *Effectuation: Elements of Entrepreneurial Expertise*. Edward Elgar Publishing. <https://doi.org/10.4337/9781848440197>
- Shepherd, D. A., V. Souitaris, and M. Gruber. 2021. "Creating new Ventures: A Review and Research Agenda." *Journal of Management* 47 (1): 11–42. <https://doi.org/10.1177/0149206319900537>.
- Siegel, D. S., and M. Wright. 2015. "Academic Entrepreneurship: Time for a Rethink?" *British Journal of Management* 26 (4): 582–595. <https://doi.org/10.1111/1467-8551.12116>.
- Stake, R. E. 1995. *The art of Case Study Research*. Sage.
- Startup Estonia. 2023. *Chapter 2022 of the Estonian Startup Sector – the Test of Resilience*. <https://startupestonia.ee/statistics-surveys/chapter-2022-of-the-estonian-startup-sector-the-test-of-resilience/>.
- Stenard, B. S. 2023. "Interdisciplinary Skills for STEAM Entrepreneurship Education." *Entrepreneurship Education and Pedagogy* 6 (1): 32–59. <https://doi.org/10.1177/25151274211029204>.
- Strauss, A., and J. Corbin. 1998. *Basics of Qualitative Research Techniques*.
- Streeter, D. H., J. P. Jaquette Jr., and K. Hovis. 2002. *University-Wide Entrepreneurship Education: Alternative Models and Current Trends*. Working paper No. 127271. Ithaca, NY: Cornell University.
- Sykes, W. 1990. "Validity and Reliability in Qualitative Market Research: A Review of the Literature." *Journal of the Market Research Society* 33 (1): 1–11. <https://doi.org/10.1177/147078539103300101>.
- Täks, M., P. Tynjälä, and H. Kukemelk. 2016. "Engineering Students' Conceptions of Entrepreneurial Learning as Part of Their Education." *European Journal of Engineering Education* 41 (1): 53–69. <https://doi.org/10.1080/03043797.2015.1012708>.
- Täks, M., P. Tynjälä, M. Toding, H. Kukemelk, and U. Venesaar. 2014. "Engineering Students' Experiences in Studying Entrepreneurship." *Journal of Engineering Education* 103 (4): 573–598. <https://doi.org/10.1002/jee.20056>.
- Taltech. 2021. *Strategic Plan of Tallinn University of Technology 2021-2025*. <https://haldus.taltech.ee/sites/default/files/2021-03/StrategicPlanofTallinn%20UniversityofTechnology202021-2025.pdf>
- Tellis, W. 1997. "Application of a Case Study Methodology." *The Qualitative Report* 3 (3): 1–19. <https://doi.org/10.46743/2160-3715/1997.2015>.
- Ulijn, J. M., M. O. Duill, and S. A. Robertson. 2004. "Teaching Business Plan Negotiation: Fostering Entrepreneurship among Business and Engineering Students." *Business Communication Quarterly* 67 (1): 41–57. <https://doi.org/10.1177/1080569903262040>.
- Valentine, A., M. Marinelli, and S. Male. 2021. "Successfully Facilitating Initiation of Industry Engagement in Activities Which Involve Students in Engineering Education, Through Social Capital." *European Journal of Engineering Education* 47 (3): 413–428. <https://doi.org/10.1080/03043797.2021.2010033>.

- VentureWell. 2024. *Engineering for One Planet* | VentureWell, January 16. <https://venturewell.org/engineering-for-one-planet/>.
- Volkman, C., and D. Audretsch. 2017. "Entrepreneurship Education at Universities: Learning from Twenty European Cases." In *International Studies in Entrepreneurship*, 1–10. Springer International Publishing AG. <https://doi.org/10.1007/978-3-319-55547-8>.
- Vygotsky, L. 1978. *Mind in Society: The Development of Higher Mental Processes*. Cambridge: Harvard University Press.
- Vygotsky, L. 1987. *Thinking and Speech*. New York: Plenum.
- Welter, F., T. Baker, D. B. Audretsch, and W. B. Gartner. 2017. "Everyday Entrepreneurship—a Call for Entrepreneurship Research to Embrace Entrepreneurial Diversity." *Entrepreneurship Theory and Practice* 41 (3): 311–321. <https://doi.org/10.1111/etap.12258>.
- Winkler, C., A. Fust, and T. Jenert. 2023a. "From Entrepreneurial Experience to Expertise: A Self-Regulated Learning Perspective." *Journal of Small Business Management* 61 (4): 2071–2096. <https://doi.org/10.1080/00472778.2021.1883041>.
- Winkler, C., B. Hammada, E. Noyes, and M. Van Gelderen. 2023b. "Entrepreneurship Education at the Dawn of Generative Artificial Intelligence." *Entrepreneurship Education and Pedagogy* 6 (4): 579–589. <https://doi.org/10.1177/25151274231198799>.
- Winkler, C., E. E. Trout, C. Schweikert, and S. A. Schulman. 2015. "Infusing Business and Entrepreneurship Education Into a Computer Science Curriculum—A Case Study of the STEM Virtual Enterprise." *Journal of Business and Entrepreneurship* 27 (1): 1.
- Wraae, B., and N. Nybye. 2024. "What we Don't Talk About in Entrepreneurship: Moving the Spotlight from the "Hero Entrepreneur" to the "Unremarkable" Everyday Lives of Student Entrepreneurs." In *Contemporary Entrepreneurship: Global Perspectives and Cases*, edited by B. Hammada, and S. Durst. Routledge. <https://doi.org/10.4324/9781003371403-10>.
- Yazan, B. 2015. "Three Approaches to Case Study Methods in Education: Yin, Merriam, and Stake." *The Qualitative Report* 20 (2): 134–152. <https://doi.org/10.46743/2160-3715/2015.2102>.
- Yi, S., and N. Duval-Couetil. 2018. "What Drives Engineering Students to be Entrepreneurs? Evidence of Validity for an Entrepreneurial Motivation Scale." *Journal of Engineering Education* 107 (2): 291–317. <https://doi.org/10.1002/jee.20199>.
- Yin, R. K. 1994. "Discovering the Future of the Case Study." *Evaluation Practice* 15 (3): 283–290. <https://doi.org/10.1177/109821409401500309>.
- Yin, R. K. 2003. "Designing Case Studies." *Qualitative Research Methods* 5 (14): 359–386.
- Yin, R. K. 2009. *Case Study Research: Design and Methods*. Vol. 5. Thousand Oaks, CA: Sage.
- Zappe, S. E., S. L. Cutler, and L. Gase. 2023. "A Systematic Review of the Impacts of Entrepreneurial Support Programs in Science, Technology, Engineering, and Math Fields." *Entrepreneurship Education and Pedagogy* 6 (1): 3–31. <https://doi.org/10.1177/25151274211040422>.
- Zhang, P., and K. W. Cain. 2017. "Reassessing the Link Between Risk Aversion and Entrepreneurial Intention: The Mediating Role of the Determinants of Planned Behavior." *International Journal of Entrepreneurial Behavior & Research* 23 (5): 793–811. <https://doi.org/10.1108/IJEBR-08-2016-0248>.

## Appendix 1. Course structure.

W	Session	Topic	Description/ Activities	Active methods used
1	Lecture Seminar	Introduction to entrepreneurship Introduction to entrepreneurship	Course outline, entrepreneurial drivers, lifecycle/stages, impact <b>Views on entrepreneurship:</b> Discuss and articulate your views on entrepreneurship from social, economic, lifestyle, and innovation perspectives. <b>Startup I like:</b> Select a startup or an entrepreneur that you idolise. Search for, prepare, and present a 3-minute overview	<ul style="list-style-type: none"> <li>• Groupwork</li> <li>• Online search</li> <li>• Social media</li> <li>• Presentation</li> </ul>
2	Seminar	Entrepreneurial competences	<b>Reflective assignment:</b> Evaluate your entrepreneurial competencies using the EntreComp evaluation matrix. Reflect on their development and develop a self-improvement plan	<ul style="list-style-type: none"> <li>• Reflection</li> <li>• Multimedia</li> <li>• Guest speaker (Local entrepreneur)</li> </ul>

(Continued)

Continued.

W	Session	Topic	Description/ Activities	Active methods used
3	Lecture Seminar	Emerging trends in entrepreneurship Ethical issues	Technology, Deep tech, Climatech, Social, Fintech, Contentpreneurship <b>Data privacy case:</b> Analyse the case of (social media platform) data privacy and sharing. Provide your with and against arguments. Present possible remedies at individual, company, and policy levels	<ul style="list-style-type: none"> <li>• Case study</li> <li>• Online search</li> <li>• Guest speakers (Entrepreneurship without borders)</li> </ul>
4	Seminar	Design thinking	<b>Problematisation and prototyping:</b> Following the design thinking model, identify problems and test your proposed value proposition	<ul style="list-style-type: none"> <li>• Groupwork</li> <li>• Guest speaker (Design lab)</li> </ul>
5	Lecture Seminar	Market research Entrepreneurship ecosystem	Macro, meso & micro levels Ecosystem components	<ul style="list-style-type: none"> <li>• Guest speaker (Ecosystem builder)</li> </ul>
6	Seminar	Marketing & growth hacking	Marketing strategy and planning, growth hacking techniques <b>Social media hacking case:</b> Analyse the growth hacking techniques of (cosmetics startup) and reflect on the reasons behind its success	<ul style="list-style-type: none"> <li>• Multimedia &amp; social media</li> <li>• Case study</li> </ul>
7	Lecture Seminar	Business model Business model canvas	Types of business models, business model innovation BMC development: Groups work on developing a BMC based on their value proposition	<ul style="list-style-type: none"> <li>• Groupwork</li> </ul>
8	Seminar	Ask	Benefits and methods of asking for support. <b>Seek out:</b> Identify and profile platforms for mentoring, accelerator/ incubator, and angel network/ venture capital. Reach out to the three and request a 30-minute meeting to discuss your business idea	<ul style="list-style-type: none"> <li>• Online search</li> <li>• Mentoring</li> <li>• Guest speaker (Startup mentor)</li> </ul>
9	Seminar	Founding teams	Characteristics, best practices, and pitfalls. <b>Born globals case:</b> Analyse the challenges faced by the founding team of (the ride-sharing platform) and possible ways to mitigate them	<ul style="list-style-type: none"> <li>• Case study</li> </ul>
10	Seminar	Startup funding	Sources and phases	<ul style="list-style-type: none"> <li>• Guest speaker (VC manager)</li> </ul>
11	Seminar Office hours	Financial projections 1-on-1 mentoring	Basic financial terms and statements. <b>Financial projections exercise:</b> Build your own using the template sheet provided <b>Mentoring session:</b> 1-on-1 60-minute session with the educator at his office to get feedback on BMC, pitch deck, and practice pitching	<ul style="list-style-type: none"> <li>• Groupwork</li> <li>• Presentation</li> <li>• Mentoring</li> </ul>
12	Seminar	Pitching	<b>Final pitch:</b> Present your startup idea following the pitch deck guide	<ul style="list-style-type: none"> <li>• Guest speaker (Expert judge)</li> </ul>

**Publication IV**

Hammoda, B., & Foli, S. (2024). A digital competence framework for learners (DCFL): A conceptual framework for digital literacy. *Knowledge Management & E-Learning*, 16(3).



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## **A digital competence framework for learners (DCFL): A conceptual framework for digital literacy**

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**Abstract:** Digital technologies are the main driver of the future economy, with technology jobs and those requiring digital skills on the rise. In educational settings, there is an accelerated propagation of digital learning environments, which was amplified by the online shift following COVID-19. To equip learners with the necessary digital skills, there ought to be a purpose-built framework that can be used as a reference point. Although in recent years there were multiple attempts to develop digital literacy frameworks such as DigComp by the European Commission and the Digital Literacy Global Framework (DLGF) by UNESCO, with several other frameworks built on top of them, there is a lack of frameworks devised specifically for learners and students. This paper proposes a conceptual digital literacy framework for learners, building mainly on DigComp 2.0 and the DLGF. We use an integrative review methodology of six main empirical frameworks, developed in recent years with educational applications, to achieve our aim. We added new competencies specific to mobile learning environments and career-related digital endeavors by learners. In addition, we further tailored the competences related to device and software operations to both personal computers and mobile devices. The proposed framework in this paper expounds on DigComp and DLGF by adding several competences which are deemed essential for learners in today's digital world. The framework can be used by educational institutes, policymakers, as well as learners to assess their digital skills and devise strategies for capacity building.

**Keywords:** Digital literacy; Digital competence; Digital skill; Framework; Education

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## 1. Introduction

Digital literacy is perceived as a vital element in today's learning environment (Khan et al., 2022; Polizzi, 2020) and a requirement for improved student performance (Tohara et al., 2021). Thus, it became an essential policy agenda for many countries; whether developed or on their path of development (Law et al., 2018; Salas-Pilco, 2013). Digital literacy brings forth enormous benefits not only to individuals but also to the institutions and the society at large. It has the potential to support the development of educational institutions as learning organizations, and provide ground for dialogue, collaboration, and reflection in professional communities of practice (Caena & Redecker, 2019).

The definition of digital literacy remains inconclusive and there are several other terms that are used interchangeably across the literature to indicate the same notion (Falloon, 2020; Park et al., 2020; Stopar & Bartol, 2019), such as '*information literacy*' (Tewell, 2015; Zurkowski 1974), '*computer literacy*' (Epperson, 2010; Tsai & Hebert, 2002), '*internet literacy*' (Bauer & Ahoeei, 2018; Harrison & Alvermann, 2018), and '*media literacy*' (Christ & Potter 1998; Potter, 2018). For the purpose of this research, we anchor on the definition provided by Law et al. (2018):

*"Digital literacy is the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for employment, decent jobs and entrepreneurship. It includes competences that are variously referred to as computer literacy, ICT literacy, information literacy and media literacy."*

Many scholars share a similar view that digital literacy goes beyond the know-how of digital tools. The ability for an individual to apply his/her skills and competences to comprehend and make meaningful deductions from digital content is also essentially important. The mere fact that digital technology evolves (Hammoda, 2024a; Tang & Chaw, 2016) emphasizes the need to have an up-to-date digital literacy framework that would reflect all available information and new changes that might have transpired over time, especially with the recent massive shift to online education triggered by the COVID-19 pandemic (Hammoda et al., 2023). Although much research has been conducted on areas of digital competence and digital literacy over the past years, there is still a lack of their specific identification within an educational context (Zhao et al., 2021), especially on the learners' side (Khan et al., 2022). Pettersson (2018) also found that most extant research focuses on teachers (e.g., Borthwick & Hansen, 2017; Caena & Redecker, 2019; Falloon, 2020; Savage, 2015; Záhorec et al., 2019).

This paper aims to develop a conceptual digital competence framework specialized for learners, using an integrative literature review methodology. The proposed framework mainly relies in its building blocks on the Digital Competence Framework for Citizens

(DigComp 2.0) by Van den Brande et al. (2016) and UNESCO's 2018 global framework; Digital Literacy Global Framework (DLGF) by Law et al. (2018). The latter initially reviewed frameworks from 47 countries, then directly mapped a selected nine frameworks, including both national and enterprise digital competence frameworks, against DigComp 2.0: The European Digital Competence Framework for Citizens (Van den Brande et al., 2016) as a reference point.

We developed the following questions to guide our research after a preliminary literature review on digital competence frameworks:

**RQ1:** What is the state of the art with regard to widely recognized digital competence/literacy frameworks?

**RQ2:** What are the missing competences in those frameworks within a learner/student context in the digital era and how they can be addressed?

The paper is structured as follows. In the next section, we review and analyse extant literature on digital competences and the previous attempts at constructing digital literacy frameworks, with a special focus on the DigComp series of publications by the European Commission and UNESCO's Digital Literacy Global Framework. Then, we present the proposed Digital Competence Framework for Learners (DCFL), which highlights competence areas and individual competences with its descriptions. Afterwards, we discuss the proposed framework and contrast it with the two main frameworks we used as building blocks and benchmarks: DigComp 2.0 and UNESCO's Digital Literacy Global Framework. Lastly, we conclude by explaining the possible implications and opportunities that this framework presents as it helps advance academic discourse in this field, supports the mobilization of digital literacy initiatives within educational contexts, and provides guidance to policymakers. We identify the limitations of this paper, being of a conceptual nature, and set the future direction for research that can build on our work.

## 2. Literature review

### 2.1. Digital competence

#### 2.1.1. Origin and definitions

Digital literacy, which is often used interchangeably with digital competence (DC) (Madsen et al., 2018), especially in a European context (Ferrari, 2012; Krumsvik, 2008), was introduced by Gilster (1997). DC is one of the eight key skills for life-long learning identified by the European Union (2006). It refers to the skills and abilities needed by a person to learn and perform in a digitally empowered society (Ilomäki et al., 2016; Jones-Kavalier & Flannigan, 2021) and extends even beyond the technical skills (Bawden, 2008), to include attitudes as well (Janssen et al., 2013).

Discussions about digital literacy/digital competence have reached new heights in recent years (Gallardo-Echenique et al., 2015), and were further accelerated by the COVID-19 pandemic and its huge impact on the education industry (Zhao et al., 2021), as it increased attention to the urgent need for digital skills development in this sector (Iansiti & Richards, 2020).

### *2.1.2. Digital competence in education literature*

Although much research has been conducted on areas of digital competence and digital literacy over the past years, there is still a lack of their specific identification within an educational context (Zhao et al., 2021), especially on the learners' side, with most literature focusing on teachers (Pettersson, 2018). Since the DigComp 2.0 publication (Van den Brande et al., 2016), there have been scarce attempts to build on it by devising a digital literacy framework for students/ learners (e.g., Kampylis et al., 2017; Guitert et al., 2021). Most studies discussing the digital competences of students dealt with a certain level of education only (e.g., Aesaert et al., 2015; Generalitat de Catalunya, 2017); preceded the DigComp era (e.g., Calvani et al., 2008; Norwegian Directorate for Education and Training, 2012; Welsh Government, 2008); were mainly of empirical nature (e.g., Guzmán-Simón et al., 2017; Shariman et al., 2012) which mostly relied on questionnaires (Zhao et al., 2021); reviewed extant literature (e.g., Nowak, 2019; Zhao et al., 2021); or discussed it as a subset of digital competences in teachers (e.g., Caena & Redecker, 2019; Guillén-Gámez & Mayorga-Fernández, 2020; Svensson & Baelo, 2015). Thus, research needs to focus on producing more frameworks that address current gaps (Zhao et al., 2021), and propose new approaches for assessing and enhancing digital competence in educational contexts in general (Pettersson, 2018), and students in specific.

### *2.1.3. Digital competence in education institutes*

Digital transformation has changed and complicated education institutes (EI) operations (Hatlevik & Christophersen, 2013; Murawski & Bick, 2017; Zaphiris & Ioannou, 2018), with many EI modifying pedagogies and methods to adapt to the new digital reality (Hammada, 2023, 2024b). Although students are regarded as digital natives, a significant number only have a basic digital skills level (Bennett et al., 2008; Cabezas González & Casillas Martín, 2017; Petit et al., 2024; Zhao et al., 2021). Thus, there is an increasing urgency to improve the digital skills of learners (Bond et al., 2018), in order to graduate digitally knowledgeable citizens to engage in society (Aesaert et al., 2013; Somerville et al., 2007) and perform in the technology intense workplaces of the future (Ancarani & Di Mauro, 2018; Janssen et al., 2013). Moreover, recent use cases have emerged that necessitate advancing students' digital skills beyond basic knowledge. For example, students and their future selves as workers are faced with situations where they must deal with cyber threats and identity theft, which requires advanced technical and non-technical skills and knowledge (Falloon, 2020; Formosa et al., 2021; Palermi et al., 2017), which was highlighted under competence area 4: Safety 4.1 Protecting devices in DigComp 2.1 (Carretero et al., 2017). They are also expected to manage their digital profiles prudently and apply circumspect judgment on online information utilisation and dissemination (Labrecque et al., 2011; Van Dijck, 2013).

In response, education institutes are asked to develop both teachers' and students' digital competences (Zhao et al., 2021). However, it is argued that single actors need to take control of improving their own digital skills as well (Pettersson, 2018). There are several individual factors that were found to affect digital competence among students which need to be considered by the different EI and actors such as gender, with men found to have a higher perception of their abilities (García-Peñalvo et al., 2021), and readiness and previous digital work experience or training (Kim et al., 2019; Romero-Tena et al., 2020).

2.1.4. Digital competence importance

Digital competence has become essential for people worldwide (Castells, 2010) and it is closely connected to sustainable development (Poore, 2011; Pradhan et al., 2014; Sharma & Mokhtar, 2006), as it enables the participation of different stakeholders in society to leverage knowledge for economic progress (Hilbert, 2011; Poore, 2011). It also has a key role in improving people’s ability to leverage available information, collaborate and interact with others and participate in public life (Gallardo-Echenique et al., 2015; Zhong, 2011). In addition, most organizations these days require a decent level of digital skills (Ancarani & Di Mauro, 2018; Gallardo-Echenique et al., 2015).

Most importantly though, multiple studies have shown a clear positive association between university students’ digital competence and their performance, academic engagement, involvement in student activities and collaboration on project and group-based assignments (He & Li, 2019; He & Zhu, 2017; He et al., 2018; Kim et al., 2019).

2.2. Digital competence frameworks relevant to the learner/student context

In this part, we review and analyze the six main digital competence frameworks that are included in our integrative review. Table 1 compares these frameworks based on the competence areas, number of competences, target audience, year of publication, affiliated organizations and geographical coverage.

**Table 1**  
Comparison of digital competence frameworks relevant to the learner/student context

	DigComp 2.0	DLGF	DigCompEDU	DigComp 2.1	DCFS	COBADI ®
Competence areas						
Information and data literacy	✓	✓		✓	✓	✓
Communication and collaboration	✓	✓		✓	✓	✓
Digital content creation	✓	✓		✓	✓	✓
Safety	✓	✓		✓		
Problem-solving	✓	✓		✓	✓	
Professional engagement			✓			
Digital resources			✓			
Teaching and learning			✓			
Assessment			✓			
Empowering learners			✓			
Facilitating learners’ digital competence			✓			
Devices and software operations		✓				
Career-related competences		✓				
Digital citizenship					✓	
Number of competence areas	5	7	6	5	5	3
Number of individual competences	21	26	22	21	12	22
Intended audience/use cases	All citizens	All citizens; focus on youth.	School and university students; CPD; teacher-centric	All citizens; employment and learning use cases provided	School students (10y – 16y)	University students
Year published	2016	2018	2017	2017	2020	2020

Affiliated organization	European Commission	UNESCO	European Commission	European Commission	Higher educational institute	Higher educational institutes
Geographical merit	Europe	Global	Europe	Europe	Europe	Europe

*Source.* Compiled by authors based on their analysis of Carretero et al. (2017), Guitert et al. (2021), Law et al. (2018), López-Meneses et al. (2020), Redecker (2017), and Van den Brande et al. (2016).

### 2.2.1. *tDigComp 2.0*

Van den Brande et al. (2016) drafted the Digital Competence Framework for Citizens (DigComp 2.0) based on the prior framework (DigComp 1.0), that was originally proposed by Petit et al. in 2024. Although the motivation to ‘improve citizens’ digital competence, to help policymakers formulate policies that support digital competence building, and to plan education and training initiatives to improve the digital competence of specific target groups (Petit et al., 2024), that fueled the buildup of the previous framework was not annulled in that of DigComp 2.0 development. However, DigComp 2.0 intended to advance it by contextualizing and incorporating the concept of digitalization which over the last decade has been regarded as an innovative tool for sustainable economic growth (Myovella et al., 2020). To develop DigComp 2.0, Van den Brande et al. (2016) engaged multiple stakeholders of high expertise, such as national authorities, relevant interest groups, and others.

The architecture of DigComp 2.0 shows two phases; one of the phases depicts the conceptual reference model located at the inner core of the structure, while the other phase is the covering layer called the real framework. It is also noted that there are two dimensions for each phase: Phase 1 represents the competence areas and the competences; Phase 2 accommodates all three proficiency levels, and the description of the knowledge, skills and attitudes pertaining to each competence. It should be noted that despite DigComp 2.0’s contributions, its limited and narrow proficiency levels are a major setback (Carretero et al., 2017).

### 2.2.2. *UNESCO’s Digital Literacy Global Framework (DLGF)*

Law et al. (2018) produced a similar framework called the Digital Literacy Global Framework (DLGF), where they synthesized 47 frameworks from several geographical regions including Asia, the European Union, high-income countries outside the European Union, Latin America, the Middle East and North Africa, and Sub-Saharan Africa. In conjunction, they reviewed enterprise frameworks mainly from the ICT industry. Aside from that, they supported the results obtained from the mapping stage, with concrete data gathered through experts’ consultations and deliberations while using DigComp 2.0 as a reference point. DLGF primarily aims at enhancing digital literacy among all citizens, with much focus on youth. In addition, it serves as a bedrock for the Sustainable Development Goals (SDGs) 4.4 and 8.6, which stress the provision of digital literacy skills for the youth to help promote employment, education and training (United Nations, n.d.).

With reference to the DLGF, 7 competence areas were developed against the 5 and 6 competence areas of DigComp 2.0 and DigComp 2.1 respectively. DLGF extended DigComp 2.0 by adding two additional competence areas. The first addition is the competence area “*0. Devices and software operations*”, which identifies the necessary skills needed to operate digital hardware, tools, applications and information needed to use digital devices and related software. It has two further individual competences: “*0.1*

*Physical operations of digital devices*” and “0.2 *Software operations in digital devices*”. The second additional competence area that DLGF introduced is “6. *Career-related competences*”, which covers relevant digital skills pertinent to each professional specialization or industry; those that are considered necessary to work and advance your career in a certain field. This competence area also provided two additional individual competences: “6.1 *Operating specialized digital technologies for a particular field*” and “6.2 *Interpreting and manipulating data, information and digital content for a particular field*”. In addition, UNESCO’s DLGF introduced a fifth individual competence under competence area “5. *Problem-solving*”, which is “5.5 *Computational thinking*” provided the following description for it: “*To process a computable problem into sequential and logical steps as a solution for human and computer systems*”.

Competence areas “1. *Information and data literacy*”, “2. *Communication and collaboration*”, “3. *Digital content creation*”, “4. *Safety*”, and most of competence area “5. *Problem-solving*” remained the same as listed on DigComp 2.0 without the introduction of additional individual competences (except for competence area “5. *Problem-solving*”) or making any changes to the descriptions provided against the main competence areas or the individual competences (Law et al., 2018).

### 2.2.3. DigCompEDU

The project, carried out by Redecker (2017), developed the European Framework for the Digital Competence of Educators (DigCompEdu) which was primarily designed for educational institutes to support teachers’ practices and continuous professional development (CPD). The objective of DigCompEdu is to provide a digital pedagogical competence framework for teachers which would have a ripple effect on the quality of both online and on-site teaching-learning experiences. Apart from its emphasis on teachers, it also intends to support the growth and development of learning organizations in EU countries. DigCompEdu leveraged extended consultations with experts and practitioners, coupled with thorough analysis and synthesis of existing frameworks gathered from sub-national, national, and international levels.

The structure of the DigCompEdu framework consists of three overall areas: “*Educators’ professional competences*”, “*Educators’ pedagogic competences*”, and “*Learners’ competences*”. These 3 main areas cover six distinctive sub-areas commonly referred to as competence areas: “*Professional engagement*”, “*Digital resources*”, “*Teaching and learning*”, “*Assessment*”, “*Empowering learners*”, and “*Facilitating learners’ digital competence*”. It is observed from the framework that each of the aforementioned competence areas is assessed using a 6-pointer proficiency level drawn from the Common European Framework of Reference for Languages (CEFR) (Redecker, 2017). A major drawback of the DigCompEdu framework though, is that it is generally recognized to be more teacher-centric, with little emphasis on the learner.

### 2.2.4. DigComp 2.1

Notwithstanding the efforts made earlier to continuously update and improve digital competence frameworks, they still faced a challenge with the development of learning and teaching materials in more complex ecosystems. In response to the shortcomings of DigComp 1.0 and DigComp 2.0, Carretero et al. (2017) extended DigComp 2.0 by proposing an additional layer covering the applicability of competences to different

purposes; employment and learning to be specific. They also added 5 extra proficiency levels, to sum up to 8 in total. The framework was then called DigComp 2.1. The developmental phases of DigComp 2.1 were also supported by a series of stakeholders' consultations with the objective of expanding it and making it more comprehensive. It is however recommended as a suitable benchmark for institutes to improvise on when assessing competences of citizens for the purposes of job promotion or career guidance.

#### *2.2.5. Digital Competence Framework for Students (DCFS)*

Guitert et al. (2021) noticed the scarcity of frameworks developed for primary and secondary school students. Hence, they devised the Digital Competence Framework for Students (DCFS) for 10-16-year-olds, based primarily on DigComp 2.0, while reviewing other frameworks from seven European countries and inputs from 100+ teachers and experts. They identified five main competence areas: "*Citizenship*", "*Communication and collaboration*", "*Information seeking and management*", "*Content creation*", and "*Problem solving*". They then assigned 12 sub-competences and 35 performance (assessment) criteria among them. A major limitation of DCFS's broader application in educational settings is that it focuses on secondary school students only, which makes its ability to address the needs and competencies of tertiary students questionable.

#### *2.2.6. University Students' Basic Digital Competences 2.0 (COBADI®)*

López-Meneses et al. (2020) designed the COBADI® (University Students' Basic Digital Competences 2.0) framework/ questionnaire, which they tested among students of three European universities. They relied on the first three competence areas in DigComp 2.1 in developing it. COBADI® included three competence areas (blocks) with 22 items underneath them as follows: 1) individual competence to use technology tools (10 items); 2) digital competence in searching for, and treatment of information (8 items); and 3) ICT use as a virtual and social communication tool in the university context (4 items). Although the results of the assessment showed a crucial need to develop digital skills among university students to improve their professional and academic performance through better utilization of available digital tools, the framework was based only on a quantitative study without qualitative inputs or adequate literature review.

In conclusion, the aforementioned frameworks have not spared effort in identifying competencies needed for individuals to comprehend and utilize digital tools and artefacts across a multitude of daily settings. DigComp 2.0 is intended as a seminal framework that other scholars and policymakers can use to build on more specific utility frameworks. DLGF advanced DigComp 2.0 by adding two main competence areas. One is related to the usage of digital devices which are shaping human-machine interaction, and the other is career-oriented as a practical application of the developed digital skills. DigComp 2.1 and DigComp Edu built on DigComp 2.0 by adding specific proficiency/assessment levels for employability and learning and providing a more nuanced educator digital competence archetype respectively. DCFS while using DigComp 2.0 as a starting point, reconfigured it to suit the 10-16-year-old students' levels with COBADI developing an assessment model for the university students' digital skills, using part of the DigComp 2.1 framework.

### 3. Method

We followed an integrative review methodology (Torraco, 2016) to inspect extant literature and critique existing digital competence/ literacy frameworks. This was coupled with the author's own views. As Snyder (2019) states: "*A literature review is an excellent way of synthesizing research findings to show evidence on a meta-level and to uncover areas in which more research is needed, which is a critical component of creating theoretical frameworks and building conceptual models.*"

Although integrative reviews are not as well organized as other types of literature reviews as there are no set criteria to follow (Torraco, 2005), if done properly they can add remarkable value to both academia and practice by introducing new conceptual frameworks (MacInnis, 2011). Integrative reviews are forward-looking in nature focusing on advancing existing models and theories rather than simply reviewing and discussing previous literature. Hence, they are deemed suitable for the purpose of this paper.

We searched for relevant literature on the Scopus database as it has the largest selection of academic journals (Thelwall, 2018; Waltman, 2016). We used a combination of keywords "*digital competence*" or "*digital literacy*" and "*framework*" or "*model*" to search in the title and abstract. The first hit generated 114 articles, which were initially filtered to 48 articles by keeping only journal articles that were written in the English language and published in peer-reviewed journals. The authors had prior knowledge of the DigComp series and DLGF frameworks. Thus, we used a snowballing method as well to find relevant articles cited in them, that were not included in our database search results. A total of 26 articles were identified by the snowballing method and added to the list, to make it into 74 articles. For all 74 articles, we went through the abstracts and the methodology sections, at least, to exclude non-relevant papers. The inclusion criteria were empirical papers, incorporated Delphi expert methodology (Linstone & Turoff, 1975), developed a framework, published after DigComp and of a global or regional merit. Four articles remained after applying our selection criteria: Carretero et al. (2017); Guitert et al. (2021); López-Meneses et al. (2020); and Redecker (2017). They were added to DigComp 2.0 (Van den Brande et al., 2016) and DLGF (Law et al., 2018). The six articles and the frameworks included within each were investigated in depth, mainly focusing on the context, competence areas, individual competences, descriptions, use cases, applications and limitations.



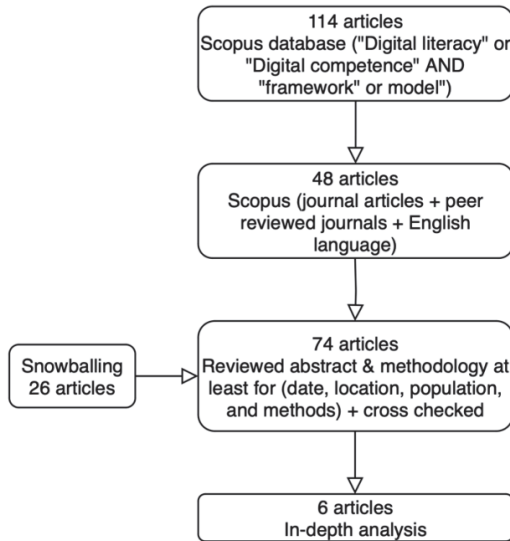


Fig. 1. Literature review steps (Compiled by authors)

#### 4. Digital Competence Framework for Learners (DCFL)

In Table 2, we present the proposed digital competence framework for learners (DCFL), based on the analysis and synthesis of reviewed frameworks and the author’s own views. The framework includes main competence areas with subsequent individual competences and the description of each. The parts that have been adjusted, synthesized or developed for the specific purpose of this framework are highlighted.

Table 2

The proposed competence areas, competences and their descriptions for the Digital Competence Framework for Learners (DCFL)

Competence areas and competences	Origin	Description
0. Devices and software operations		<ul style="list-style-type: none"> <li>To identify and use hardware tools and technologies.</li> <li>To identify data, information and digital content needed to operate software tools and technologies.</li> </ul>
0.1 Physical operations of PCs and Laptops	Adjusted from DLGF and supported by literature (e.g., Cooper, 2007; Grimes & Warschauer, 2008; Moos & Azevedo, 2009; Nusir et al., 2013)	<ul style="list-style-type: none"> <li>To identify and use the functions and features of PC and laptop tools and technologies.</li> </ul>
0.2 Software operations in PCs and Laptops		<ul style="list-style-type: none"> <li>To know and understand the data, information and/or digital content that are needed to operate software tools and technologies.</li> </ul>
0.3 Physical operations of mobile devices	Adjusted from DLGF and derived from the literature (e.g., Drigas et al., 2015; European Commission, 2020; Gikas & Grant, 2013; Martin & Martin, 2015; Woodcock et al., 2012)	<ul style="list-style-type: none"> <li>To identify and use the functions and features of mobile tools and technologies.</li> </ul>
0.4 Software operations in mobile devices		<ul style="list-style-type: none"> <li>To know and understand the data, information and/or digital content that are needed to operate software tools and technologies.</li> </ul>

1. Information and data literacy		<ul style="list-style-type: none"> <li>To articulate information needs, to locate and retrieve digital data, information and content.</li> <li>To judge the relevance of the source and its content.</li> <li>To store, manage and organize digital data, information and content.</li> </ul>
1.1 Browsing, searching and filtering data, information and digital content	DigComp 2.0	<ul style="list-style-type: none"> <li>To articulate information needs, to search for data, information and content in digital environments, to access them and to navigate between them.</li> </ul>
1.2 Evaluating data, information and digital content	DigComp 2.0	<ul style="list-style-type: none"> <li>To create and update personal search strategies.</li> <li>To analyze, compare and critically evaluate the credibility and reliability of sources of data, information and digital content.</li> <li>To analyze, interpret and critically evaluate the data, information and digital content.</li> </ul>
1.3 Managing data, information and digital content	DigComp 2.0	<ul style="list-style-type: none"> <li>To organize, store and retrieve data, information and content in digital environments.</li> <li>To organize and process them in a structured environment.</li> </ul>
<hr/>		
2. Communication and collaboration		<ul style="list-style-type: none"> <li>To interact, communicate and collaborate through digital technologies while being aware of cultural and generational diversity.</li> <li>To participate in society through public and private digital services and participatory citizenship.</li> <li>To manage one's digital identity and reputation.</li> <li>To interact through a variety of digital technologies and to understand appropriate digital communication means for a given context.</li> </ul>
2.1 Interacting through digital technologies	DigComp 2.0	<ul style="list-style-type: none"> <li>To interact through a variety of digital technologies and to understand appropriate digital communication means for a given context.</li> </ul>
2.2 Sharing through digital technologies	DigComp 2.0	<ul style="list-style-type: none"> <li>To share data, information and digital content with others through appropriate digital technologies.</li> <li>To act as an intermediary, to know about referencing and attribution practices.</li> </ul>
2.3 Engaging in citizenship through digital technologies	DigComp 2.0	<ul style="list-style-type: none"> <li>To participate in society through the use of public and private digital services.</li> <li>To seek opportunities for self-empowerment and for participatory citizenship through appropriate digital technologies.</li> </ul>
2.4 Collaborating through digital technologies	DigComp 2.0	<ul style="list-style-type: none"> <li>To use digital tools and technologies for collaborative processes and co-construction and co-creation of resources and knowledge.</li> </ul>
2.5 Netiquette	DigComp 2.0	<ul style="list-style-type: none"> <li>To be aware of behavioral norms and know-how while using digital technologies and interacting in digital environments.</li> <li>To adapt communication strategies to the specific audience and to be aware of cultural and generational diversity in digital environments.</li> </ul>
2.6 Managing digital identity	DigComp 2.0	<ul style="list-style-type: none"> <li>To create and manage one or multiple digital identities, to be able to protect one's own reputation, and to deal with the data that one produces through several digital tools, environments and services.</li> </ul>
<hr/>		
3. Digital content creation		<ul style="list-style-type: none"> <li>To create and edit digital content.</li> <li>To improve and integrate information and content into an existing body of knowledge while understanding how copyright and licenses are to be applied.</li> <li>To know how to give understandable instructions for a computer system.</li> </ul>
3.1 Developing digital content	DigComp 2.0	<ul style="list-style-type: none"> <li>To create and edit digital content in different formats, to express oneself through digital means.</li> </ul>

3.2 Integrating and re-elaborating digital content	DigComp 2.0	<ul style="list-style-type: none"> <li>To modify, refine, improve and integrate information and content into an existing body of knowledge to create new, original and relevant content and knowledge.</li> </ul>
3.3 Copyright and licenses	DigComp 2.0	<ul style="list-style-type: none"> <li>To understand how copyright and licenses apply to data, information and digital content.</li> </ul>
3.4 Programming	DigComp 2.0	<ul style="list-style-type: none"> <li>To plan and develop a sequence of understandable instructions for a computing system to solve a given problem or perform a specific task.</li> </ul>
<hr/>		
4. Safety		<ul style="list-style-type: none"> <li>To protect devices, content, personal data and privacy in digital environments. To protect physical and psychological health, and to be aware of digital technologies for social well-being and social inclusion.</li> <li>To be aware of the environmental impact of digital technologies and their use.</li> </ul>
4.1 Protecting devices	DigComp 2.0	<ul style="list-style-type: none"> <li>To protect devices and digital content, and to understand risks and threats in digital environments.</li> <li>To know about safety and security measures and to have due regard to reliability and privacy.</li> </ul>
4.2 Protecting personal data and privacy	DigComp 2.0	<ul style="list-style-type: none"> <li>To protect personal data and privacy in digital environments.</li> <li>To understand how to use and share personally identifiable information while being able to protect oneself and others from damage.</li> <li>To understand that digital services use a “<i>Privacy policy</i>” to inform how personal data is used.</li> </ul>
4.3 Protecting health and well-being	DigComp 2.0	<ul style="list-style-type: none"> <li>To be able to avoid health risks and threats to physical and psychological well-being while using digital technologies.</li> <li>To be able to protect oneself and others from possible dangers in digital environments (e.g., cyberbullying).</li> <li>To be aware of digital technologies for social well-being and social inclusion.</li> </ul>
4.4 Protecting the environment	DigComp 2.0	<ul style="list-style-type: none"> <li>To be aware of the environmental impact of digital technologies and their use.</li> </ul>
<hr/>		
5. Problem-solving		<ul style="list-style-type: none"> <li>To identify needs and problems and to resolve conceptual problems and problem situations in digital environments.</li> <li>To use digital tools to innovate processes and products.</li> <li>To keep up to date with the digital evolution.</li> </ul>
5.1 Solving technical problems	DigComp 2.0	<ul style="list-style-type: none"> <li>To identify technical problems when operating devices and using digital environments, and to solve them (from troubleshooting to solving more complex problems).</li> </ul>
5.2 Identifying needs and technological responses	DigComp 2.0	<ul style="list-style-type: none"> <li>To assess needs and to identify, evaluate, select and use digital tools and possible technological responses to solve them.</li> <li>To adjust and customize digital environments to personal needs (e.g., accessibility).</li> </ul>
5.3 Creatively using digital technologies	DigComp 2.0	<ul style="list-style-type: none"> <li>To use digital tools and technologies to create knowledge and to innovate processes and products.</li> <li>To engage individually and collectively in cognitive processing to understand and resolve conceptual problems and problem situations in digital environments.</li> </ul>
5.4 Identifying digital competence gaps	DigComp 2.0	<ul style="list-style-type: none"> <li>To understand where one’s own digital competence needs to be improved or updated.</li> <li>To be able to support others with their digital competence development.</li> <li>To seek opportunities for self-development and to keep up to date with the digital evolution.</li> </ul>

5.5 Computational thinking	DLGF	<ul style="list-style-type: none"> <li>To process a computable problem into sequential and logical steps as a solution for human and computer systems.</li> </ul>
6. Career-related competences		<ul style="list-style-type: none"> <li>To operate specialized digital technologies and to understand, analyze and evaluate specialised data, information and digital content for a particular field.</li> </ul>
6.1 Operating specialized digital technologies for a particular field	DLGF	<ul style="list-style-type: none"> <li>To identify and use specialized digital tools and technologies for a particular field.</li> </ul>
6.2 Interpreting and manipulating data, information and digital content for a particular field	DLGF	<ul style="list-style-type: none"> <li>To understand, analyze and evaluate specialised data, information and digital content for a particular field within a digital environment.</li> </ul>
6.3 Creating and editing career-related profiles	Derived from literature (e.g., Florenthal, 2015; Hinchliffe & Jolly, 2011; Jackson, 2017; Van Dijck, 2013).	<ul style="list-style-type: none"> <li>To understand the components of a curriculum vitae and how to present skills, knowledge and experience in a professional, concise and easy-to-understand way.</li> </ul>
6.4 Browsing, searching, filtering and evaluating career opportunities	Synthesized from DigComp 2.1 - Competency 1.1: Example of use 01: Employment Scenario: Job Seeking Process	<ul style="list-style-type: none"> <li>To identify and use career-related portals, advertising jobs and projects in for a particular field</li> </ul>

Source. Carretero et al. (2017); Law et al. (2018); Van den Brande et al. (2016).

## 5. Discussion

The digital revolution has transformed the way people access information and learn (Caena & Redecker, 2019; Ogbodoakum et al., 2022), especially young people who are more connected than ever (Schleicher, 2019). However, this was not matched by enough endeavors from researchers to devise a digital literacy framework specifically targeted at learners, even after the release of the EU-wide DigComp 2.0 framework in recent years (Van den Brande et al., 2016). The framework proposed through this study addresses this gap and draws inspiration from DigComp 2.1, an evolved version of DigComp 2.0 (Carretero et al., 2017), and the Digital Literacy Global Framework (DLGF). This developed framework, titled Digital Competence Framework for Learners (DCFL) (see Table 2 above), not only presents an upgraded framework but also presents a tailor-made framework specifically designed for learners.

The proposed Digital Competence Framework for Learners (DCFL) maintains all the fundamental competence areas outlined in the DLGF (Law et al., 2018). Nevertheless, a more detailed examination of the competencies within each core area of our framework reveals specific modifications. Notably, within the “*Devices and software operations*” competence area, four competences have been adjusted. These include physical operations of PCs and laptops, software operations in PCs and laptops, physical operations of mobile devices, and software operations in mobile devices. Unlike the DLGF, which covers digital devices in general (Law et al., 2018), our framework focuses exclusively on PCs, laptops, and mobile devices.

The use of computers and laptops offers numerous advantages to learners (Cooper, 2007; Grimes & Warschauer, 2008; Moos & Azevedo, 2009). One notable advantage is the development of competences in navigating the web, which allows students to access online libraries, research papers, educational websites, and digital resources (Shopova, 2014; Ukwoma et al., 2016). This access to a vast amount of information greatly facilitates self-directed learning, empowers students to gather relevant data, and improves their understanding of various subjects (Bayrak, 2022; Rana et al., 2016; Zhu et al., 2020). In

addition to accessing information, laptops and PCs can also enable students to engage in collaborative activities and communication with peers, teachers, and experts globally (Caballé et al., 2010). Online platforms like collaborative document editors and video conferencing tools serve as valuable resources for group projects, discussions, and knowledge-sharing (Kumaraswamy & Chitale, 2012). The development of competences in online collaboration and communication not only enhances students' teamwork skills but also broadens their perspectives through meaningful interactions. Furthermore, the availability of various software applications on PCs and laptops allows students to create multimedia presentations, design graphics, produce videos, and develop interactive projects (Nusir et al., 2013). These competences foster innovative thinking and also enable students to effectively showcase their knowledge and express themselves, ultimately enhancing their overall learning experience.

In a similar manner, the acquisition of skills and competences in using mobile devices is crucial for learners. As mobile devices are becoming increasingly powerful and technologically sophisticated (Aazam et al., 2021), learning with them requires that learners acquire a certain level of competency in utilizing these devices (Lim et al., 2019). In fact, the European Commission (2020) emphasizes the importance of acquiring skills in social media and mobile use as part of the Digital Competence and New Skills Agenda. One of the primary advantages of mobile devices is their portability, enabling students to access information anytime and anywhere (Chen et al., 2008). This accessibility empowers students to engage in autonomous learning, expand their knowledge beyond the boundaries of the classroom, and stay up to date with current information relevant to their studies. Additionally, mobile devices, particularly smartphones, provide students with a rich multimedia learning environment (Drigas et al., 2015). Equipped with built-in cameras, audio recorders, and video capabilities, smartphones offer opportunities for students to engage in hands-on learning experiences (Martin & Martin, 2015). By developing competences in capturing images, recording audio, and shooting videos, students can document experiments, create visual presentations, and capture real-world examples that support their learning. This interactive and engaging approach enhances their comprehension and retention of knowledge. Furthermore, smartphones provide a wide range of educational resources and applications that cater to a variety of learning styles and subjects (Woodcock et al., 2012). Students will be able to access interactive tutorials, digital textbooks, language learning tools, and academic resources tailored to meet their specific needs by developing competences in identifying and utilizing educational apps. These applications provide personalized learning experiences, reinforce concepts, and offer opportunities for practice and self-assessment.

Employability competences were separately highlighted in DLGF in comparison to DigComp 2.0 through the addition of a separate competence area "*Career-related competences*" (Law et al., 2018). We find this competence is very important to the end goal of digital literacy capacity-building programs among learners, i.e., improving their job market readiness and employability potential (Ancarani & Di Mauro, 2018; Gallardo-Echenique et al., 2015; Khan et al., 2022). As an extension of this competence area, we introduced two additional individual competencies. The first aspect is "*Creating and editing career-related profiles*," which focuses on understanding the components of a curriculum vitae (CV) and effectively presenting skills, knowledge, and experience in a professional and concise manner, including in online environments and professional communities (Florenthal, 2015; Van Dijk, 2013). Students can also present themselves in a manner that aligns with professional expectations and industry standards by carefully curating their profiles in terms of language, tone, and formatting (Hinchliffe & Jolly, 2011;

Jackson, 2017). Furthermore, regularly updating and adapting their profiles to reflect new skills, certifications, or experiences showcases their ability to learn and adapt to changing workplace dynamics, demonstrating their employability.

The second aspect is “*Browsing, searching, filtering, and evaluating career opportunities*,” which highlights the ability to identify and utilize career-related portals that advertise jobs and projects specific to a particular field. This competence aims at developing an essential skill that career-seeking graduates need to master and thus complements the existing employability competences described in the DLGF, namely “*Operating specialized digital technologies for a particular field*” and “*Interpreting and manipulating data, information, and digital content for a particular field*”, forming a comprehensive set of skill package that would allow them to find and excel in their chosen career paths. Through job portals, career websites, professional networking platforms, and industry-specific resources, students can explore a wide range of options. This exposure helps students understand the demands of the job market, and gain insights into the skills and qualifications sought by employers (Ala-Mutka, 2011; Jackson & Wilton, 2016). By actively engaging in professional communities, joining relevant groups, and connecting with industry professionals, students can leverage the power of networking and ultimately enhance their employability (Florenthal, 2015; Van Dijk, 2013).

### 5.1. Implications

This framework is among the few available frameworks discussing digital literacy within a learner context, and as the first to utilize inputs from both DigComp 2.0 (Van den Brande et al., 2016) and UNESCO’s Digital Literacy Global Framework (DLGF) (Law et al., 2018) and build on them. The proposed framework presents opportunities for advancing academic research in the field of digital competences/digital literacy and their mobilization, as an area that begs further scholarly attention (Falloon, 2020; Madsen et al., 2018). It adds a comprehensive and updated model that caters for the changes induced by COVID-19 (Zhao et al., 2021), to the short list of digital competence frameworks targeted at learners (Pettersson, 2018).

On national and regional levels, it can be used as a guide to policymakers and regulators in areas of education, employment, and industry. It can contribute to defining policies and standards for learners’ digital competence assessment and development, whether through the educational institute or by themselves (Caena & Redecker, 2019), as it has become evident that user buy-in and engagement are essential for the success of digital literacy programs (Kampylis et al., 2017). From an economic development angle, having digitally skilled graduates is becoming a critical success factor of today’s technology-reliant businesses and organizations (Ancarani & Di Mauro, 2018; Janssen et al., 2013). Educational institutes have recently started recognizing this urgent need (Bond et al., 2018) and are prioritizing the development of digital skills among their students (Aesaert et al., 2013; Somerville et al., 2007), in order to graduate digitally capable manpower. Thus, this framework supports and contributes towards digital literacy development initiatives at education institutes and within life-long learning environments, which can enhance the innovation ability (Caena & Redecker, 2019) of societies’ future workforce and entrepreneurs.

### *5.2. Limitations*

To develop the proposed framework, we conducted a thorough literature review of digital competence/literacy frameworks, including but not limited to the DigComp series of frameworks and UNESCO's Digital Literacy Global Framework. However, we understand that the reviewed literature is non-exhaustive as there is potentially an infinite number of digital competence frameworks, whether in published literature where we searched or those published by governments and industry in non-academic portals. Our proposed framework is a conceptual one, based primarily on synthesizing and integrating the reviewed literature with additional modifications and inputs supported by the literature. It will need to be further refined and validated through experts' feedback and learners' surveys, which we intend to perform as the next step. In addition, variations in technology implementation across educational institutes and other organizations, imply that the proposed digital competence framework for learners (DCFL) will need to be tailored to match its intended purpose of use in different settings.

### *5.3. Future research*

Building on this conceptual paper, further work needs to be done to improve and validate the proposed framework by following an iterative process of expert and stakeholders' consultations with item revision (Janssen et al., 2013). We intend to request and draft elaborations on examples of use for each competence as these are deemed beneficial for bringing the topic to life and improving its comprehension and application by the learner and educator (Brown, 1982; Carretero et al., 2017). We plan to include lecturers, recruiters, digital transformation experts, educational consultants, instructional designers and student representatives in our consultations. In addition, an assessment matrix for each of the seven competence areas needs to be developed that can be readily applied and utilized by the different stakeholders (Littlejohn et al., 2012): learners, educational institutions, industry and policy planners.

## **6. Conclusion**

This study followed an integrative approach to reviewing digital literacy frameworks to advance our understanding of this increasingly important field of study and to propose an updated framework that is specifically relevant to new generations of learners who are naturally digitally savvy (Schleicher, 2019). We started our search with 114 articles on Scopus and ended up reviewing 6 articles (frameworks) in depth. The resultant proposed framework builds mainly on DigComp 2.0 (Van den Brande et al., 2016) and DLGF (Law et al., 2018) and adds to 170 competences that we argue are relevant to the modern learning and professional environments. These competences address specifically the usage of mobile devices and software, including cloud-based computing, which became the main interface for machine-human interaction, in addition to competences related to managing their profiles in digital environments and searching for jobs using online portals.

### **Author Statement**

The authors declare that there is no conflict of interest.

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## References

- Aazam, M., Zeadally, S., & Flushing, E. F. (2021). Task offloading in edge computing for machine learning-based smart healthcare. *Computer Networks*, 191: 108019. <https://doi.org/10.1016/j.comnet.2021.108019>
- Aesaert, K., Van Braak, J., Van Nijlen, D., & Vanderlinde, R. (2015). Primary school pupils' ICT competences: Extensive model and scale development. *Computers & Education*, 81, 326–344. <https://doi.org/10.1016/j.compedu.2014.10.021>
- Aesaert, K., Vanderlinde, R., Tondeur, J., & Van Braak, J. (2013). The content of educational technology curricula: A cross-curricular state of the art. *Educational Technology Research and Development*, 61(1), 131–151. <https://doi.org/10.1007/s11423-012-9279-9>
- Ala-Mutka, K. (2011). *Mapping digital competence: Towards a conceptual understanding*. Institute for Prospective Technological Studies, Joint Research Centre, European Commission. Retrieved from [https://www.academia.edu/42521335/Mapping\\_Digital\\_Competence\\_Towards\\_a\\_Conceptual\\_Understanding](https://www.academia.edu/42521335/Mapping_Digital_Competence_Towards_a_Conceptual_Understanding)
- Ancarani, A., & Di Mauro, C. (2018). Successful digital transformations need a focus on the individual. In F. Schupp & H. Wöhner (Eds.), *Digitalisierung im Einkauf* (pp. 11–26). Springer.
- Bauer, A. T., & Ahooei, E. M. (2018). Rearticulating internet literacy. *Journal of Cyberspace Studies*, 2(1), 29–53. <https://doi.org/10.22059/jcss.2018.245833.1012>
- Bawden, D. (2008). Origins and concepts of digital literacy. In C. Lankshear & M. Knobel (Eds.), *Digital Literacies: Concepts, Policies and Practices* (pp. 17–32). Peter Lang.
- Bayrak, F. (2022). Associations between university students' online learning preferences, readiness, and satisfaction. *Knowledge Management & E-Learning*, 14(2), 186–201. <https://doi.org/10.34105/j.kmel.2022.14.011>
- Bennett, S., Maton, K., & Kervin, L. (2008). The 'digital natives' debate: A critical review of the evidence. *British Journal of Educational Technology*, 39(5), 775–786. <https://doi.org/10.1111/j.1467-8535.2007.00793.x>
- Bond, M., Marín, V. I., Dolch, C., Bedenlier, S., & Zawacki-Richter, O. (2018). Digital transformation in German higher education: student and teacher perceptions and usage of digital media. *International Journal of Educational Technology in Higher Education*, 15: 48. <https://doi.org/10.1186/s41239-018-0130-1>
- Borthwick, A. C., & Hansen, R. (2017). Digital literacy in teacher education: Are teacher educators competent? *Journal of Digital Learning in Teacher Education*, 33(2), 46–48. <https://doi.org/10.1080/21532974.2017.1291249>
- Brown, D. E. (1992). Using examples and analogies to remediate misconceptions in physics: Factors influencing conceptual change. *Journal of Research in Science Teaching*, 29(1), 17–34. <https://doi.org/10.1002/tea.3660290104>
- Caballé, S., Xhafa, F., & Barolli, L. (2010). Using mobile devices to support online collaborative learning. *Mobile Information Systems*, 6(1), 27–47. <https://doi.org/10.1155/2010/935169>



- Cabezas González, M., & Casillas Martín, S. (2017). ¿Son los futuros educadores sociales residentes digitales? *Revista Electrónica de Investigación Educativa*, 19(4), 61–72. <https://doi.org/10.24320/redie.2017.19.4.1369>
- Caena, F., & Redecker, C. (2019). Aligning teacher competence frameworks to 21st century challenges: The case for the European Digital Competence Framework for Educators (DIGCOMPEDU). *European Journal of Education*, 54(3), 356–369. <https://doi.org/10.1111/ejed.12345>
- Calvani, A., Cartelli, A., Fini, A., & Ranieri, M. (2008). Models and instruments for assessing digital competence at school. *Journal of E-learning and Knowledge Society*, 4(3), 183–193.
- Carretero, S., Vuorikari, R., & Punie, Y. (2017). *DigComp 2.1: The digital competence framework for citizens with eight proficiency levels and examples of use*. Joint Research Centre (European Commission). Retrieved from <https://data.europa.eu/doi/10.2760/38842>
- Castells, M. (2010). *The rise of the network society* (2nd ed.). Wiley-Blackwell.
- Chen, G. D., Chang, C. K., & Wang, C. Y. (2008). Ubiquitous learning website: Scaffold learners by mobile devices with information-aware techniques. *Computers & Education*, 50(1), 77–90. <https://doi.org/10.1016/j.compedu.2006.03.004>
- Christ, W. G., & Potter, W. J. (1998). Media literacy, media education, and the academy. *Journal of Communication*, 48(1), 5–15. <https://doi.org/10.1111/j.1460-2466.1998.tb02733.x>
- Cooper, B. (2007). Central issues in the use of computer-based materials for high volume entrepreneurship education. *Active Learning in Higher Education*, 8(3), 201–217. <https://doi.org/10.1177/1469787407081887>
- Drigas, A., Kokkalia, G., & Lytras, M. D. (2015). Mobile and multimedia learning in preschool education. *Journal of Mobile Multimedia*, 11(1/2), 119–133.
- Epperson, A. (2010). Computer literacy revisited: A comprehensive investigation of computer literacy. *ACM Inroads*, 1(2), 30–33. <https://doi.org/10.1145/1805724.1805736>
- European Commission. (2020). *European skills agenda for sustainable competitiveness, social fairness and resilience*. European Commission. Retrieved from [https://ec.europa.eu/migrant-integration/library-document/european-skills-agenda-sustainable-competitiveness-social-fairness-and-resilience\\_en](https://ec.europa.eu/migrant-integration/library-document/european-skills-agenda-sustainable-competitiveness-social-fairness-and-resilience_en)
- European Union. (2006). *Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning*. Publications Office of the European Union. Retrieved from <http://op.europa.eu/en/publication-detail/-/publication/0259ec35-9594-4648-b5a4-fb2b23218096/language-en>
- Falloon, G. (2020). From digital literacy to digital competence: The teacher digital competency (TDC) framework. *Educational Technology Research and Development*, 68, 2449–2472. <https://doi.org/10.1007/s11423-020-09767-4>
- Ferrari, A. (2012). *Digital competence in practice – An analysis of frameworks*. Publications Office of the European Union. Retrieved from <https://data.europa.eu/doi/10.2791/82116>
- Florenthal, B. (2015). Applying uses and gratifications theory to students' LinkedIn usage. *Young Consumers*, 16(1), 17–35. <https://doi.org/10.1108/yc-12-2013-00416>
- Formosa, P., Wilson, M., & Richards, D. (2021). A principlist framework for cybersecurity ethics. *Computers & Security*, 109, 102382. <https://doi.org/10.1016/j.cose.2021.102382>
- Gallardo-Echenique, E. E., De Oliveira, J. M., Marqués-Molias, L., Esteve-Mon, F., Wang, Y., & Baker, R. (2015). Digital competence in the knowledge society. *MERLOT*

- Journal of Online Learning and Teaching*, 11(1), 1–16.
- García-Peñalvo, F. J., Corell, A., Abella-García, V., & Grande-de-Prado, M. (2021). Recommendations for mandatory online assessment in higher education during the COVID-19 pandemic. In D. Burgos, A. Tlili and A. Tabacco (Eds.), *Radical Solutions for Education in a Crisis Context* (pp. 85–98). Springer. [https://doi.org/10.1007/978-981-15-7869-4\\_6](https://doi.org/10.1007/978-981-15-7869-4_6)
- Generalitat de Catalunya. (2017). *Competències bàsiques de l'àmbit digital. Identificació i desplegament a l'educació secundària obligatòria*. Departament d'Ensenyament. Retrieved from <https://educacio.gencat.cat/web/.content/home/departament/publicacions/colleccions/competencies-basiques/eso/ambit-digital.pdf>
- Gikas, J., & Grant, M. M. (2013). Mobile computing devices in higher education: Student perspectives on learning with cellphones, smartphones & social media. *The Internet and Higher Education*, 19, 18–26. <https://doi.org/10.1016/j.iheduc.2013.06.002>
- Gilster, P. (1997). *Digital literacy*. Wiley Computer Publication.
- Grimes, D., & Warschauer, M. (2008). Learning with laptops: A multi-method case study. *Journal of Educational Computing Research*, 38(3), 305–332. <https://doi.org/10.2190/EC.38.3.d>
- Guillén-Gámez, F. D., & Mayorga-Fernández, M. (2020). Quantitative-comparative research on digital competence in students, graduates and professors of faculty education: An analysis with ANOVA. *Education and Information Technologies*, 25(5), 4157–4174. <https://doi.org/10.1007/s10639-020-10160-0>
- Guitert, M., Romeu, T., & Baztán, P. (2021). The digital competence framework for primary and secondary schools in Europe. *European Journal of Education*, 56(1), 133–149. <https://doi.org/10.1111/ejed.12430>
- Guzmán-Simón, F., García-Jiménez, E., & López-Cobo, I. (2017). Undergraduate students' perspectives on digital competence and academic literacy in a Spanish University. *Computers in Human Behavior*, 74, 196–204. <https://doi.org/10.1016/j.chb.2017.04.040>
- Hammoda, B. (2023). Digital technology in entrepreneurship education: An overview of the status quo. In S. Durst & A. Pevkur (Eds.), *Digital Transformation for Entrepreneurship* (pp. 71–93). World Scientific. [https://doi.org/10.1142/9789811270178\\_0006](https://doi.org/10.1142/9789811270178_0006)
- Hammoda, B. (2024a). ChatGPT for founding teams: An entrepreneurial pedagogical innovation. *International Journal of Technology in Education*, 7(1), 154–173. <https://doi.org/10.46328/ijte.530>
- Hammoda, B. (2024b). The impact of educational technologies on entrepreneurial competencies: A systematic review of empirical evidence. *Knowledge Management & E-Learning*, 16(2), 309–333. <https://doi.org/10.34105/j.kmel.2024.16.015>
- Hammoda, B., Ellyton, M., Foli, S., Mallarge, J., Durst, S., & Rothenberger, S. (2023). Reference framework for inclusive digital education – A project report. In M., Pietrzykowski, S. Cardinali, & K. Mühlmann (Eds.), *Fostering Digital Skills and Competencies in Higher Education* (pp. 150–197). Bogucki Wydawnictwo Naukowe.
- Harrison, C., & Alvermann, D. E. (2018). Critical internet literacy: What is it, and how should we teach it? *Journal of Adolescent & Adult Literacy*, 61(4), 461–464.
- Hatlevik, O. E., & Christophersen, K. A. (2013). Digital competence at the beginning of upper secondary school: Identifying factors explaining digital inclusion. *Computers & Education*, 63, 240–247. <https://doi.org/10.1016/j.compedu.2012.11.015>
- He, T., & Li, S. (2019). A comparative study of digital informal learning: The effects of

- digital competence and technology expectancy. *British Journal of Educational Technology*, 50(4), 1744–1758. <https://doi.org/10.1111/bjet.12778>
- He, T., & Zhu, C. (2017). Digital informal learning among Chinese university students: the effects of digital competence and personal factors. *International Journal of Educational Technology in Higher Education*, 14: 44. <https://doi.org/10.1186/s41239-017-0082-x>
- He, T., Zhu, C., & Questier, F. (2018). Predicting digital informal learning: An empirical study among Chinese University students. *Asia Pacific Education Review*, 19, 79–90. <https://doi.org/10.1007/s12564-018-9517-x>
- Hilbert, M. (2011). The end justifies the definition: The manifold outlooks on the digital divide and their practical usefulness for policy-making. *Telecommunications Policy*, 35(8), 715–736. <https://doi.org/10.1016/j.telpol.2011.06.012>
- Hinchliffe, G. W., & Jolly, A. (2011). Graduate identity and employability. *British Educational Research Journal*, 37(4), 563–584. <https://doi.org/10.1080/01411926.2010.482200>
- Iansiti, M., & Richards, G. (2020, March 26). *Coronavirus is widening the corporate digital divide*. Harvard Business Review. Retrieved from <https://hbr.org/2020/03/coronavirus-is-widening-the-corporate-digital-divide>
- Iloimäki, L., Paavola, S., Lakkala, M., & Kantosalo, A. (2016). Digital competence – An emergent boundary concept for policy and educational research. *Education and Information Technologies*, 21, 655–679. <https://doi.org/10.1007/s10639-014-9346-4>
- Jackson, D. (2017). Developing pre-professional identity in undergraduates through work-integrated learning. *Higher Education*, 74, 833–853. <https://doi.org/10.1007/s10734-016-0080-2>
- Jackson, D., & Wilton, N. (2016). Developing career management competencies among undergraduates and the role of work-integrated learning. *Teaching in Higher Education*, 21(3), 266–286. <https://doi.org/10.1080/13562517.2015.1136281>
- Janssen, J., Stoyanov, S., Ferrari, A., Punie, Y., Pannekeet, K., & Sloep, P. (2013). Experts' views on digital competence: Commonalities and differences. *Computers & Education*, 68, 473–481. <https://doi.org/10.1016/j.compedu.2013.06.008>
- Jones-Kavalier, B., & Flannigan, S. (2006). *Connecting the digital dots: Literacy of the 21st century*. EDUCAUSE Review. Retrieved from <https://er.educause.edu/articles/2006/4/connecting-the-digital-dots-literacy-of-the-21st-century>
- Kampylis, P., Bacigalupo, M., Punie, Y., Redecker, C. Langer, L., Rasmussen, M., Conrads, J., Winters, N., & Geniet, A. (2017). *Digital education policies in Europe and beyond – Key design principles for more effective policies*. Publications Office of the European Union. Retrieved from <https://data.europa.eu/doi/10.2760/462941>
- Khan, N., Sarwar, A., Chen, T. B., & Khan, S. (2022). Connecting digital literacy in higher education to the 21st Century workforce. *Knowledge Management & E-Learning*, 14(1), 46–61. <https://doi.org/10.34105/j.kmel.2022.14.004>
- Kim, H. J., Hong, A. J., & Song, H. D. (2019). The roles of academic engagement and digital readiness in students' achievements in university e-learning environments. *International Journal of Educational Technology in Higher Education*, 16: 21. <https://doi.org/10.1186/s41239-019-0152-3>
- Krumsvik, R. J. (2008). Situated learning and teachers' digital competence. *Education and Information Technologies*, 13(4), 279–290. <https://doi.org/10.1007/s10639-008-9069-5>
- Kumaraswamy, K. S. N., & Chitale, C. M. (2012). Collaborative knowledge sharing strategy to enhance organizational learning. *Journal of Management Development*, 31(3), 308–322. <https://doi.org/10.1108/02621711211208934>

- Labrecque, L. I., Markos, E., & Milne, G. R. (2011). Online personal branding: Processes, challenges, and implications. *Journal of Interactive Marketing*, 25(1), 37–50. <https://doi.org/10.1016/j.intmar.2010.09.002>
- Law, N., Woo, D., & Wong, G. (2018). *A global framework of reference on digital literacy skills for indicator 4.4.2*. UNESCO. Retrieved from <http://uis.unesco.org/sites/default/files/documents/ip51-global-framework-reference-digital-literacy-skills-2018-en.pdf>
- Lim, G., Shelley, A., & Heo, D. (2019). The regulation of learning and co-creation of new knowledge in mobile learning. *Knowledge Management & E-Learning*, 11(4), 449–484. <https://doi.org/10.34105/j.kmel.2019.11.024>
- Linstone, H. A., & Turoff, M. (1975). *The Delphi method: Techniques and applications*. Addison-Wesley.
- Littlejohn, A., Beetham, H., & McGill, L. (2012). Learning at the digital frontier: A review of digital literacies in theory and practice. *Journal of Computer Assisted Learning*, 28(6), 547–556. <https://doi.org/10.1111/j.1365-2729.2011.00474.x>
- López-Meneses, E., Sirignano, F. M., Vázquez-Cano, E., & Ramírez-Hurtado, J. M. (2020). University students' digital competence in three areas of the DigCom 2.1 model: A comparative study at three European universities. *Australasian Journal of Educational Technology*, 36(3), 69–88. <https://doi.org/10.14742/ajet.5583>
- MacInnis, D. J. (2011). A framework for conceptual contributions in marketing. *Journal of Marketing*, 75(4), 136–154. <https://doi.org/10.1509/jmkg.75.4.136>
- Madsen, S. S., Thorvaldsen, S., & Archard, S. (2018). Teacher educators' perceptions of working with digital technologies. *Nordic Journal of Digital Literacy*, 13(3), 177–196. <https://doi.org/10.18261/issn.1891-943x-2018-03-04>
- Martin, N. A., & Martin, R. (2015). Would you watch it? Creating effective and engaging video tutorials. *Journal of Library & Information Services in Distance Learning*, 9(1/2), 40–56. <https://doi.org/10.1080/1533290X.2014.946345>
- Moos, D. C., & Azevedo, R. (2009). Learning with computer-based learning environments: A literature review of computer self-efficacy. *Review of Educational Research*, 79(2), 576–600. <https://doi.org/10.3102/0034654308326083>
- Murawski, M., & Bick, M. (2017). Digital competences of the workforce – A research topic? *Business Process Management Journal*, 23(3), 721–734. <https://doi.org/10.1108/BPMJ-06-2016-0126>
- Myovella, G., Karacuka, M., & Haucap, J. (2020). Digitalization and economic growth: A comparative analysis of Sub-Saharan Africa and OECD economies. *Telecommunications Policy*, 44(2): 101856. <https://doi.org/10.1016/j.tepol.2019.101856>
- Norwegian Directorate for Education and Training. (2012). *Framework for basic skills*. Norwegian Ministry of Education and Research. Retrieved from [https://www.udir.no/contentassets/fd2d6bfbf2364e1c98b73e030119bd38/framework\\_for\\_basic\\_skills.pdf](https://www.udir.no/contentassets/fd2d6bfbf2364e1c98b73e030119bd38/framework_for_basic_skills.pdf)
- Nowak, B. M. (2019). The development of digital competence of students of teacher training studies – Polish cases. *International Journal of Higher Education*, 8(6), 262–266. <https://doi.org/10.5430/ijhe.v8n6p262>
- Nusir, S., Alsmadi, I., Al-Kabi, M., & Sharadgah, F. (2013). Studying the impact of using multimedia interactive programs on children's ability to learn basic math skills. *E-learning and Digital Media*, 10(3), 305–319. <https://doi.org/10.2304/elea.2013.10.3.305>
- Ogbodoakum, N., Ayub, A. F. M., & Abiddin, N. Z. (2022). The influence of individual

- and organizational factors on readiness to accept online learning among higher education lecturers in Nigeria. *Knowledge Management & E-Learning*, 14(3), 304–328. <https://doi.org/10.34105/j.kmel.2022.14.017>
- Palermi, A. L., Servidio, R., Bartolo, M. G., & Costabile, A. (2017). Cyberbullying and self-esteem: An Italian study. *Computers in Human Behavior*, 69, 136–141. <https://doi.org/10.1016/j.chb.2016.12.026>
- Park, H., Kim, H. S., & Park, H. W. (2020). A scientometric study of digital literacy, ICT literacy, information literacy, and media literacy. *Journal of Data and Information Science*, 6(2), 116–138. <https://doi.org/10.2478/jdis-2021-0001>
- Petit, A., Wala, Z., Ciucci, M., & Martinello B. (2024). *Digital agenda for Europe*. European Parliament. Retrieved from <https://www.europarl.europa.eu/factsheets/en/sheet/64/digital-agenda-for-europe>
- Pettersson, F. (2018). On the issues of digital competence in educational contexts – A review of literature. *Education and Information Technologies*, 23(3), 1005–1021. <https://doi.org/10.1007/s10639-017-9649-3>
- Polizzi, G. (2020). Digital literacy and the national curriculum for England: Learning from how the experts engage with and evaluate online content. *Computers & Education*, 152: 103859. <https://doi.org/10.1016/j.compedu.2020.103859>
- Poore, M. (2011). Digital literacy: Human flourishing and collective intelligence in a knowledge society. *Literacy learning: The Middle Years*, 19(2), 20–26. Retrieved from <https://search.informit.org/doi/10.3316/aejpt.187377>
- Potter, W. J. (2018). *Media literacy*. Sage Publications.
- Pradhan, R. P., Arvin, M. B., Norman, N. R., & Bele, S. K. (2014). Economic growth and the development of telecommunications infrastructure in the G-20 countries: A panel-VAR approach. *Telecommunications Policy*, 38(7), 634–649. <https://doi.org/10.1016/j.telpol.2014.03.001>
- Rana, S., Ardichvili, A., & Polesello, D. (2016). Promoting self-directed learning in a learning organization: Tools and practices. *European Journal of Training and Development*, 40(7), 470–489. <https://doi.org/10.1108/EJTD-10-2015-0076>
- Redecker, C., & Punie, Y. (2017). *European framework for the digital competence of educators: DigCompEdu*. Publications Office of the European Union. <https://doi.org/10.2760/159770>
- Romero-Tena, R., Barragán-Sánchez, R., Llorente-Cejudo, C., & Palacios-Rodríguez, A. (2020). The challenge of initial training for early childhood teachers. A cross sectional study of their digital competences. *Sustainability*, 12(11): 4782. <https://doi.org/10.3390/su12114782>
- Salas-Pilco, S. Z. (2013). Evolution of the framework for 21st century competencies. *Knowledge Management & E-Learning*, 5(1), 10–24. <https://doi.org/10.34105/j.kmel.2013.05.002b>
- Savage, M. (2015). *Digital literacy for primary teachers*. Critical Publishing.
- Schleicher, A. (2019). *Helping our youngest to learn and grow: Policies for early learning*. OECD Publishing.
- Shariman, T. P. N. T., Razak, N. A., & Noor, N. F. M. (2012). Digital literacy competence for academic needs: An analysis of Malaysian students in three universities. *Procedia – Social and Behavioral Sciences*, 69, 1489–1496. <https://doi.org/10.1016/j.sbspro.2012.12.090>
- Sharma, R., & Mokhtar, I. A. (2006). Bridging the digital divide in Asia: Challenges and solutions. *International Journal of Technology, Knowledge & Society*, 1(3), 15–30. <https://doi.org/10.18848/1832-3669/CGP/v01i03/55886>
- Shopova, T. (2014). Digital literacy of students and its improvement at the university.

- Journal on Efficiency and Responsibility in Education and Science*, 7(2), 26–32. <https://doi.org/10.7160/eriesj.2014.070201>
- Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, 104, 333–339. <https://doi.org/10.1016/j.jbusres.2019.07.039>
- Somerville, M. M., Lampert, L. D., Dabbour, K. S., Harlan, S., & Schader, B. (2007). Toward large scale assessment of information and communication technology literacy: Implementation considerations for the ETS ICT literacy instrument. *Reference Services Review*, 35(1), 8–20. <https://doi.org/10.1108/00907320710729337>
- Stopar, K., & Bartol, T. (2019). Digital competences, computer skills and information literacy in secondary education: Mapping and visualization of trends and concepts. *Scientometrics*, 118, 479–498. <https://doi.org/10.1007/s11192-018-2990-5>
- Svensson, M., & Baelo, R. (2015). Teacher students' perceptions of their digital competence. *Procedia – Social and Behavioral Sciences*, 180, 1527–1534. <https://doi.org/10.1016/j.sbspro.2015.02.302>
- Tang, C. M., & Chaw, L. Y. (2016). Digital literacy: A prerequisite for effective learning in a blended learning environment? *Electronic Journal of E-learning*, 14(1), 54–65.
- Tewell, E. (2015). A decade of critical information literacy: A review of the literature. *Communications in Information Literacy*, 9(1), 24–43. <https://doi.org/10.15760/comminfolit.2015.9.1.174>
- Thelwall, M. (2018). Dimensions: A competitor to Scopus and the Web of Science? *Journal of Informetrics*, 12(2), 430–435. <https://doi.org/10.1016/j.joi.2018.03.006>
- Toharal, A. J. T., Shuhidan, S. M., Bahry, F. D. S., & bin Nordin, M. N. (2021). Exploring digital literacy strategies for students with special educational needs in the Digital Age. *Turkish Journal of Computer and Mathematics Education*, 12(9), 3345–3358. <https://doi.org/10.17762/turcomat.v12i9.5741>
- Torraco, R. J. (2005). Writing integrative literature reviews: Guidelines and examples. *Human Resource Development Review*, 4(3), 356–367. <https://doi.org/10.1177/1534484305278283>
- Torraco, R. J. (2016). Writing integrative literature reviews: Using the past and present to explore the future. *Human Resource Development Review*, 15(4), 404–428. <https://doi.org/10.1177/1534484316671606>
- Tsai, N., & Hebert, T. E. (2002). Measurement of a college computer literacy course. In M. Dadashzadeh, A. Saber, & S. Saber (Eds.), *Information Technology Education in the New Millennium* (pp. 49–53). IGI Global.
- Ukwoma, S. C., Iwundu, N. E., & Iwundu, I. E. (2016). Digital literacy skills possessed by students of UNN, implications for effective learning and performance: A study of the MTN Universities Connect Library. *New Library World*, 117(11/12), 702–720. <https://doi.org/10.1108/NLW-08-2016-0061>
- United Nations. (n.d.). *The 17 goals | Sustainable development*. United Nations. Retrieved from <https://sdgs.un.org/goals>
- Van den Brande, L., Carretero, S., Vuorikari, R., & Punie, Y. (2016). *DigComp 2.0: The digital competence framework for citizens*. Publications Office of the European Union. Retrieved from <https://data.europa.eu/doi/10.2791/11517>
- Van Dijk, J. (2013). ‘You have one identity’: Performing the self on Facebook and LinkedIn. *Media, Culture & Society*, 35(2), 199–215. <https://doi.org/10.1177/0163443712468605>
- Waltman, L. (2016). A review of the literature on citation impact indicators. *Journal of Informetrics*, 10(2), 365–391. <https://doi.org/10.1016/j.joi.2016.02.007>

- Welsh Government. (2008). *Digital competence framework*. Welsh Government. Retrieved from <https://hwb.gov.wales/curriculum-for-wales/cross-curricular-skills-frameworks/digital-competence-framework>
- Woodcock, B., Middleton, A., & Nortcliffe, A. (2012). Considering the Smartphone Learner: an investigation into student interest in the use of personal technology to enhance their learning. *Student Engagement and Experience Journal*, 1(1), 1–15.
- Záhorec, J., Hašková, A., & Munk, M. (2019). Teachers' professional digital literacy skills and their upgrade. *European Journal of Contemporary Education*, 8(2), 378–393. <https://doi.org/10.13187/ejced.2019.2.378>
- Zaphiris, P., & Ioannou, A. (2018, July). Learning and collaboration technologies. Design, development and technological innovation. In *Proceedings of the 5th International Conference on Learning and Collaboration Technologies (LCT 2018) (Vol. 1)*. Springer.
- Zhao, Y., Llorente, A. M. P., & Gómez, M. C. S. (2021). Digital competence in higher education research: A systematic literature review. *Computers & Education*, 168: 104212. <https://doi.org/10.1016/j.compedu.2021.104212>
- Zhong, Z. J. (2011). From access to usage: The divide of self-reported digital skills among adolescents. *Computers & Education*, 56(3), 736–746. <https://doi.org/10.1016/j.compedu.2010.10.016>
- Zhu, M., Bonk, C. J., & Doo, M. Y. (2020). Self-directed learning in MOOCs: Exploring the relationships among motivation, self-monitoring, and self-management. *Educational Technology Research and Development*, 68, 2073–2093. <https://doi.org/10.1007/s11423-020-09747-8>
- Zurkowski, P. G. (1974). *The information service environment relationships and priorities*. National Commission on Libraries and Information Science. Retrieved from <https://files.eric.ed.gov/fulltext/ED100391.pdf>

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# ChatGPT for Founding Teams: An Entrepreneurial Pedagogical Innovation

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## Abstract

ChatGPT is taking the world and the education sector by storm. Many educators are still hesitant to integrate it within their curricula, owing to the limited practical and theoretical guidance on its applications, despite early conceptual studies advocating for its potential benefits. This pedagogical innovation applied an effectual logic to implement ChatGPT for a founding team activity within an entrepreneurship course. Composing a founding team is an inundating task in venture creation, with long-lasting consequences. So far, there is yet to be an ideal approach proposed in literature or observed in real-life for doing it. In this pedagogical innovation, three student teams with varying business ideas prompted ChatGPT using different keywords and levels of details, to get recommendations on essential team members, their roles and equity split. Each team presented their findings, and then the classroom engaged in a collective discussion. The students were surveyed afterwards to assess the reception and effectiveness of the intervention. Their feedback showed an overwhelming favoritism of ChatGPT, as a convenient and resourceful learning tool. The study establishes the potential value of ChatGPT as a heutagogical tool that supports student-centric entrepreneurial learning across educational institutions and the entrepreneurship ecosystem that extends to the venture creation process.

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## Introduction

The advent of ChatGPT towards the end of 2022 (OpenAI, 2022) is already being regarded as a key milestone in human history (Lim et al., 2023; Lodge et al., 2023; Winkler et al., 2023). The new “humanized” AI chatbot has changed the way we regard the potential of “machines” in different aspects of life, with almost every industry and individual trying it out for a myriad of different purposes (Berg et al., 2023). The education sector has been split on how and whether to approach it (Qadir, 2022), as it has been hesitant with exploring and incorporating artificial intelligence (AI) applications (Alneyadi & Wardat, 2023; Brunetti et al., 2020; ElBanna & Armstrong, 2023; Farrokhnia et al., 2023; Mucharraz et al., 2023). Although early studies, mainly conceptual, have listed several potential benefits to students and educators such as improving learning outcomes, supporting a student-centered approach, increasing efficiency of the educational process, helping with course design and improving critical thinking and reflective skills (Alshater, 2022; Farrokhnia et al., 2023; O’Connor & ChatGPT, 2023; Terwiesch, 2023; Zhai, 2022), some academics are still skeptical of embracing it in their pedagogies as they fear its potential

negative impact, as in facilitating cheating and plagiarism (Susnjak, 2022), diminishing students' cognitive abilities (Kasneci et al., 2023) and substituting for researchers and lecturers. Within the entrepreneurship education field, scholars are still to make their move as the discipline is late on exploring the potential of applying artificial intelligence and other advanced technologies.

This study is among the first to explore its empirical applications for teaching entrepreneurship through describing a pedagogical intervention using it in an entrepreneurship course for undergraduates. It applies an effectual lens to implementing ChatGPT for a founding team composition activity, thus positioning it as an effective tool to make the best of entrepreneurial resources at hand and adjust to the dynamic entrepreneurial contingencies (Bojica et al. 2018; Sarasvathy, 2001). Forming a coherent and effectively performing founding team is among the most ardent tasks in building a new venture. The founding members of a startup often exhibit different backgrounds and experiences, and have varying expectations with regards to their roles, leadership sequence and remuneration structure (Ruef et al., 2003; Shepherd et al. 2021). There are several discussions in literature with regards to founding teams' compositions, with some authors advocating for homogeneity among its members and other enumerating the benefits of having a diverse leadership team (ibid). However, there is a lack of clarity among researchers and practitioners on a working formula for structuring founding teams (Klotz et al., 2014). Hence, ChatGPT with its advanced computational capabilities that pulls on a wide pool of factual evidence to provide contextually relevant answers to user prompts (Alneyadi & Wardat, 2023; Farrokhnia et al., 2023), could be well suited in our opinion to play an important role in clarifying the nuances of founding teams' composition and guiding nascent entrepreneurs on forming effective teams. We herein through this pedagogical innovation posit ChatGPT as a heutagogical tool that can provide student centred learning experiences, that adjust to the evolving situational needs (Gibb, 2002; Rae, 2005) in a dialogical approach.

The objective of this pedagogical innovation is to explore the suitability and effectiveness of applying ChatGPT as an entrepreneurial education tool, to support students with developing a better understanding of founding teams compositions in different entrepreneurial scenarios. The students in this activity used ChatGPT as an advisory figure to provide them with recommendations on the composition of the founding team for their startup idea and possible split of equity. They prompted ChatGPT repeatedly, individually and as a group, using different combinations of keywords and information pieces about their startup and then reflected as a group on the recommendations it provided to extract learning lessons and best practices of using generative AI for entrepreneurial support. The activity was positively received by the students as extremely useful ( $\mu= 4.7, \sigma = 0.46$ ), rather easy to use ( $\mu= 4.2, \sigma = 0.68$ ), and convenient for entrepreneurial learning ( $\mu= 4.3, \sigma = 0.64$ ).

This pedagogical intervention is among the first to report on an empirical application of ChatGPT within the education sector, more specifically for entrepreneurship education. It also extends the argument for applying effectuation as the main logic for generative artificial intelligence applications for entrepreneurial support (Lupp, 2023) and establishes the connection of ChatGPT as a heutagogical tool rhyming with educational technology literature (Winkler et al., 2023). Educators can rely on this study to provide them with inspirations and theoretical guidance for developing their pedagogies (Farrokhnia et al., 2022) and incorporating ChatGPT within the educational process as a supportive and complementary rather than a substitutive tool, especially for educating

and empowering entrepreneurs (Haefner et al., 2021; Kakatkar et al., 2020; Obschonka & Audretsch, 2020; von Krogh, 2018). Hence, we conclude that ChatGPT can be effectively incorporated within the educational process (ElBanna & Armstrong, 2023) and we position ChatGPT as the missing link between entrepreneurship education and entrepreneurial action.

The paper is structured as follows: in the next section we elaborate on the relevant literature streams and concepts. We then describe the subsequent steps on the pedagogical innovation, and comment on its effectiveness and reception among the students through their submitted feedback forms. Moving forward, we discuss the pedagogical innovation against extant literature and highlight several contributions to both research and practice.

## **Background Literature**

Entrepreneurship education (EE) is highly regarded for its role in equipping future entrepreneurs with the required skills and tools to launch entrepreneurial ventures that contribute positively to our economies (Matlay, 2009; Pittaway & Cope, 2007). Traditional pedagogies teaching students “about” entrepreneurship is based on mechanistic knowledge imparting, following the cognitive model and have failed at disseminating practical knowledge and skills among students (Hägg & Kurczewska, 2021; Robinson et al., 2016). These are being replaced with more active approaches (Günzel-Jensen & Robinson, 2017; Robinson et al., 2016), that promote an experiential and self-driven learning (Hase & Kenyon, 2000, 2007; Jones et al., 2019; Neck & Corbett, 2018). Effectual logic is being recognized as one of the heutagogical and practical learning models that is gaining increasing popularity (Günzel-Jensen & Robinson, 2017).

However, this transformation mandated that educators and researchers go through a journey of exploration and experimentation with different sets of pedagogies applying a variety of learning paradigms, without a clear sight on to the ideal route to follow yet (Farroknia et al., 2022; Hammoda, 2023b; Neck et al., 2014; Neck & Corbett, 2018). In this part, we elaborate on the definitions and scholarly discussions literature on concepts and literary streams pertinent to this pedagogical innovation and build their linkages with EE and each other. These are effectuation, heutagogy and student-centred learning, founding teams, and our chosen delivery tool, ChatGPT.

### **Effectuation**

One method increasingly used in student-focused and practice-driven EE is effectuation. As explained by Sarasvathy (2001, 2008), effectuation implies that entrepreneurs begin with a general vision and use available resources, knowledge, and connections (who they are, what they know, and who they know). The direction is not set in advance, and they remain adaptive as they progress with their journey towards realizing their entrepreneurial aspiration, leveraging opportunities as they are made available to them and learn through their actions.

Building on effectual logic, entrepreneurship educators can adopt a processual approach to teaching that revolves around the learner. This approach leaves space for entrepreneurs to receive tailored support while they explore multiple options, take affordable risks, leverage connections at their disposal, make use of environmental

contingencies and learn on the job through experimentation. Hence, applying effectuation principles in EE challenges the causation-based dogmatic approaches to education (Morris et al., 2011), as it promotes heutagogical and student-centered pedagogies tailored around the learner needs, circumstances, resources and stakeholders (Rae, 2005). Hence, effectuation follows a constructivist and scaffolding approach to educating future entrepreneurs (Rae, 2005; Robinson et al., 2016). It offers personalized learning, develops entrepreneurial mindset, and improves self-awareness, which are critical aspects of entrepreneurial learning (Williams Middleton & Donnellon, 2014; Rae, 2005), leading to better outcomes (Fayolle & Gailly, 2008).

Effectuation core premise to make do with what's available (Daniel et al., 2015; Deligianni et al. 2017) is applied in the learning activity of this study, that leverages ChatGPT to train entrepreneurial students on founding teams compositions for their startups. ChatGPT is accessible to virtually everyone with internet access and does not require advanced technical skills to use (Tlili et al., 2023). Moreover, as the students try to explore several combinations of core members that can launch and run their venture, they follow an effectual approach to explore the different options available to them (Saravathy, 2001), by using an assortment of varying key words and sentences to prompt ChatGPT for situated responses. As their circumstances and existing resources change and the venture idea evolves and matures throughout the duration of the course and beyond (Saravathy & Venkataraman, 2011; Bojica et al. 2018), students can always come back to ChatGPT for up-to-date advice that suits their narrative. Hence, embodying the non-linear trajectory of an effectual logic to entrepreneurship (Saravathy, 2001).

Although EE focuses mainly on developing entrepreneurial competences (Nabi et al., 2017), these skills solely are not enough for entrepreneurial success as entrepreneurs need to learn how to enact them through a series of trade-offs in the daily startup life (Ibrahim & Soufani, 2002). Effectuation in practice focuses on supporting the decision-making behaviors of entrepreneurs (Servantie & Hlady-Rispal, 2018), with previous studies on AI applications in EE showing a strong support for developing decision-making abilities among learners (Ma et al., 2020). Moreover, effectuation is especially significant and effective in the early trial stages of starting a business, when entrepreneurs are faced with several options, have limited resources at hand and faced with surmount uncertainty (Perry et al., 2012; Saravathy, 2001). Hence, it is suitable for EE courses where students work in a scaffolding manner on shaping a workable business idea. However, despite its attractiveness and apparent naturalness, understanding and applying effectuation principles remains elusive and there is limited scholarly work in EE literature building on the effectual logic, with most of those studies being of a conceptual nature (Günzel-Jensen & Robinson, 2017; Perry et al., 2012).

### **Heutagogy and Student-centered Learning**

Heutagogy emphasizes human agency in the learning process, where a person embarks independently on an intellectual journey of discovery and experience (Hase & Kenyon, 2000, 2007; Jones et al., 2019). Here in, heutagogy rhymes with student-centered approaches to education (ibid). Heutagogical pedagogies emphasize the role of the learner as the center of the learning process and the master of his own learning journey, through an interactive inquisitive approach, which is not confined to the standardized linear curricula (Gibb, 2002; Rae,

2005). In student-centered models, the educator, and universities endeavor to personalize the learning experience of their students and play a rather supportive and mentoring role to support their development of critical thinking skills (ibid). Heutagogy is thus a natural process for educators in the EE domain as it seeks transformational learning outcomes (Jones et al., 2019). Through these interventions, educators assist students in developing reflexivity, high self-efficacy, and competencies to be used in both familiar and novel situations without the educator's involvement (ibid).

Heutagogical approaches are tied to experiential knowledge acquisition and application, which is a common denominator they share with entrepreneurial learning and practice (Tunstall & Neergaard, 2022). Given the uncertainty of entrepreneurial realities, it has been argued that the theorizing around heutagogy fits well with entrepreneurship education (Jones et al., 2019; Neck & Corbett, 2018) and heutagogical pedagogies adds an element of learning for life to entrepreneurship students which is a key asset when facing uncertainties (Barnett, 2011; QAA, 2018). Thus, heutagogy is argued to be a fundamental element of transformational learning in any EE context. Rae (2005) also emphasizes the focus on the learner as the fulcrum of entrepreneurial pedagogies. Together with other scholars (e.g., Pittaway & Cope, 2007; Pittaway et al. 2011, 2015), he argues that entrepreneurial learning is better framed and enacted within the social and contextual environments of the learner. These propositions are thus in alignment with the effectual logic.

Advanced technology, such as AI applications, applied for educational purposes is considered a key enabler of heutagogical approaches, with ChatGPT posited as an enabler of student-centric pedagogies (Lodge et al., 2023; Mucharrar et al., 2023). It increases course attractiveness, opens access to wider groups of learners, transcending space, and time boundaries (Oyelere et al., 2016). It has been used effectively to shift EE into a more active, practical, and competency-based arena (Wu et al., 2018), and led to improved engagement, satisfaction and academic performance among students (Coccoli et al., 2014). Moreover, current university students belong to Generation Z who interact heavily with technology in every task. We assume that using advanced technologies in the classroom will bring a sense of familiarity and liking to the process (Mavlutova et al., 2020).

### **Founding Teams**

Startups are usually founded by teams (Beckman, 2006; Klotz et al., 2014; Ruef et al., 2003), as they tend to be more sustainable (Reich, 1987) and able to secure better funding (Alsos et al., 2006). A founding team refers to a group of individuals who collectively create a venture. Founding teams have often varied experiences, bring in diverse attributes, sometimes have prior shared experiences, and are influenced by structure (Ruef et al., 2003; Shepherd et al. 2021). The attributes of each member of the founding team are important for new-venture creation (Wasserman, 2017), and thus a pragmatic reasoning when forming an entrepreneurial founding team, as in selecting members with relevant and complementary skills and experiences is usually followed by entrepreneurs (Klotz et al., 2014).

Several studies have pointed out to the importance of the heterogeneity of founding teams' collective powers (Franke et al., 2006; Kim & Aldrich, 2005) in terms of skills, educational backgrounds, and experiences

(Davidsson & Honig, 2003; Shah et al., 2019). The possession of several competences within the founding team is crucial to the success of the new venture such as technological knowledge (Gruber et al., 2013), financial mastery (Brinckmann et al., 2011), entrepreneurial and managerial experience (Gruber et al., 2013), industry-specific insights and connections (Walske & Zacharakis, 2009), and leadership skills (Franke et al., 2006). However, Shah et al. (2019) points out that the possession of certain skills such as critical thinking, problem solving, and sharing essential values and trust, i.e., homophily, are also important for effective founding teams' functioning.

Although the founding team characteristics affect startup prospects, researchers are still unclear on what team compositions and assortments are ideal for optimal firm performance (Devine & Philips, 2001; Ensley & Hmieleski, 2005; Klotz et al., 2014). Hence, there is a need for more studies on founding teams characteristics that are tailored to specific contexts and roles, as they can provide long-awaited answers to more nuanced founding teams settings (ibid). Entrepreneurial teams must deal with an exceptionally ambiguous and uncharted environment (Gartner, 1990; Schumpeter, 1934). The list of uncertainties they encounter include decisions related to customer segmentation and targeting, market selection and entry modes, human capital selection, organizational structures, and their portfolio of offerings (Karlsson & Nowell, 2021). These obscurities are heightened in learning settings, as students mostly lack professional or entrepreneurial experiences. In this situation, students can prompt ChatGPT for all those queries and receive reasonably situated guidance which is both contextually and semantically relevant. Hence, leveraging ChatGPT and AI assisted tools for entrepreneurship resembles a virtual form of mentoring and agglomerate community of enquiry, following a social learning paradigm from a heutagogical standpoint (Hammoda, 2023b).

### **ChatGPT and AI for Entrepreneurship Education**

ChatGPT was launched late in 2022 by OpenAI, an AI innovation lab supported by Microsoft as a breakthrough communicative natural language processing (NLP) application that intelligently analyses text and visual prompts (requests) and provide narrative responses that are highly contextualized. A conversational AI, like ChatGPT, was conceptualized to have several potential benefits on education as in improving learning outcomes, supporting a student-centred approach, and increasing efficiency of the educational process (Ali & Abdel-Haq, 2021; Chen & Yu, 2020; Farrokhnia et al., 2023; O'Connor & ChatGPT, 2023; Peng et al., 2019). Moreover, it is argued to help improve critical thinking, discussion, reflection, and knowledge application capabilities among students (Alshater, 2022; Terwiesch, 2023). However, ChatGPT is feared for its potential negative impact, as in facilitating cheating and plagiarism (Susnjak, 2022), diminishing students' cognitive abilities (Kasneci et al., 2023), not providing enough depth (Choi, 2023), factual inaccuracies and potential bias (ElBanna & Armstrong, 2023, Farrokhnia et al., 2023) and substituting for researchers and lecturers. However, this fearful vibe is not uncommon when an innovative breakthrough starts gaining traction in society or academia (Mucharraz et al., 2023; Qadir, 2022).

The application of AI and ChatGPT for teaching and supporting entrepreneurship might sound alien. However, given their computational capabilities and knowledge resourcefulness, and the high levels of uncertainty and complexity that characterize entrepreneurial realities (Fayolle, 2018; Neck & Greene, 2011), we can argue that

their deployment for entrepreneurial learning (Blank, 2023; Chen & Yu, 2020; Shepherd & Majchrzak, 2022) is a natural occurrence. Early studies on their application in EE has shown their immense potential for providing more accurate planning and forecasting of entrepreneurial projects, while reaching larger groups of students through personalized support (Chen & Yu, 2020; Mavlutova et al., 2020; Ma et al., 2020). However, given the technical intricacies and theoretical and methodological obscurities associated with their implementation (Ma et al., 2020), as with other pedagogical interventions in EE (Farrokhnia et al., 2022), there has been little scholarly attempts to unravel their true potential.

## **The Pedagogical Innovation**

In this section, we elaborate on the pedagogical innovation in details, First, we explain the background of the entrepreneurship course and the pedagogical innovation build up, the setup of the seminar, where the ChatGPT learning activity took place, and the intended learning outcomes. We then identify and explain the activities undertaken in each of its six steps, which are visually illustrated and summarized in Figure (1). Finally, we report on the effectiveness and reception of the pedagogical innovation based on the results from a brief follow-up student survey and educator observations.

### **Background**

Building on the effectual logic, we took it in our own hands to experiment with ChatGPT as a heutagogical tool for EE. AI applications have proven to be of recognizable value in providing guidance to students and nascent entrepreneurs when making calls regarding several key decisions in the venture creation process (Chen & Yu, 2020; Mavlutova et al., 2020). Given the critical role of team composition in defining the prospects of a startup (Ruef et al., 2003; Shepherd et al. 2021) and that entrepreneurship students often lack professional experience and entrepreneurial networks, we decided to apply ChatGPT in a seminar on founding teams as part of an entrepreneurship course. The entrepreneurship course covers the basics of entrepreneurship for undergraduate students from both business and non-business disciplines and is organised over 12 weeks, through a mixture of lectures (4) and seminars (12). The ChatGPT based learning innovation was introduced as the main exercise in a seminar covering founding teams, towards the end of the course when the student groups had a more detailed and clearer view of their business ideas that they have been developing throughout the course. The seminar was of two hours duration. It typically involves a theoretical part and one or more practical group activities. It then ends with a collective discussion or Q&As with all students involved. The first theoretical part focused on discussing important aspects related to entrepreneurial teams such as characteristics, solo vs team of founders, common pitfalls, and shareholder agreements. This lasted for roughly 30 minutes. The main practical part is when we applied our ChatGPT based learning innovation and lasted for nearly an hour and a half.

### **Setup**

There were 20 students in the seminar organized in three groups, with each including 6-8 students. Although each group had several business ideas among its members them, we asked them to select only one for this activity. This



concentration ensured there is enough time allocated for in-depth discussion afterwards. Students were informed about the activity prior to the seminar. They were asked to sign up to <https://chat.openai.com/> and familiarize themselves with the platform. They were also requested to bring along their laptops, which they naturally do in every class. The classroom where the activity was held was well prepared with separate “groupwork” tables equipped with a monitor each that you can plug in your laptop to.

### **Intended Learning Objectives**

The learning innovation aimed primarily at educating students about the different compositions of founding teams, that vary according to the type of business. Also, to make them aware of the value that each of these roles contribute to the business, which is provided by the ChatGPT narrative explanation and justification of these roles and reflects on the suggested equity split (see appendices 1, 2, 3, 4, 5 & 6). It aimed at putting them in the driving seat as potential entrepreneurs, enacting entrepreneurial narratives where they get to interact with and seek advice from available resources in an effectual manner (Perry et al., 2012; Sarasvathy, 2008) and make decisions about their company accordingly. In drafting the learning objectives, we followed Bloom’s taxonomy of educational objectives which charts learning activities for cognitive attainment in an ascending order: knowledge, comprehension, application, analysis, synthesis, and evaluation (Bloom, 1956).

1. Understand how generative AI tools can help nascent entrepreneurs
2. Practice using generative AI tools
3. Analyze the results produced by the supportive tool
4. Synthesis those results for complementing your entrepreneurial idea
5. Reflect and evaluate your experience using ChatGPT, your learnings, and what to change in the future when using generative AI tools

### **Process**

After the initial theoretical part of the seminar was concluded, we moved to the ChatGPT activity. In this part, we explain the different steps of the activity as it happened and provide some comments against each. The different steps involved in the process are depicted in Figure 1.

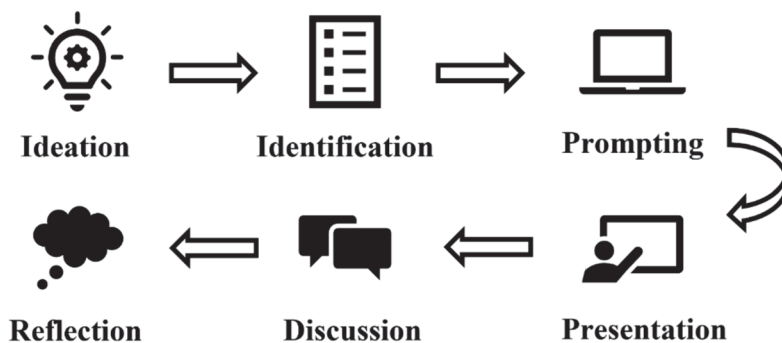


Figure 1. Steps of the ChatGPT Pedagogical Innovation

*Step 1 - Ideation*

The students have been working on business ideas in small groups 2-5 each throughout the course. For this activity however, students' groups were asked to join forces and self-form 3 relatively large groups of 6-8 each. They were asked to discuss among themselves and settle on one business idea to use for the activity. We also see that it is also possible if the students come up with an outline for a new business idea solely for the purposes of this activity. This can become relevant if it is conducted separately from an entrepreneurship course, as in training workshops and webinars.

Duration: 10 minutes

*Step 2 - Identification*

All groups were asked to write down a brief about the nature of their business, its main offerings, targeted customer segments and intended geographies for operations. This information was deemed essential to adequately prompt ChatGPT and receive adequate answers in advance. ChatGPT as a conversational tool provides contextual and semantically relevant responses (O'Connor & ChatGPT, 2023; Open AI, 2023), and the quality of the guidance it provides depends largely on the information included in the prompts (Kuhail et al., 2023; Tlili et al., 2023). The three ideas that the student groups agreed upon were found to serve the purpose of the exercise greatly by being distinctively different and cover a broad spectrum of real-life business. However, we suggest that other educators with bigger classes might want to get involved in defining the types of business to ensure required diversity. The first idea was for a laundry business, a traditional brick and mortar establishment without any significant technical knowledge. The second idea was for an ecommerce platform, which requires a significant marketing capacity, logistics experience and web platform building/ maintenance knowledge. The third was a legal software as a service (SaaS) offering, a heavily technological offering that requires advanced technical and domain expertise.

Duration: 10 minutes

*Step 3 - Prompting*

After having all necessary information about their business, students were asked to prompt ChatGPT, asking for guidance on the ideal founding team structure/ composition, the characteristics of the founding team or key members and suggested split of equity among them. Students were advised to use different combinations of keywords and sentence structures until ChatGPT provides them with a satisfactory enough answer. We allowed individual students within the groups to try asking ChatGPT separately to develop a sense of initiative and raise their personal AI literacy (Ng et al., 2022), as ChatGPT usage is intended as a heutagogical approach (Deng & Lin, 2022). However, we requested that one member takes charge of the communication as a group with ChatGPT to ensure consistency and get the students to discuss and work together among the groups effectively, which is an essential skill for entrepreneurs (Hammoda, 2023b). The final prompts used by the team leads for each group and ChatGPT responses are depicted in appendices 1, 2, 3, 4, 5 & 6 for reference.

Duration: 20 minutes

*Step 4 - Presentation*

After the exercise, each student group explained their startup idea briefly to the class, what they asked ChatGPT for (i.e., their prompts), ChatGPT responses and their comments on both prompting ChatGPT and the recommendations received.

Duration: 10 minutes for each group = total 30 minutes

*Step 5 - Discussion*

After all the groups finished sharing their experience, each group registered its idea, ChatGPT prompts and responses and these were made available to all the students through a collaborative learning platform. The whole classroom then engaged in an open discussion about the process, its pros and cons. Most importantly, they were asked to discuss and reflect on the suggestions provided by ChatGPT and the reasons for the differences in team compositions recommended by it, whether that being related to the nature of their business, its location, required partners, the type of offering, etc. This was an important step to achieve the intended learning objectives as in developing critical thinking skills, improving their understanding of different managerial topics, understanding how to better use ChatGPT (Rospigliosi, 2023), and internalising knowledge and skills through reflection (Gerstein, 2014).

Duration: 20 minutes

*Step 6 - Reflection and evaluation*

After the class, students were sent a brief survey to ask for their feedback and reflections on the learning innovation (Jones & English, 2004). They were asked to comment briefly on their experience. They were also asked to evaluate the perceived ease of use and perceived usefulness (Kemp et al., 2019) and convenience of using ChatGPT/ AI tool for learning against a 5 points Likert scale. Additionally, the students were asked to write a non-graded short reflective piece on their experience of using ChatGPT/ AI applications for entrepreneurship and learning more broadly, as an essential factor for introspection and internalisation of knowledge and expertise related to AI literacy to apply them in future entrepreneurial experiences (Corbett, 2005; Long & Magerko, 2020; Neck et al., 2014; Neck & Corbett, 2018).

**Evidence of Effectiveness**

To assess the effectiveness of the learning innovation, we relied on the educator's observations and the feedback survey responses. The educator observed students while participating in the classroom activity in terms of their level of engagement, transacting with their colleagues within groups and participation in the collective classroom discussion at the end of the activity. Although these observations are subjective, but generally and in comparison with other learning methods, the students were enthusiastically engaged in the activity and in the group discussions. This was evident through several instances. First, although most of the students affirmed that they only heard about ChatGPT but never tried it before, all participants in the seminar accessed ChatGPT and

familiarized themselves with it before they came to the classroom, to prepare themselves for the activity. Moreover, they all came prepared with their laptops. Second, all the students, while the educator was moving between tables, had ChatGPT open on their laptops and were actively prompting it. Thirdly, after each group presented their findings, the students started asking questions about the origins of the variance in ChatGPT recommendations and some volunteered in providing answers, enthusiastically.

A brief survey was sent out directly after the seminar to avoid recall bias (Schmidt et al., 2023). It requested that the students evaluate their experience using ChatGPT for receiving guidance on founding team composition, through three questions and an open feedback comment box (optional). In total, 17 out of the 20 students responded to the survey (85%). The responses were imported to Microsoft Excel and analyzed for the mean and standard deviation to understand the general agreement/ disagreement in student responses and the variance in students views, with regards to the survey questions (Stockemer et al., 2019). The results were overwhelmingly in favor of the ChatGPT learning activity. Students perceived it as extremely useful in supporting them in understanding the varying compositions of founding teams pertinent to the type of business and developing an insightful comprehension of the recommended constellations ( $\mu= 4.7$ ,  $\sigma = 0.46$ ), and relatively easy to use for venture ideation and creation activities ( $\mu= 4.2$ ,  $\sigma = 0.68$ ). They also found it to be rather convenient for entrepreneurial learning in comparison to the habitual lectures and classroom-based methods ( $\mu= 4.3$ ,  $\sigma = 0.64$ ).

Commenting on their experience in the survey, the students felt that machine can support them and help guide their thinking. It also allowed them to use their time to think and reflect on the results and consider how to put it to action. They valued the collective discussion at the end of the activity as the most beneficial part in their opinion. ChatGPT recommendations were helpful from an entrepreneurial learning perspective indeed as in previous studies applying AI to EE have shown (e.g., Ma et al., 2020), but their synthesis of the dialogue with ChatGPT and then reflecting on the variances in the recommendations it provided was the essential part in their learning through this activity (Kolb & Kolb, 2005). Some excerpts from their responses included: “We enjoyed using it”, “It made us feel that we are learning using the most advanced tools and not just theory”, “Now, we feel more confident about starting a business, knowing how to use tools like ChatGPT and what kind of support we can expect from it”, and “We believe it will be helpful to support other initiatives we pursue as well”.

## **Discussion and Implications**

The advent of ChatGPT has raised attention of educators to the urgency of updating their pedagogies to include advanced technologies, especially those that are grossly adopted in students’ daily lives and provide a sense of relevance to them (Alneyadi & Wardat, 2023; Hammoda & Foli, 2024; Neergaard & Christensen, 2017). This is significantly important in a practical and dynamic discipline like entrepreneurship (Neck & Corbett, 2018), where mechanistic traditional methods are falling short of achieving the desired outcomes of improving learners’ skills and capabilities (Hägg & Kurczewska, 2021; Robinson et al., 2016).

This transformation necessitates a mindset change among educators towards a heutagogical and student-centered approach, where the lecturer relinquishes his role as the sole source of knowledge and transforms into a mentoring

and guiding role (Jones et al., 2019). This change is further accentuated by the ChatGPT impetus. This pedagogical innovation thus contributes to the heutagogical remodeling of entrepreneurship education and can serve as a guidance for fellow entrepreneurship educators on adopting advanced technologies, as in ChatGPT and AI applications. In doing so, it serves as an exemplar for applying advanced technology for transformative learning purposes (Mezirow, 2003). In addition, this pedagogical innovation is among the first to report on an empirical application of ChatGPT within the education sector, more specifically for entrepreneurship education, which is currently limited in literature.

The case builds on the effectual logic of Sarasvathy (2001) and adds to it by applying it within the context of entrepreneurial students. It thus extends the argument for applying effectuation as the main logic for generative artificial intelligence applications for entrepreneurial support (Lupp, 2023). It illuminates the potential for effectual approaches in supporting students morphing into active entrepreneurs (Krueger, 2007). By applying it within an educational context to potential student entrepreneurs, it provides additional avenue to support the work of both educators and researchers in the higher education space, as the original theorizing of effectuation as an entrepreneurial paradigm was based on analysis of experienced entrepreneurs' activities only. It also provides a much-needed empirical illustration of effectuation principles affixation to education practices (Günzel-Jensen & Robinson, 2017), by depicting the design, implementation, and assessment of the learning innovation, thus extending our limited understanding of effectuation process applications which are mostly dominated by conceptual work in extant literature (Engel et al., 2014). Moreover, we build connections between effectuation and heutagogy, in response to Perry et al. (2012) call for building relationships between effectuation and established paradigms.

We applied these learning and entrepreneurial models through a ChatGPT based activity for founding teams' composition. The purpose of prompting ChatGPT was to broker recommendations from its knowledge pool on the essential founding team members, their skills and equity split among them in relation to various startup business models with different characteristics. Thus, ChatGPT and similar advanced technologies help overcome limitations of knowledge sourcing and processing pertinent to entrepreneurial endeavors (Haefner et al., 2021; Nambisan, 2017; von Krogh, 2018). The significance of focusing on founding teams is in the crucial role it plays towards the success of a new venture (Wasserman, 2017). Thus, scholars have argued for the importance of conducting more nuanced studies on team characteristics in different situational and contextual factors (Klotz et al., 2014), such as nature of business, location and addressable market which were included by the students in their ChatGPT prompts.

Moreover, this empirical learning study adds to our understanding of the intricacies of founding teams compositions and their ideal alignment conducive to a well-performing venture (Karlsson & Nowell, 2021), which lacks an established methodology in entrepreneurship research and practice. It is worth noting that although having team members with complementary assortment of required skills and experiences is beneficial for firm performance (Beckman, 2006), this might not be enough for a burgeoning new venture. Several scholars have highlighted the importance homophily among team members as in their consensus, shared values and subsequent trust and emotional bonds on firm performance (Lazar et al., 2020; Ruef et al., 2003; Shah et al., 2019). Indeed,

entrepreneurship researchers posit that the relationships between team characteristics and composition are non-linear and thus no set rule can be applied (Devine & Philips, 2001; Ensley & Hmieleski, 2005; Klotz et al., 2014).

The results and recommendations provided by ChatGPT must be subjected to due consideration and reflections by the user to avoid potential bias and inaccuracies, however (Farrokhnia et al., 2023; Mucharraz et al., 2023). Overcoming this pitfall was designed into the pedagogical activity when students spent time reflecting on and discussing ChatGPT results versus their knowledge repositories and collective experiences. This reflective exercise was also a core component of their learning process by extracting new meanings and remodeling their cognitive mindmaps about the studied topic (Corbett, 2005; Kolb & Kolb, 2005), i.e., founding teams. In this regard, ElTarabishy (2023) advocates the use of ChatGPT in what he labelled as “The Socratic Method” to engage students in reflective conversations concerning the recommendations provided by ChatGPT. Hence, it is important for educators and students undertaking a similar learning activity to reflect deeply on the results provided by ChatGPT, in relation to their convictions and realistic entrepreneurial models.

Educators and instructional designers can rely on this study to provide them with inspirations and theoretical guidance for incorporating ChatGPT within the educational process as a supportive and complementary rather than a substitutive tool, especially for educating and empowering entrepreneurs (Haefner et al., 2021; Kakatkar et al., 2020; Obschonka & Audretsch, 2020; von Krogh, 2018). The implementation of ChatGPT in education indeed should happen through its integration within existing curricula, complementing theoretical knowledge rather than relying on it solely to achieve the desired learning outcomes. Although it does broker a student-centered approach as a heutagogical tool, we should not nonetheless subdue the role of the educator in guiding ChatGPT and similar technology-supported educational activities (Farrokhnia et al., 2023). Moreover, the ChatGPT activity effectively facilitated the shift in the positioning of the educator, to a facilitator of knowledge and skills acquisition. Hence, this study potential value transcends the educational institutions boundaries and can serve as a guidance to entrepreneurship and business actors in the community such as managers in accelerators and incubators, startup mentors and advisors, corporate intrapreneurship and innovation trainers, and the entrepreneurs themselves, on designing effective learning activities for their designated audience. However, we urge educators and leaders across the entrepreneurship ecosystem, to improve their digital and AI literacy in order to apply it adequately within their classrooms and varying learning spaces (ElBanna & Armstrong, 2023; Kasneci et al., 2023), and guide their students and trainees on using it appropriately (Neumann et al., 2023).

## **Conclusion and Future Directions**

This pedagogical innovation applied ChatGPT through a personalized and interactive approach (Gibb, 2002; Rae, 2005), to one of the critical tasks in the venture creation process; team foundation (Ruef et al., 2003; Shepherd et al. 2021). It elicited discussion and provoked reflection among the students to internalize the learning gains from their classroom experiences (Kolb, 1984; Rae, 2005). Our work coincides with several scholars’ call (Gibb, 2002; Preedy et al., 2020) for more research and application of heutagogical approaches to entrepreneurial learning as a life-long constant process. Building linkages between EE and different learning models and theories will help us as educators and researchers in understanding what works and why, hence support us in developing better

pedagogies (Farrokhnia et al., 2022; Hammada, 2023b; Robinson et al., 2016). In addition, this paper fulfils the need to accelerate our understanding and integration of emerging technologies in EE, as it is argued to become the dominant learning mode in the near future (Hammada, 2023a; Mavlutova et al., 2020; Tretyakova et al., 2021).

We call for researchers, not only those focusing on education or entrepreneurship but from all other disciplines, to accelerate the scholarly efforts that aim at exploring, demystifying, and empirically studying possible applications of generative AI for educational purposes. On a broader ecosystem level, we call for the different educational and community actors to explore, try and fail, and communicate their experiences of integrating ChatGPT and similar advanced educational technologies in the methods they use to educate and train entrepreneurs (Winkler et al., 2023). Noting its conceptualized efficiency, personalization, and effectiveness, we advocate for EE agents and those concerned with its innovation to roll their sleeves and put it to test through empirical investigations, similar to this pedagogical innovation, aiming for an incremental and interconnected cycles of experimentation, reporting and reflecting (Corbett, 2005; Kolb, 1984). We conclude that generative AI and ChatGPT can be effectively incorporated within the educational process, and we position it as potentially the missing link between entrepreneurship education and entrepreneurial action.

## References

- Ali, M., & Abdel-Haq, M. K. (2021). Bibliographical analysis of artificial intelligence learning in Higher Education: is the role of the human educator and educated a thing of the past?. In *Fostering Communication and Learning With Underutilized Technologies in Higher Education* (pp. 36-52). IGI Global.
- Alneyadi, S., & Wardat, Y. (2023). ChatGPT: Revolutionizing student achievement in the electronic magnetism unit for eleventh-grade students in Emirates schools. *Contemporary Educational Technology, 15*(4), ep448.
- Alsos, G. A., Isaksen, E. J., & Ljunggren, E. (2006). New venture financing and subsequent business growth in men–and women–led businesses. *Entrepreneurship theory and practice, 30*(5), 667-686.
- Barnett, R. (2011). Lifewide education: A new and transformative concept for higher education. *Learning for a complex world: A lifewide concept of learning, education and personal development, 22-38*.
- Beckman, C. M. (2006). The influence of founding team company affiliations on firm behavior. *Academy of management Journal, 49*(4), 741-758.
- Blank, S. (April 4, 2023). *Steve Blank Playing With Fire – ChatGPT*. Available at: <https://steveblank.com/2023/04/04/playing-with-fire-chatgpt/>
- Bloom, B. (1956). Bloom’s taxonomy.
- Brinckmann, J., Salomo, S., & Gemuenden, H. G. (2011). Financial management competence of founding teams and growth of new technology–based firms. *Entrepreneurship Theory and Practice, 35*(2), 217-243.
- Bojica, A. M., Ruiz Jiménez, J. M., Ruiz Nava, J. A., & Fuentes-Fuentes, M. M. (2018). Bricolage and growth in social entrepreneurship organisations. *Entrepreneurship & Regional Development, 30*(3-4), 362-389.
- Chen, Z., & Yu, X. (2020). Adoption of Human Personality Development Theory Combined With Deep Neural Network in Entrepreneurship Education of College Students. *Frontiers in Psychology, 11*, 1346.

- Coccoli, M., Guercio, A., Maresca, P., & Stanganelli, L. (2014). Smarter universities: A vision for the fast changing digital era. *Journal of Visual Languages & Computing*, 25(6), 1003-1011.
- Corbett, A. C. (2005). Experiential learning within the process of opportunity identification and exploitation. *Entrepreneurship theory and practice*, 29(4), 473-491.
- Daniel, E. M., Domenico, M. D., & Sharma, S. (2015). Effectuation and home-based online business entrepreneurs. *International Small Business Journal*, 33(8), 799-823.
- Davidsson, P., & Honig, B. (2003). The role of social and human capital among nascent entrepreneurs. *Journal of business venturing*, 18(3), 301-331.
- Deligianni, I., Voudouris, I., & Lioukas, S. (2017). Do effectuation processes shape the relationship between product diversification and performance in new ventures?. *Entrepreneurship Theory and Practice*, 41(3), 349-377.
- Deng, J., & Lin, Y. (2022). The Benefits and Challenges of ChatGPT: An Overview. *Frontiers in Computing and Intelligent Systems*, 2(2), 81-83.
- Devine, D. J., & Philips, J. L. (2001). Do smarter teams do better: A meta-analysis of cognitive ability and team performance. *Small group research*, 32(5), 507-532.
- Elbanna, S., & Armstrong, L. (2023). Exploring the integration of ChatGPT in education: adapting for the future. *Management & Sustainability: An Arab Review*.
- ElTarabishy, A. (2023, April 24). *AI Meet Socrates*. ICSB | International Council for Small Business. <https://icsb.org/ai-meet-socrates/>
- Engel, Y., Dimitrova, N. G., Khapova, S. N., & Elfring, T. (2014). Uncertain but able: Entrepreneurial self-efficacy and novices' use of expert decision-logic under uncertainty. *Journal of Business Venturing Insights*, 1, 12-17.
- Ensley, M. D., & Hmieleski, K. M. (2005). A comparative study of new venture top management team composition, dynamics and performance between university-based and independent start-ups. *Research policy*, 34(7), 1091-1105.
- Farrokhnia, M., Baggen, Y., Biemans, H., & Noroozi, O. (2022). Bridging the fields of entrepreneurship and education: The role of philosophical perspectives in fostering opportunity identification. *The International Journal of Management Education*, 20(2), 100632.
- Farrokhnia, M., Banihashem, S. K., Noroozi, O., & Wals, A. (2023). A SWOT analysis of ChatGPT: Implications for educational practice and research. *Innovations in Education and Teaching International*, 1-15.
- Fayolle, A. (2018). Personal views on the future of entrepreneurship education. In *A research agenda for entrepreneurship education* (pp. 127-138). Edward Elgar Publishing.
- Fayolle, A., & Gailly, B. (2008). From craft to science: Teaching models and learning processes in entrepreneurship education. *Journal of European industrial training*.
- Franke, N., Gruber, M., Harhoff, D., & Henkel, J. (2006). What you are is what you like—similarity biases in venture capitalists' evaluations of start-up teams. *Journal of Business Venturing*, 21(6), 802-826.
- Gartner, W. B. (1990). What are we talking about when we talk about entrepreneurship?. *Journal of Business venturing*, 5(1), 15-28.
- Gerstein, J. (2014). Moving from education 1.0 through education 2.0 towards education 3.0.
- Gibb, A. (2002). In pursuit of a new 'enterprise' and 'entrepreneurship' paradigm for learning: creative destruction,



- new values, new ways of doing things and new combinations of knowledge. *International journal of management reviews*, 4(3), 233-269.
- Gruber, M., MacMillan, I. C., & Thompson, J. D. (2013). Escaping the prior knowledge corridor: What shapes the number and variety of market opportunities identified before market entry of technology start-ups?. *Organization science*, 24(1), 280-300.
- Günzel-Jensen, F., & Robinson, S. (2017). Effectuation in the undergraduate classroom: Three barriers to entrepreneurial learning. *Education+ Training*.
- Haefner, N., Wincent, J., Parida, V., & Gassmann, O. (2021). Artificial intelligence and innovation management: A review, framework, and research agenda☆. *Technological Forecasting and Social Change*, 162, 120392.
- Hägg, G., & Kurczewska, A. (2021). Toward a learning philosophy based on experience in entrepreneurship education. *Entrepreneurship Education and Pedagogy*, 4(1), 4-29.
- Hammoda, B. (2023a). Digital Technology in Entrepreneurship Education: An Overview of the Status Quo. In Durst, S. & Pevkur, A. (Ed.). *Digital Transformation for Entrepreneurship. Digital Transformation: Accelerating Organizational Intelligence* (69-90). World Scientific Publishing Company. [https://doi.org/10.1142/9789811270178\\_0006](https://doi.org/10.1142/9789811270178_0006)
- Hammoda, B. (2023b). Extracurricular activities for entrepreneurial learning: A typology based on learning theories. *Entrepreneurship Education and Pedagogy*. <https://doi.org/10.1177/25151274231218212>.
- Hammoda, B. & Foli, S. (2024). A digital competence framework for learners (DCFL): A conceptual framework for digital literacy. *Knowledge Management & E-Learning*. (In press)
- Hase, S., & Kenyon, C. (2000). From andragogy to heutagogy. *UltiBASE In-Site*.
- Hase, S., & Kenyon, C. (2007). Heutagogy: A child of complexity theory. *Complicity: An international journal of complexity and education*, 4(1).
- Ibrahim, A. B., & Soufani, K. (2002). Entrepreneurship education and training in Canada: a critical assessment. *Education+ training*, 44(8/9), 421-430.
- Jones, C., & English, J. (2004). A contemporary approach to entrepreneurship education. *Education+ training*, 46(8/9), 416-423.
- Jones, C., Penaluna, K., & Penaluna, A. (2019). The promise of andragogy, heutagogy and academagogy to enterprise and entrepreneurship education pedagogy. *Education+ Training*.
- Kakatkar, C., Bilgram, V., & Füller, J. (2020). Innovation analytics: Leveraging artificial intelligence in the innovation process. *Business Horizons*, 63(2), 171-181.
- Karlsson, T., & Nowell, P. (2021). Entrepreneurship education: team composition in known worlds and new frontiers. *Entrepreneurship Education and Pedagogy*, 4(3), 282-311.
- Kasneci, E., Seßler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., ... & Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences*, 103, 102274.
- Kemp, A., Palmer, E., & Strelan, P. (2019). A taxonomy of factors affecting attitudes towards educational technologies for use with technology acceptance models. *British Journal of Educational Technology*, 50(5), 2394-2413.
- Kim, P. H., & Aldrich, H. E. (2005). Social capital and entrepreneurship. *Foundations and Trends® in*

- Entrepreneurship*, 1(2), 55-104.
- Klotz, A. C., Hmieleski, K. M., Bradley, B. H., & Busenitz, L. W. (2014). New venture teams: A review of the literature and roadmap for future research. *Journal of management*, 40(1), 226-255.
- Kolb, D. A. (1984). Experience as the source of learning and development. *Upper Sadle River: Prentice Hall*.
- Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of management learning & education*, 4(2), 193-212.
- Kuhail, M. A., Alturki, N., Alramlawi, S., & Alhejori, K. (2023). Interacting with educational chatbots: A systematic review. *Education and Information Technologies*, 28(1), 973-1018.
- Lazar, M., Miron-Spektor, E., Agarwal, R., Erez, M., Goldfarb, B., & Chen, G. (2020). Entrepreneurial team formation. *Academy of Management Annals*, 14(1), 29-59.
- Lim, W. M., Gunasekara, A., Pallant, J. L., Pallant, J. I., & Pechenkina, E. (2023). Generative AI and the future of education: Ragnarök or reformation? A paradoxical perspective from management educators. *The International Journal of Management Education*, 21(2), 100790.
- Lodge, J. M., Thompson, K., & Corrin, L. (2023). Mapping out a research agenda for generative artificial intelligence in tertiary education. *Australasian Journal of Educational Technology*, 39(1), 1-8.
- Long, D., & Magerko, B. (2020, April). What is AI literacy? Competencies and design considerations. In *Proceedings of the 2020 CHI conference on human factors in computing systems* (pp. 1-16).
- Lupp, D. (2023). Effectuation, causation, and machine learning in co-creating entrepreneurial opportunities. *Journal of Business Venturing Insights*, 19, e00355.
- M Alshater, M. (2022). Exploring the role of artificial intelligence in enhancing academic performance: A case study of ChatGPT. *Available at SSRN*.
- Ma, H., Lang, C., Liu, Y., & Gao, Y. (2020). Constructing a Hierarchical Framework for Assessing the Application of Big Data Technology in Entrepreneurship Education. *Frontiers in Psychology*, 11. <https://doi.org/10.3389/fpsyg.2020.551389>
- Matlay, H. (2009). Entrepreneurship education in the UK: a critical analysis of stakeholder involvement and expectations. *Journal of small business and enterprise development*, 16(2), 355-368.
- Mavlutova, I., Lesinskas, K., Liogys, M., & Hermanis, J. (2020). Innovative teaching techniques for entrepreneurship education in the era of digitalisation. *WSEAS Transactions on Environment and Development*, 16(1), 725-733.
- Mezirow, J. (2003). Transformative learning as discourse. *Journal of transformative education*, 1(1), 58-63.
- Morris, M. H., Kuratko, D. F., Schindehutte, M., & Spivack, A. J. (2012). Framing the entrepreneurial experience. *Entrepreneurship theory and practice*, 36(1), 11-40.
- Mucharraz y Cano, Y., Venuti, F., & Herrera Martinez, R. (2023, February 1). *Harvard Business Publishing Education*. <https://hbsp.harvard.edu/inspiring-minds/chatgpt-and-ai-text-generators-should-academia-adapt-or-resist>
- Nabi, G., Liñán, F., Fayolle, A., Krueger, N., & Walmsley, A. (2017). The impact of entrepreneurship education in higher education: A systematic review and research agenda. *Academy of management learning & education*, 16(2), 277-299.
- Nambisan, S. (2017). Digital entrepreneurship: Toward a digital technology perspective of entrepreneurship. *Entrepreneurship theory and practice*, 41(6), 1029-1055.

- Neck, H. M., & Greene, P. G. (2011). Entrepreneurship education: known worlds and new frontiers. *Journal of small business management*, 49(1), 55-70.
- Neck, H. M., Greene, P. G., & Brush, C. G. (Eds.). (2014). *Teaching entrepreneurship: A practice-based approach*. Edward Elgar Publishing.
- Neck, H. M., & Corbett, A. C. (2018). The scholarship of teaching and learning entrepreneurship. *Entrepreneurship Education and Pedagogy*, 1(1), 8-41.
- Neergaard, H., & Christensen, D. R. (2017). Breaking the waves: Routines and rituals in entrepreneurship education. *Industry and Higher Education*, 31(2), 90-100.
- Neumann, M., Rauschenberger, M., & Schön, E. M. (2023). "We Need To Talk About ChatGPT": The Future of AI and Higher Education.
- Ng, D. T. K., Luo, W., Chan, H. M. Y., & Chu, S. K. W. (2022). Using digital story writing as a pedagogy to develop AI literacy among primary students. *Computers and Education: Artificial Intelligence*, 3, 100054.
- O'Connor, S., & ChatGPT. (2023). Open artificial intelligence platforms in nursing education: Tools for academic progress or abuse? *Nurse Education in Practice*, 66, 103-537
- Obschonka, M., & Audretsch, D. B. (2020). Artificial intelligence and big data in entrepreneurship: a new era has begun. *Small Business Economics*, 55, 529-539.
- OpenAI. (n.d.). *Introducing ChatGPT*. (n.d.). <https://openai.com/blog/chatgpt>
- Oyelere, S. S., Suhonen, J., & Sutinen, E. (2016). M-learning: A new paradigm of learning ICT in Nigeria. *International Journal of Interactive Mobile Technologies*, 10(1).
- Peng, H., Ma, S., & Spector, J. M. (2019). Personalized adaptive learning: an emerging pedagogical approach enabled by a smart learning environment. *Smart Learning Environments*, 6(1), 1-14.
- Perry, J. T., Chandler, G. N., & Markova, G. (2012). Entrepreneurial effectuation: a review and suggestions for future research. *Entrepreneurship theory and practice*, 36(4), 837-861.
- Pittaway, L., & Cope, J. (2007). Simulating entrepreneurial learning: Integrating experiential and collaborative approaches to learning. *Management learning*, 38(2), 211-233.
- Pittaway, L. A., Gazzard, J., Shore, A., & Williamson, T. (2015). Student clubs: experiences in entrepreneurial learning. *Entrepreneurship & Regional Development*, 27(3-4), 127-153.
- Pittaway, L., Rodriguez-Falcon, E., Aiyegbayo, O., & King, A. (2011). The role of entrepreneurship clubs and societies in entrepreneurial learning. *International Small Business Journal*, 29(1), 37-57.
- Preedy, S., Jones, P., Maas, G., & Duckett, H. (2020). Examining the perceived value of extracurricular enterprise activities in relation to entrepreneurial learning processes. *Journal of Small Business and Enterprise Development*, 27(7), 1085-1105.
- QAA (2018), Enterprise and entrepreneurship: guidance for UK higher education providers", available at: [www.qaa.ac.uk/en/Publications/Documents/Enterprise-and-entrepreneurship-education-2018.pdf](http://www.qaa.ac.uk/en/Publications/Documents/Enterprise-and-entrepreneurship-education-2018.pdf)
- Qadir, J. (2022). Engineering Education in the Era of ChatGPT: Promise and Pitfalls of Generative AI for Education.
- Rae, D. (2005). Cultural diffusion: a formative process in creative entrepreneurship?. *The International Journal of Entrepreneurship and Innovation*, 6(3), 185-192.
- Reich, R. B. (1987). Entrepreneurship reconsidered: The team as hero. *Harvard Business Rev*, 65, 77-78.

- Robinson, S., Neergaard, H., Tanggaard, L., & Krueger, N. F. (2016). New horizons in entrepreneurship education: from teacher-led to student-centered learning. *Education+ training*, 58(7/8), 661-683.
- Ruef, M., Aldrich, H. E., & Carter, N. M. (2003). The structure of founding teams: Homophily, strong ties, and isolation among US entrepreneurs. *American sociological review*, 195-222.
- Sarasvathy, S. D. (2001). Causation and effectuation: Toward a theoretical shift from economic inevitability to entrepreneurial contingency. *Academy of management Review*, 26(2), 243-263.
- Sarasvathy, S. D. (2008). Effectuation: Elements of entrepreneurial expertise. In *Effectuation*. Edward Elgar Publishing.
- Sarasvathy, S. D., & Venkataraman, S. (2011). Entrepreneurship as method: Open questions for an entrepreneurial future. *Entrepreneurship theory and practice*, 35(1), 113-135.
- Schmidt, P., Jendryczko, D., Zurbruggen, C. L., & Nussbeck, F. W. (2023). Recall bias of students' affective experiences in adolescence: The role of personality and internalizing behavior. *Journal of Adolescence*.
- Schumpeter, J. A. (1934). The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle.
- Servantie, V., & Rispal, M. H. (2018). Bricolage, effectuation, and causation shifts over time in the context of social entrepreneurship. *Entrepreneurship & Regional Development*, 30(3-4), 310-335.
- Shah, S. K., Agarwal, R., & Echambadi, R. (2019). Jewels in the crown: Exploring the motivations and team building processes of employee entrepreneurs. *Strategic Management Journal*, 40(9), 1417-1452.
- Shepherd, D. A., Souitaris, V., & Gruber, M. (2021). Creating new ventures: A review and research agenda. *Journal of Management*, 47(1), 11-42.
- Shepherd, D. A., & Majchrzak, A. (2022). Machines augmenting entrepreneurs: Opportunities (and threats) at the Nexus of artificial intelligence and entrepreneurship. *Journal of Business Venturing*, 37(4), 106227.
- Stockemer, D., Stockemer, G., & Glaeser, J. (2019). *Quantitative methods for the social sciences* (Vol. 50, p. 185). Cham, Switzerland: Springer International Publishing.
- Susnjak, T. (2022). ChatGPT: The End of Online Exam Integrity?. *arXiv preprint arXiv:2212.09292*.
- Terwiesch, C. (2023). Would chat GPT3 get a Wharton MBA? A prediction based on its performance in the operations management course. *Mack Institute for Innovation Management at the Wharton School, University of Pennsylvania*.
- Tlili, A., Shehata, B., Adarkwah, M. A., Bozkurt, A., Hickey, D. T., Huang, R., & Agyemang, B. (2023). What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education. *Smart Learning Environments*, 10(1), 15.
- Tretyakova, N., Lyzhin, A., Chubarkova, E., Uandykova, M., & Lukiyanova, M. (2021). Mobile-learning platform for the development of entrepreneurial competences of the students.
- Tunstall, R., & Neergaard, H. (2022). Flashmob: A Heutagogical tool for social learning in entrepreneurship education. *Entrepreneurship Education and Pedagogy*, 5(3), 472-492.
- Von Krogh, G. (2018). Artificial intelligence in organizations: New opportunities for phenomenon-based theorizing. *Academy of Management Discoveries*.
- Walske, J. M., & Zacharakis, A. (2009). Genetically engineered: Why some venture capital firms are more successful than others. *Entrepreneurship Theory and Practice*, 33(1), 297-318.
- Wasserman, N. (2017). The throne vs. the kingdom: Founder control and value creation in startups. *Strategic*

*Management Journal*, 38(2), 255-277.

Williams Middleton, K., & Donnellon, A. (2014). Personalizing entrepreneurial learning: A pedagogy for facilitating the know why. *Entrepreneurship research journal*, 4(2), 167-204.

Winkler, C., Hammada, B., Noyes, E., & Van Gelderen, M. (2023). Entrepreneurship Education at the Dawn of Generative Artificial Intelligence. *Entrepreneurship Education and Pedagogy*, 6(4). <https://doi.org/10.1177/25151274231198799>

Wu, Y. J., Yuan, C. H., & Pan, C. I. (2018). Entrepreneurship education: an experimental study with information and communication technology. *Sustainability*, 10(3), 691.

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# Academic Startup Clinic: Applying effectuation and experiential learning principles to educate and support academic entrepreneurs

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## ABSTRACT

*Academic entrepreneurs hold the potential for supporting economic development in their communities and finding workable solutions to current societal problems through their innovations. However, they face peculiar challenges to first acquire required business knowledge and skills, and then develop their innovation from a research-based model to a marketable solution, following different trajectories. One of the entrepreneurial models that has emerged in recent years which shows promising potential in supporting entrepreneurs in a contextualized and adjustable manner pertinent to their needs is effectuation. This chapter conceptualizes the application of effectuation principles in educating and supporting nascent academic entrepreneurs in their journey from the lab to the real world.*

## 1. INTRODUCTION

Entrepreneurship education (EE) has emerged as a reliable tool to facilitate and accelerate the production of entrepreneurs and entrepreneurial firms which benefit the economy (Matlay, 2005; Pittaway and Cope, 2007). Recently, there is a growing direction to move from traditional approaches that focus on knowledge transfer to one which equips learners with the required skills and competences through a person-centric, processual, and active approach (teaching through entrepreneurship) (Günzel-Jensen and Robinson, 2017; Hammoda, 2023; Mäkimurto-Koivumaa and Puhakka, 2013).

One method increasingly used in “through courses” is effectuation. As explained by Sarasvathy (2001), effectuation implies that entrepreneurs begin with a general vision, and use available resources, knowledge, and connections (who they are, what they know, and who they know). The direction is not set in advance, and they remain adaptive as they progress with their journey towards realizing their entrepreneurial aspiration, leveraging opportunities as they are made available to them and learn through their actions. Building on effectual logic, entrepreneurship educators can adopt a processual approach to teaching that revolves around the learner. This approach allows for entrepreneurs to receive tailored support while they explore multiple options, take affordable risks, leverage connections at their disposal, make use of environmental contingencies, and learn on the job through experimentation (Sarasvathy, 2001).

In the context of academic entrepreneurship, an effectual approach could prove particularly relevant. Academic entrepreneurs (AEs) typically face resource and time constraints (Alexander *et al.*, 2015), witness insufficient interest from higher educational institutions (HEIs) in their entrepreneurial endeavours (Abreu and Grinivich, 2013), lack exposure to entrepreneurial role models (Miller *et al.*, 2018), face trade-offs between their academic and entrepreneurial identities (Radosevich, 1995), and need to improve their skills and stay motivated (Miller *et al.*, 2018). Thus, Fayolle and Gailly (2008) argued that effectuation can be used effectively in developing



entrepreneurial learning initiatives, which should be aligned with the individual preferences, context, and available resources and connections of the learners (Rae, 2005).

In this chapter, a model for academic entrepreneurship education and support is conceptualized and proposed, building on effectuation principles and experiential learning concepts. Effectuation principles are synthesized, adapted, and complemented with experiential logic to be applied in an educational context, specific to nascent AEs. We first review the literature on academic entrepreneurship and effectuation, highlighting the research and practice state of affairs in each. We then present the conceptual model and explain its different components and their interlinkages.

## **2. BACKGROUND**

### **2.1. ACADEMIC ENTREPRENEURSHIP**

In literature, the concept of academic entrepreneurship is a complex one with several subfields contributing to its scholarly development and understanding of its predeterminants and impact (Skute, 2019). These literature streams include entrepreneurial university, spinoffs, innovation, knowledge transfer, knowledge co-creation, and entrepreneurial identity, among others. We can define academic entrepreneurship as the processes and configurations that HEIs apply to establish, promote, and realize the benefits of their entrepreneurial orientation. It features a dynamic, multi-layered ecosystem with individual, organizational, and societal stakeholders (Audretsch *et al.*, 2019; Guerrero and Urbano 2012; Hayter *et al.*, 2018).

Academic entrepreneurship has been receiving increasing attention from the scholarly community, policymakers, and industry professionals in recent years (e.g., Gümüşay and Bohné 2018; Secudno *et al.*, 2020; Skute, 2019), as science based new ventures are judged to have a more tangible role in technological and economic development than traditional ones (Rasmussen *et al.*, 2014). Academic entrepreneurship is indeed considered an important source of innovation (Bienkowska *et al.*, 2016; Galan-Muros *et al.*, 2017), regional economic and societal development (Fini *et al.*, 2011; Perkmann *et al.*, 2013), and provides additional revenues to HEIs (Hmieleski and Powell, 2018). Recognizing that, governments and HEIs adjusted their policies and strategies to ignite an innovative drive among researchers and support them in transforming their innovations to products and services (Bienkowska *et al.*, 2016).

#### **The changing role of academic entrepreneurship**

The needle has moved however in recent years due to changes in government support policies, market demands, and the business models of HEIs. Universities are expected now to generate more income from private sources. Moreover, university spinoffs are becoming a competitive advantage in the higher education industry. They affect universities rankings and play an important role in attracting students and researchers (Siegel and Wright, 2015). As a result, HEIs are encouraged to become more entrepreneurial and production hubs of innovative solutions (Bienkowska *et al.*, 2016). They are more and more regarded as the epicentre for local innovation and the fulcrum of industry and government collaboration (Secundo *et al.*, 2020). Hence, instead of relying on patent revenues, HEIs and AEs alike, have started focusing on commercializing innovation through creating and launching research-driven start-ups (Galan-Muros *et al.*, 2017; Grimaldi *et al.*, 2011; Siegel and Wright, 2015).

This transition however is proving difficult. Universities have now a broader set of priorities, which can disperse their efforts. Moreover, they have inherent expertise in fulfilling their education and research roles, but not in establishing and directing an entrepreneurial organization.

Universities also have to invest in physical, human, and technological capital in order to provide build a supportive platform for their spin-offs (Gianiodis and Meek, 2020; Grimaldi *et al.*, 2011).

While originally confined to faculty (professors) pursuing entrepreneurial projects, the scope of academic entrepreneurship has expanded lately to include graduate students, doctoral candidates, postdoctoral and early career researchers, and even alumni (Siegel and Wright, 2015). Therefore, universities are expected to play a bigger role in facilitating the acquisition of a broader base of current and potential AEs with the required skills, ecosystem networks, professional experiences, and access to resources. This necessitates rethinking and reinventing the current models and approaches to support AEs, that is centred around them as individuals.

### **The focus on academic entrepreneurs**

Several scholars turned our attention to the importance of individual level determinants of academic entrepreneurship such as Jain *et al.* (2009), who highlighted the role identity conflict that researchers with entrepreneurial intentions witness. They argued for a stronger focus on supporting the researcher as the core foundation of academic entrepreneurship. Hayter *et al.* (2018) underlined the role of graduate students in university spin-offs as in identifying market opportunities and acquiring research funding, while dealing with challenges such as finding talent with relevant scientific and business knowledge. Siegel and Wright (2015) highlighted the motivating role of funding dedicated to scientific innovation from public and private entities on AEs commercialization activity, while Grimaldi *et al.* (2011) in their review of literature on academic entrepreneurship highlighted the individual scientist as an important factor. Although, they still emphasized the strong impact of university and system level factors on shaping researchers' entrepreneurial intentions and orientation. Moreover, Zhang *et al.* (2022) examined the factors influencing AE intentions and motivation and posited that these factors do not exert a causal or linear effect on AEs but are rather diverse and complex in nature.

Academic entrepreneurs and the factors impacting them are different from regular entrepreneurs, as they try to find compromises between their original research-focused and the to-be commercially driven orientations. There are several challenges that intersect their way to achieve their entrepreneurial dreams. They lack required resources and time (Alexander *et al.*, 2015; Müller-Wieland *et al.*, 2019). HEIs tend to deprioritize their entrepreneurial interests (Abreu and Grinivich, 2013). They are isolated in the university without much interaction with startups, industry, or markets (Lubik and Garnsey, 2016; Miller *et al.*, 2018). They face high levels of uncertainty (Sinell *et al.*, 2015). Consistently trying to align their academic and entrepreneurial identities (Li *et al.*, 2020). They are also hindered by a rigid academic hierarchy (Skute, 2019).

Most importantly, AEs lack the necessary means to improve their entrepreneurial skills and self-efficacy (Miller *et al.*, 2018). Despite the growth in entrepreneurship education in HEIs, there is a lack of courses and programs designed to address the specific learning and training needs of scientific researchers (Pittaway *et al.*, 2023; Siegel and Wright, 2015). It therefore comes as no surprise that the literature has concluded that a significant proportion of research-driven entrepreneurial projects fail at conception or dwindle as the time goes by (Fini *et al.*, 2017; Fisher *et al.*, 2016). This finding is shared with more 'regular' startups with some studies finding the firm closures are at a higher rate the new firms' establishment (Metzger, 2014), with a remarkably high failure rates among startups (92%) reported in the Startup Genome project (Marmer *et al.*, 2012). The universities face similar consequences with the majority of technology transfer offices (TTOs) showing little (Fini *et al.*, 2017) or even negative return on investment (Lafuente and Berbegal-Mirabent, 2019; Puntillo *et al.*, 2022).

## Academic entrepreneurship education

A key element in achieving the desired outcomes of academic entrepreneurship, is to equip AEs with the relevant business knowledge, skills, and experiences. While AEs might exhibit high degrees of scientific and technological knowledge, they suffer from a lack of relevant education and training on opportunity identification and exploitation (Skute, 2019). In addition, universities are expected to broker their connections with the wider entrepreneurial ecosystem and industry (Secundo *et al.*, 2016). Entrepreneurship education is regarded a viable option to provide academics with necessary mindset and competences in support of their entrepreneurial aspirations (Bienkowska *et al.*, 2016; Rippa *et al.*, 2022). EE can prepare researchers for exploring business opportunities and adapting their innovations to market needs (Pittaway *et al.*, 2023; Munoz *et al.*, 2020). Moreover, Gianiodis and Meek (2020) argue for the bigger impact that EE can have on universities towards achieving their desired technology transfer and commercialization outcomes.

However, current research on the pedagogical approaches to academic EE among researchers is scarce and displays a fragmentation among HEIs approach (Bienkowska *et al.*, 2016; Rippa *et al.*, 2022). Bolzani *et al.* (2021) for example, found that the majority of TTOs that are tasked with research commercialization, participate in the provision of EE to university scientists. They do so either directly by offering EE programs to faculty and students, or through collaborating with departmental EE programs. While Gianiodis and Meek (2020), argued for incorporating diverse stakeholders in academic EE and proposed a modular framework for supporting innovation and assessing it. Hence, a promising area of research is investigating the development of entrepreneurial competences by academics (Gümüşay and Bohné 2018; Oosterbeek *et al.*, 2010) through applying specialized approaches to entrepreneurial learning (Guerrero and Urbano, 2012), as they advance through the entrepreneurial process.

## Effectuation in academic entrepreneurship

Given the challenges and uncertainty that academic entrepreneurs face and the lack of attuned approaches and programs to upskill them, Li *et al.* (2020) suggest that an effectual logic could be suitable for addressing those shortcomings that academic entrepreneurs face. This is especially true for the educational part of their development (Faylle and Gailly, 2008) as AEs face a conundrum between their academic career in doing research and teaching students, and the entrepreneurial one in marshaling resources and transforming their innovation into a viable business (Müller-Wieland *et al.*, 2019; Villani *et al.*, 2018).

Moreover, such transformation requires acquisition of new (entrepreneurial) behaviors, while they maintain their existing (academic) roles (Jain *et al.*, 2009). Effectuation as a heavily behavioral model advocates for entrepreneurs to enact several attitudes such as fomenting existing resources, leveraging contingencies as they occur, capitalizing on connections, and containing and managing risks (Sarasvathy, 2001). In addition, the effectual logic supports emergent decision making within academic entrepreneurship context. It advocates for a bootstrapping approach to mapping and mobilizing resources (Politis *et al.*, 2012), idea discovery, evaluation, and testing (Lubik and Garney, 2016), flexibility in adjusting the developing model to the changing circumstances (*ibid*), navigating around bottlenecks and critical events, and emphasizing the positive role of the connections an entrepreneur makes along the way. These explicit effectual activities are synonymous to the process of scientific innovation and commercialization.

## 2.2. EFFECTUATION

Effectuation was proposed by Sarasvathy (2001) as a behavioral model to provide a complementary alternative to causation (Agogué *et al.*, 2015; Reymen *et al.*, 2015), which often follows a linear logic to entrepreneurship (Mäkimurto-Koivumaa and Puhakka, 2013). Following a causal approach to venture creation, the entrepreneur sets a goal, procures the required resources to achieve it, researches the market, and forecasts returns and possible risks. Effectuation, however, explores the unpredictable decision-making process of entrepreneurs when they are faced by uncertainty, through leveraging available resources, knowledge, and connections (Dew *et al.*, 2009; Read and Sarasvathy, 2005; Sarasvathy, 2009). Hitherto, it rhymes with the entrepreneurial premise of making use of available means and exploiting opportunities (Racat *et al.*, 2023). Given the increasing degree of environmental and market dynamism and uncertainty, there has been a growing interest in effectuation as a decision-making approach in business and entrepreneurship recently as an alternative logic to causation (Frese *et al.*, 2020; Hammoda, 2024; Hauser *et al.*, 2020).

First studied on experienced entrepreneurs, Sarasvathy (2001) established four main principles of applying an effectual logic. These are affordable loss, that limits resource sacrifice and hemorrhage rather than chasing expected returns; leveraging industry connections as alliances rather than viewing them as competitive forces; exploiting contingencies along the way instead of deliberate planning and precise goal setting; and controlling uncertainty rather than adopting a predictive analytical behavior (Sarasvathy, 2001). Effectuation thus advocates for adopting resource preservation, partnerships building, business model flexibility, and experimentation in entrepreneurial activities (Chandler *et al.*, 2011). We elaborate on effectuation principles below.

### Effectuation principles

**Means:** Effectual entrepreneurs start with available resources and proceed from there, instead of defining goals and planning backwards. In this way, effectuation draws parallels from the core logic of bricolage (Senyard *et al.*, 2009). The rationale is that entrepreneurs should focus on the resources they already have access and control over, instead of wasting effort in acquiring distant resources to attain their predefined goals. Hence, in the effectual approach, the goals are shaped as the proposition becomes clearer and remain flexible pertinent to the evolution of the business model (Honig, 2004). Moreover, in practice, entrepreneurs constantly update and adjust their strategies and goals to the changing resources and circumstances (Alvarez and Barney, 2007; Read and Sarasvathy, 2005). These means include knowledge, industry experience, skills, connection, and the financial, human, and material assets they can capitalize on.

**Affordable loss:** The concept of affordable loss directs the effectual entrepreneurs focus to resource containment when evaluating ideas and projects to pursue, instead of basing their decisions on potential future returns (Sarasvathy, 2009). Available means are identifiable and quantifiable (*ibid*), in comparison to the guesswork involved in estimating expected returns. Effectuation then directs entrepreneurs to commit only resources they are ready to relinquish, thus minimizing their losses.

**Partnerships:** The effectual logic views other individuals and organizations having similar or related businesses as potential collaborators and partners. This opposes the causal and strategic views of the business environment as a competitive battlefield. Hence, an effectual entrepreneur leverages existing and new connections to build strategic alliances that provide him with further

resources and opportunities (Sarasvathy, 2001), rather than adopting a defensive or an aggressive stance.

**Contingencies:** Exploiting contingencies entails exploring opportunities as they arise rather than viewing challenges as merely obstacles (Fisher, 2012). This mindset can be supported by adopting a flexible approach to goals definitions, based on available means. It thus leads to the adoption of a controlling approach to risks rather than trying to predict them.

**Control:** Navigating the emerging firm through the troughs and heights of the turbulent seas of entrepreneurship, is an essential concept in the effectual logic (Sarasvathy, 2009). Instead of businesses spending time upfront trying to predict and scenario plan their responses to every possible risk, the effectual approach applies a guiding principle, more or less of a firm hand, to risk contingency.

The building blocks of effectuation do not exist in isolation and are not entirely linear. The exploitation of the means and the connections, develops artefacts that can then be adjusted and adapted based on evolving contingencies. The knowledge and resources acquired through alliances, feedback into the means and aspirations of the entrepreneur. Similarly, as the entrepreneur adjusts their mental and business model along the process, new alliances are thought. This view reflects a dynamic nature of the effectual process that resembles entrepreneurial realities (Dew *et al.*, 2009).

### **Effectual logic in entrepreneurship education**

Current approaches to EE lean towards a causation-based logic (Mäkimurto-Koivumaa and Puhakka, 2013). They fall short of equipping students with real-life skills. In recent years, there have been a growing trend to follow a “through” experiential approach to EE, that can provide students with the practical skills they need for entrepreneurship. Despite an abundance of trials at theorizing the practice-based approach through several lenses, there is yet to be a concept that can be unequivocally aligned with a learning “through” approach that resembles real-life entrepreneurship (Fayolle and Gailly, 2008). A “through” approach to EE aligns with the dynamic nature of entrepreneurship as a practice (Blenker *et al.*, 2012). This is true for effectuation, as a learning model, which emphasizes the learn by doing approach, in contrast to linear cause-effect based approaches such as business planning, which are less likely to influence the daily behaviors of entrepreneurs (Politis, 2005). Hence, several scholars (e.g., Fayolle and Gailly, 2008; Günzel-Jensen and Robinson, 2017) argued that effectuation is a suitable paradigm to be applied in designing and conducting experiential entrepreneurship programs.

Moreover, EE in its broad definition of developing an entrepreneurial learner, helps develop students’ knowledge, skills, mindset, and intentions. This contrasts with the traditional narrow causation-based focus of EE on promoting firm creation among students. However, following an effectual approach translates to an EE that directly contributes to the venture creation process, without compromising on the other aims. Effectuation calls for an educational pedagogy that reflects the opportunity identification and exploitation phenomena of entrepreneurship (Sarasvathy, 2003; Shane and Venkataraman, 2000). Its principles can be more widely conceptualized as pedagogical guidelines to improve the delivery of EE and achieving its broad range of desired outcomes (Günzel-Jensen and Robinson, 2017; Mäkimurto-Koivumaa and Puhakka, 2013).

However, there are several limitations in effectuation. As a theory, it needs more clarity on the explanation of its building blocks and their configurations in different applications. Similarly, there has been limited theorizing in literature to advance our understanding of effectuation and its dispositions. Moreover, the original model stemmed from an examination of established entrepreneurs decision-making logic. Hence, its projection on nascent entrepreneurs and entrepreneurial learners needs to be further established and might require some alterations to the original model.

A few researchers applied effectuation to academic entrepreneurship (e.g., Agogu e *et al.*, 2015; Li *et al.*, 2020; Villani *et al.*, 2018) or EE in general (G unzel-Jensen and Robinson, 2017). Agogu e *et al.* (2015) explored the application of effectuation and causation logics in decision-making by nascent student technology entrepreneurs, as they analyze an existing platform and developed new applications for it, using C-K diagrams.

Li *et al.* (2020) investigated the adoption of effectual logic among AEs and its impact on firm performance, and whether their pursuit of a role innovation methodology improve the consequences. They found that, in general, adopting an effectual logic and conjoining it with role innovation leads to improved prospects of academic entrepreneurship endeavors. However, AEs applying the affordable loss principle, i.e., investing limited resources, indented their entrepreneurial chances. It is worth-noting, however, that science-based entrepreneurship is resource intensive, especially in the early stages of the business development, which can provide some rational to their findings. They also found that even when AE manage to transform their roles, it does not seem to help them become more flexible to a degree that can influence their enterprise prospects positively.

Villani *et al.* (2018) examined the antecedents for using effectuation and/ or causation by AEs, based on (fs/QCA) of a longitudinal startup dataset in the United States. They found that AEs can exhibit some inclination towards risk raking, apply their industry and startup experience, conduct deliberate planning and market research, and leverage partnerships. But they mostly lack the required flexibility compared to regular entrepreneurs, denoting a lack of effectual logic preparedness. The causal goal-defined planning approach is especially relevant among risk-averse AEs who lack enough industry and startup experience. They called for more research on understanding the causal and effectual approaches among AE.

G unzel-Jensen and Robinson, (2017), structured and delivered an undergraduate course using effectuation over six months. They inductively identified three barriers to its application among to-be entrepreneurs. The first is their noviceness. While effectuation was developed among expert entrepreneurs, students lack the required means, or an understanding of what resources are required. Secondly, the encompassing context was still “educational” and not realistic, which affected their commitment to the process. Thirdly, they suffered from a lack of legitimacy as the educator was not an entrepreneur or a mentor and thus the effectuation-based methods and processes could not be substantiated by real-world narratives.

In summation, despite the growing interest in academic entrepreneurship from all involved stakeholders, there are still several unique challenges impeding AEs pursuit of their science-based startups. In addition, current approaches to EE still unable to present the ideal model for a learning “through” approach that support nascent entrepreneurs enaction in entrepreneurial realities. By deduction from literature, I have shown that effectuation might represent the missing link between a venture creation and entrepreneurial competences development foci of EE. This duality is of critical importance to AEs as it covers their true needs of competence development while navigating their relevant industry networks.

### **3. ACADEMIC STARTUP CLINIC**

#### **3.1. BACKGROUND AND SETUP**

The developed model synthesized effectuation principles and adapted their application to an educational context, while leveraging linkages between effectuation and experiential pedagogies for developing a model for academic entrepreneurship education. The original effectuation model was designed based on expert entrepreneurs' decision-making behaviors (Sarasvathy, 2001; Perry *et al.*, 2012). Hence, it needs to be adjusted for entrepreneurial learning among AEs, who can be considered as novice entrepreneurs. AEs also have certain characteristics and face specific challenges in their pursuit of an entrepreneurial career, compared to regular entrepreneurs.

The term clinic was selected for two reasons. First, we believe that developing academic entrepreneurship is an ongoing process that requires initial assessment of the idea, business model, AE capabilities, with several support “follow-ups” spaced by a few weeks' intervals. Hence, it resembles the remedial process followed in some medical practices. Secondly, the personalized approach and connections, which resemble health care provision, are essential in supporting AEs due to the relative uniqueness of their scientific innovation, their time constraints, and their social support exigency.

The clinic should ideally be managed by a team with the following competences: EE expertise, ecosystem and industry connections, experiences in startup mentoring as well as academic research. Participation is open to all current and aspiring AEs from all disciplines with a basic idea or a general understanding of what they want to achieve. Hence, they represent a heterogenous group, with differing backgrounds, ideas, and expertise, but share a common purpose, which is becoming an entrepreneur.

This multidisciplinary organization of EE helps enrich discussions, collaborative learning, and knowledge transfer among participants (Volkman and Audretsch, 2017), following a T-shaped educational approach to academic EE (Rippa *et al.*, 2022). It can improve AEs capabilities, intentions, and self-efficacy (Fayolle and Gailly, 2008; Rippa *et al.*, 2022). Moreover, it can equip the novices among them with diverse set of skills and perspectives, complementary to their expertise, to effectively address complex real-life problems, which often require an understanding of multiple disciplines (Pittaway *et al.*, 2023).

#### **3.2. ACADEMIC STARTUP CLINIC MODEL COMPONENTS**

In this part, we explain the different components of the proposed Academic Startup Clinic model as illustrated in Figure 1 in detail, delineating their relationships and value flow.

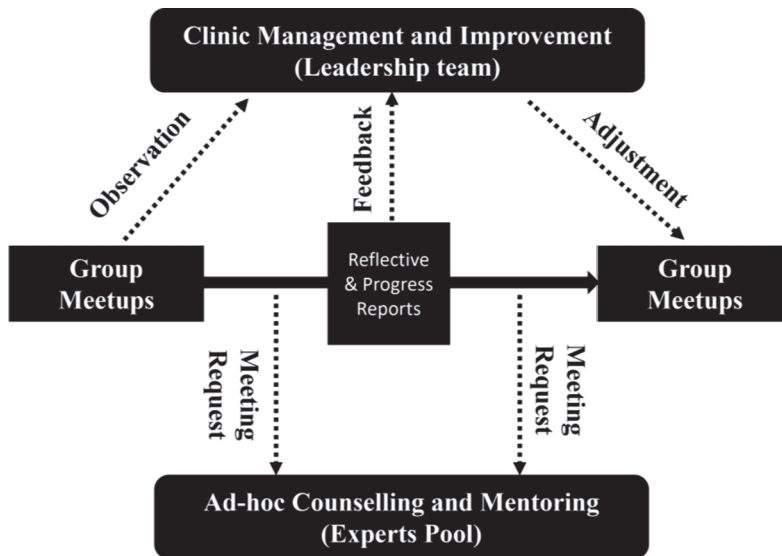


Figure 1. Academic Startup Clinic model

### Group meetups

The backbone of the model is the monthly group meetups. These take place in-person and for those who cannot attend, they can join the meetup online. The meetup typically lasts between 2-3 hours only, given the limited time available to AEs (Alexander *et al.*, 2015). It starts with a round of progress updates from the AEs. This is a chance to exhume challenges, worries, and upsets, and reflect on them (Kolb and Kolb, 2005). In return, AEs receive support and advice from other members in the social circle which resembles a community of inquiry (COI). COI have proved to expand the knowledge and social capital of entrepreneurs and provide required emotional support (Garrison *et al.*, 2010). It also resembles the group therapy approach followed in other disciplines, which have demonstrated benefits with regards to the motivation, perseverance, goal pursuit, and mental strength of small business leaders (Saraf *et al.*, 2019).

After the initial grumbling and peer feedback cycle subsides, one of the entrepreneurial topics is explained by a member of the clinic leadership team. The subject is tailored to become more relevant to research commercialization. This is done through the inclusion of apropos topics, in addition to common EE themes, models, examples, and activities. For example, topics such as university spin-offs, patenting, and industry labs operations are discussed, which do not commonly form part of standard entrepreneurship curricula. Also, alternative models are utilized such as the sustainable business model canvas (Joyce and Paquin, 2016), which advocates for a triple bottom line emphasis in business, instead of the standard Osterwalder and Pigneur (2010) canvas. When explaining entrepreneurial teams, in-class activities using multidisciplinary members are implemented, leveraging the diversity in participants academic backgrounds and expertise. This is one of the beneficial features of the startup clinic, as they improve knowledge transfer and collaborative learning (Volkmann and Audretsch, 2017).

The monthly meetups aim primarily at improving the “means” available to AEs (Sarasvathy, 2001). Through the explained topics, which are tailored to academic entrepreneurship, they can develop entrepreneurial and business knowledge, more specific to their needs. In addition, the



initial exhuming and reflection help them develop a better awareness of themselves, their capacities, and their connections (Who I am? What I have? Whom do I know?). The initial group therapy-like activity can also help build their social capital, knowledge relevant to precise scenarios and challenges, and learn from other experiences. Thus, replenish their means.

### **Ad-hoc counselling**

The second feature in the Startup Clinic is the mentoring spaces. These are set up on a need to basis, according to the AEs requests. They would typically ask for them to acquire additional or specific knowledge about a certain topic, receive advice on a situation or an aspect of managing their entrepreneurial project, ask to be connected or introduced to an industry figure, potential partner, client, or investor. When the request is received, the clinic leadership team initially “triage” it, to assess whether it could be fulfilled directly by them or will require an external support. If the latter, then relevant figures from the pool of experts that signed up to support the clinic, are contacted and a meeting is facilitated between the AE and the relevant expert.

The ad-hoc meetings thus help AEs also supplement their means. This could happen through access to specific industry or entrepreneurial knowledge or the connections they get introduced to. They also get to build partnerships, either new ones or leverage existing relationships, guided by the mentors in the ad-hoc meetings. Most importantly, whenever they face a contingent scenario or an unexpected event, the mentor is able to discuss with them possible strategies to respond to it. Thus, improving their resilience and opportunity recognition. This last role of the ad-hoc counselling is significant to AEs given their lack of business knowledge and experience (Miller *et al.*, 2018), and being traditionally risk-averse individuals who follow a systematic (causal) approach in their research.

### **Reflective and progress notes**

An essential part of the learning process is reflecting on oneself, capabilities, mental models, and attitudes (Kolb and Kolb, 2005). This is especially important for entrepreneurs as they learn through experiences in a contextually relevant social circle (Corbett, 2005), which is an integral part of the Startup Clinic proposition. AEs would be able to reflect on their progress on the previously mentioned aspects. They will become more aware of their evolving needs and resources as they acquire more means, adjust their expectations, build stronger partnerships, face contingencies, and try to control uncertainty. Hence, they can apply their conclusions from those reflective notes to adjust the course of their entrepreneurial project.

Moreover, the AEs are required to include a brief description of their progress on regular intervals, in addition to their reflective notes. This is crucial not to drift or fall behind, which is common in academic entrepreneurship (Miller *et al.*, 2018). It will also form a guiding document that can enable them to exert a controlling behavior over their emerging venture, as they navigate an uncertain environment (Sarasvathy, 2009).

### **Clinic Improvement**

The progress notes of AEs will establish the basis for the clinic leadership team, together with their observations from the group meetups and the ad-hoc meetings, to reflect on its progress and adjust its structure, topics, experts’ pool, and connections, accordingly. This will enable the leadership team to maintain the inherent flexibility of the Startup Clinic. Hence, the model becomes more responsive to the participating AEs characteristics and requirements, the evolving contextual factors within the respective academic institution, and the changes in external environment. The Startup Clinic model thus embodies an effectual approach to academic entrepreneurship learning and support.

#### 4. CONCLUSION AND IMPLICATIONS

Supporting the development of competences and entrepreneurial projects among academics, requires following a more tailored methodology, rather than the standard approaches to EE. Although they exhibit significant technological knowledge and professional maturity, they lack enough business acumen. These characteristics when combined with the specific challenges and the resource constraints they suffer from, mandates the application of a more social and behavioral approach to supporting their entrepreneurial decision-making junctures.

Following an effectual approach to educating and supporting them, hence seems logical, which is complemented by the inclusion of external agents from the entrepreneurial ecosystem (Bischoff *et al.*, 2018) and academics with diverse backgrounds (Fiore *et al.*, 2019). The description of the model provided earlier, aims to replenish the “means” of AEs, help them understand their “affordances”, build effective “partnerships”, navigate “contingencies” more successfully, and exert a guided “control” over uncertainty.

The effectuation-based model offers an alternative approach to traditional methods as well as accelerators/ incubators for educating and supporting nascent and to-be AEs. It answers better to their specific needs, challenges, and situational factors than formal entrepreneurship courses (Politis, 2005). The model allows for personalized learning, mindset development, and self-awareness, which are critical aspects of entrepreneurial learning (Rae, 2000). From a theoretical perspective, it extends our limited understanding of effectuation process applications by adapting it to an educational context and extending it to an understudied field, academic entrepreneurship. It also advances the research on EE as a process.

By focusing on novice and aspiring entrepreneurs, the model provides an additional layer to the original logic of Sarasvathy (2001) that was built on interactions with expert entrepreneurs. In addition, it adds to the scarce research on the changing role of AEs from selling patents to founders of innovative economic entities (Miller *et al.*, 2018). Moreover, integrating effectuation in processual EE among AEs, opens new avenues for research to build on our work through further empirical studies to validate and improve our model, apply it to other EE settings and experiment its implementation through various activities and approaches to EE.

Startup Clinic offers a model entrenched in effectuation and experiential principles to cater for a broader range of EE outcomes, from competences development to social capital enrichment, and venture creation. Given its inherent flexibility, universities can apply it to their specific contexts and use it as a platform to integrate the different stakeholders concerned with academic entrepreneurship and provide better support to their burgeoning AEs. Thus, cementing their role as the fulcrum of innovation-based local and regional economic development.

#### 5. REFERENCE LIST

- Abreu, M. and Grinevich, V. (2013) ‘The nature of academic entrepreneurship in the UK: Widening the focus on entrepreneurial activities.’ *Research Policy*, 42(2), pp.408-422.
- Agogué, M., Lundqvist, M. and Middleton, K.W. (2015) ‘Mindful deviation through combining causation and effectuation: A design theory-based study of technology entrepreneurship.’ *Creativity and Innovation Management*, 24(4), pp.629-644.
- Alexander, A.T., Miller, K. and Fielding, S. (2015) ‘Open for business: Universities, entrepreneurial academics and open innovation.’ *International Journal of Innovation Management*, 19(06), p.1540013.
- Alvarez, S.A. and Barney, J.B. (2007) ‘Discovery and creation: Alternative theories of entrepreneurial action.’ *Strategic entrepreneurship journal*, 1(1-2), pp.11-26.

- Audretsch, D.B., Cunningham, J.A., Kuratko, D.F., Lehmann, E.E. and Menter, M. (2019) 'Entrepreneurial ecosystems: economic, technological, and societal impacts.' *The Journal of technology transfer*, 44, pp.313-325.
- Bienkowska, D., Klofsten, M. and Rasmussen, E. (2016) 'PhD students in the entrepreneurial university-perceived support for academic entrepreneurship.' *European Journal of Education*, 51(1), pp.56-72.
- Bischoff, K., Volkmann, C.K. and Audretsch, D.B. (2018) 'Stakeholder collaboration in entrepreneurship education: an analysis of the entrepreneurial ecosystems of European higher educational institutions.' *The Journal of Technology Transfer*, 43, pp.20-46.
- Blenker, P., Frederiksen, S.H., Korsgaard, S., Müller, S., Neergaard, H. and Thrane, C. (2012) 'Entrepreneurship as everyday practice: towards a personalized pedagogy of enterprise education.' *Industry and Higher Education*, 26(6), pp.417-430.
- Bolzani, D., Munari, F., Rasmussen, E. and Toschi, L. (2021) 'Technology transfer offices as providers of science and technology entrepreneurship education.' *The Journal of Technology Transfer*, 46, pp.335-365.
- Chandler, G.N., DeTienne, D.R., McKelvie, A. and Mumford, T.V. (2011) 'Causation and effectuation processes: A validation study.' *Journal of business venturing*, 26(3), pp.375-390.
- Corbett, A.C. (2005) 'Experiential learning within the process of opportunity identification and exploitation.' *Entrepreneurship theory and practice*, 29(4), pp.473-491.
- Dew, N., Read, S., Sarasvathy, S.D. and Wiltbank, R. (2009) 'Effectual versus predictive logics in entrepreneurial decision-making: Differences between experts and novices.' *Journal of business venturing*, 24(4), pp.287-309.
- Fayolle, A. and Gailly, B. (2008) 'From craft to science: Teaching models and learning processes in entrepreneurship education.' *Journal of European industrial training*, 32(7), pp.569-593.
- Fini, R., Grimaldi, R., Santoni, S. and Sobrero, M. (2011) 'Complements or substitutes? The role of universities and local context in supporting the creation of academic spin-offs.' *Research Policy*, 40(8), pp.1113-1127.
- Fini, R., Fu, K., Mathisen, M.T., Rasmussen, E. and Wright, M. (2017) 'Institutional determinants of university spin-off quantity and quality: a longitudinal, multilevel, cross-country study.' *Small Business Economics*, 48, pp.361-391.
- Fiore, E., Sansone, G. and Paolucci, E. (2019) 'Entrepreneurship education in a multidisciplinary environment: Evidence from an entrepreneurship programme held in Turin.' *Administrative Sciences*, 9(1), p.28.
- Fisher, G. (2012) 'Effectuation, causation, and bricolage: A behavioral comparison of emerging theories in entrepreneurship research.' *Entrepreneurship theory and practice*, 36(5), pp.1019-1051.
- Fisher, G., Kotha, S. and Lahiri, A. (2016) 'Changing with the times: An integrated view of identity, legitimacy, and new venture life cycles.' *Academy of Management Review*, 41(3), pp.383-409.
- Frese, T., Geiger, I. and Dost, F. (2020) 'An empirical investigation of determinants of effectual and causal decision logics in online and high-tech start-up firms.' *Small Business Economics*, 54, pp.641-664.
- Galán-Muros, V., van der Sijde, P., Groenewegen, P. and Baaken, T. (2017) 'Nurture over nature: How do European universities support their collaboration with business?.' *The Journal of Technology Transfer*, 42, pp.184-205.
- Garrison, D.R., Anderson, T. and Archer, W. (2010) 'The first decade of the community of inquiry framework: A retrospective.' *The internet and higher education*, 13(1-2), pp.5-9.

- Gianiodis, P.T. and Meek, W.R. (2020) 'Entrepreneurial education for the entrepreneurial university: a stakeholder perspective.' *The Journal of Technology Transfer*, 45(4), pp.1167-1195.
- Grimaldi, R., Kenney, M., Siegel, D.S. and Wright, M. (2011) '30 years after Bayh-Dole: Reassessing academic entrepreneurship.' *Research policy*, 40(8), pp.1045-1057.
- Guerrero, M. and Urbano, D. (2012) 'The development of an entrepreneurial university.' *The Journal of Technology Transfer*, 37, pp.43-74.
- Gümüşay, A.A. and Bohné, T.M. (2018) 'Individual and organizational inhibitors to the development of entrepreneurial competencies in universities.' *Research Policy*, 47(2), pp.363-378.
- Günzel-Jensen, F. and Robinson, S. (2017) 'Effectuation in the undergraduate classroom: Three barriers to entrepreneurial learning.' *Education+ Training*, 59(7/8), pp.780-796.
- Hammada, B. (2023) 'Extracurricular Activities for Entrepreneurial Learning: A Typology Based on Learning Theories.' *Entrepreneurship Education and Pedagogy*, 0(0).
- Hammada, B. (2024) 'ChatGPT for founding teams: An entrepreneurial pedagogical innovation.' *International Journal of Technology in Education (IJTE)*, 7(1), pp.154-173.
- Hauser, A., Eggers, F. and Guldenberg, S. (2020) 'Strategic decision-making in SMEs: effectuation, causation, and the absence of strategy.' *Small Business Economics*, 54, pp.775-790.
- Hayter, C.S., Nelson, A.J., Zayed, S. and O'Connor, A.C. (2018) 'Conceptualizing academic entrepreneurship ecosystems: A review, analysis and extension of the literature.' *The Journal of Technology Transfer*, 43, pp.1039-1082.
- Hmieleski, K.M. and Powell, E.E. (2018) 'The psychological foundations of university science commercialization: A review of the literature and directions for future research.' *Academy of Management Perspectives*, 32(1), pp.43-77.
- Honig, B. (2004) 'Entrepreneurship education: Toward a model of contingency-based business planning.' *Academy of management learning & education*, 3(3), pp.258-273.
- Jain, S., George, G. and Maltarich, M. (2009) 'Academics or entrepreneurs? Investigating role identity modification of university scientists involved in commercialization activity.' *Research policy*, 38(6), pp.922-935.
- Joyce, A. and Paquin, R.L. (2016) 'The triple layered business model canvas: A tool to design more sustainable business models.' *Journal of cleaner production*, 135, pp.1474-1486.
- Kolb, A.Y. and Kolb, D.A. (2005) 'Learning styles and learning spaces: Enhancing experiential learning in higher education.' *Academy of management learning & education*, 4(2), pp.193-212.
- Lafuente, E. and Berbegal-Mirabent, J. (2019) 'Assessing the productivity of technology transfer offices: An analysis of the relevance of aspiration performance and portfolio complexity.' *The Journal of Technology Transfer*, 44(3), pp.778-801.
- Li, Y., Zou, B., Guo, F. and Guo, J. (2020) 'Academic entrepreneurs' effectuation logic, role innovation, and academic entrepreneurship performance: an empirical study.' *International Entrepreneurship and Management Journal*, pp.1-24.
- Lubik, S. and Garnsey, E. (2016) 'Early business model evolution in science-based ventures: the case of advanced materials.' *Long Range Planning*, 49(3), pp.393-408.
- Mäkimurto-Koivumaa, S. and Puhakka, V. (2013) 'Effectuation and causation in entrepreneurship education.' *International Journal of Entrepreneurial Venturing*, 5(1), pp.68-83.
- Marmor, M., Hermann, B. J., Dogrultan, E., and Berman, R. (2012) '*Startup genome report*'. Retrieved March 05, 2024, from

[https://cdn.startupgenome.com/sites/62c58b4d00b3f50043b92724/content\\_entry62c58c4b00b3f50043b92770/62c59def61a37b0042c28e59/files/Startup\\_Genome\\_-\\_Why\\_Startups\\_Succeed.pdf](https://cdn.startupgenome.com/sites/62c58b4d00b3f50043b92724/content_entry62c58c4b00b3f50043b92770/62c59def61a37b0042c28e59/files/Startup_Genome_-_Why_Startups_Succeed.pdf)

- Matlay, H. (2005) 'Researching entrepreneurship and education: Part 1: what is entrepreneurship and does it matter?.' *Education+ Training*, 47(8/9), pp.665-677.
- Metzger, G. (2014). 'Gründungstätigkeit wiederbelebt – Impuls aus dem Nebenerwerb'. Retrieved March 05, 2024, from <https://www.kfw.de/PDF/Download-Center/Konzernthemen/Research/PDF-Dokumente-Gr%C3%BCndungsmonitor/KfW-Gr%C3%BCndungsmonitor-2014.pdf>
- Miller, K., Alexander, A., Cunningham, J.A. and Albats, E. (2018) 'Entrepreneurial academics and academic entrepreneurs: A systematic literature review.' *International Journal of Technology Management*, 77(1-3), pp.9-37.
- Müller-Wieland, R., Muschner, A. and Schraudner, M. (2019) 'Academic entrepreneurship: phase-specific constraints and needs.' *Journal of Enterprising Communities: People and Places in the Global Economy*, 13(3), pp.353-371.
- Munoz, C.A., Guerra, M.E. and Mosey, S. (2020) 'The potential impact of entrepreneurship education on doctoral students within the non-commercial research environment in Chile.' *Studies in Higher Education*, 45(3), pp.492-510.
- Oosterbeek, H., Van Praag, M. and Ijsselstein, A. (2010) 'The impact of entrepreneurship education on entrepreneurship skills and motivation' *European Economic Review*, 54(3), pp.442-454.
- Osterwalder, A. and Pigneur, Y. (2010) *Business model generation: a handbook for visionaries, game changers, and challengers* (Vol. 1). John Wiley & Sons.
- Perkmann, M., Tartari, V., McKelvey, M., Autio, E., Broström, A., D'este, P., Fini, R., Geuna, A., Grimaldi, R., Hughes, A. and Krabel, S. (2013) 'Academic engagement and commercialisation: A review of the literature on university–industry relations.' *Research Policy*, 42(2), pp.423-442.
- Perry, J.T., Chandler, G.N. and Markova, G. (2012) 'Entrepreneurial effectuation: a review and suggestions for future research. *Entrepreneurship Theory and Practice*, 36(4), pp.837-861.
- Pittaway, L. and Cope, J. (2007) 'Entrepreneurship education: A systematic review of the evidence.' *International Small Business Journal*, 25(5), pp.479-510.
- Pittaway, L., Brush, C., Corbett, A. C., & Tantawy, M. M. (2023) 'Doctoral Programs in Entrepreneurship: Building Cognitive Apprenticeships.' *Entrepreneurship Education and Pedagogy*, 6(4), pp.608-642.
- Politis, D. (2005) 'The process of entrepreneurial learning: A conceptual framework.' *Entrepreneurship Theory and Practice*, 29(4), pp.399-424.
- Politis, D., Winborg, J. and Dahlstrand, Å.L. (2012) 'Exploring the resource logic of student entrepreneurs.' *International Small Business Journal*, 30(6), pp.659-683.
- Puntillo, P., Rubino, F. and Veltri, S. (2022) 'Transferring knowledge to improve university competitiveness: the performance of technology transfer offices.' *Governance and Performance Management in Public Universities: Current Research and Practice*, pp.129-147.
- Racat, M., Ricard, A. and Mauer, R. (2023) 'Effectuation and causation models: an integrative theoretical framework.' *Small Business Economics*, pp.1-15.
- Radosevich, R. (1995) 'A model for entrepreneurial spin-offs from public technology sources.' *International Journal of Technology Management*, 10(7-8), pp.879-893.
- Rae, D. (2005) 'Entrepreneurial learning: a narrative-based conceptual model.' *Journal of Small Business and Enterprise Development*, 12(3), pp.323-335.

- Rasmussen, E., Mosey, S. and Wright, M. (2014) 'The influence of university departments on the evolution of entrepreneurial competencies in spin-off ventures.' *Research Policy*, 43(1), pp.92-106.
- Read, S. and Sarasvathy, S.D. (2005) 'Knowing what to do and doing what you know: Effectuation as a form of entrepreneurial expertise.' *The Journal of Private Equity*, pp.45-62.
- Reymen, I., Berends, H., Oudehand, R. and Stultiëns, R. (2017) 'Decision making for business model development: a process study of effectuation and causation in new technology-based ventures.' *R&D Management*, 47(4), pp.595-606.
- Rippa, P., Landi, G., Cosimato, S., Turriziani, L. and Gheith, M. (2022) 'Embedding entrepreneurship in doctoral students: the impact of a T-shaped educational approach.' *European Journal of Innovation Management*, 25(1), pp.249-270.
- Saraf, P., Rahman, T. and Jamison, J.C. (2019) 'Group-Based Cognitive Behavioral Therapy (CBT) Training Improves Mental Health of SME Entrepreneurs: Experimental Evidence from Conflict-Affected Areas of Pakistan.' *World Bank Policy Research Working Paper*, (8872).
- 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.
- Sarasvathy, S.D. (2003) 'Entrepreneurship as a science of the artificial.' *Journal of Economic Psychology*, 24(2), pp.203-220.
- Sarasvathy, S.D. (2009) *Effectuation: Elements of Entrepreneurial Expertise*. Edward Elgar Publishing.
- Secundo, G., De Beer, C. and Passiante, G. (2016) 'Measuring university technology transfer efficiency: a maturity level approach.' *Measuring Business Excellence*, 20(3), pp.42-54.
- Secundo, G., Ndou, V., Del Vecchio, P. and De Pascale, G. (2020) 'Sustainable development, intellectual capital and technology policies: A structured literature review and future research agenda.' *Technological Forecasting and Social Change*, 153, p.119917.
- Senyard, J., Baker, T. and Davidsson, P. (2009) 'Entrepreneurial bricolage: Towards systematic empirical testing.' *Frontiers of Entrepreneurship Research*, 29(5), p.5.
- Shane, S. and Venkataraman, S. (2000) 'The promise of entrepreneurship as a field of research.' *Academy of Management Review*, 25(1), pp.217-226.
- Siegel, D.S. and Wright, M. (2015) 'Academic entrepreneurship: time for a rethink?.' *British Journal of Management*, 26(4), pp.582-595.
- Sinell, A., Heidingsfelder, M. and Schraudner, M. (2015) 'Entrepreneurship and academic employment-more alike than you'd think.' *Journal of Technology Management & Innovation*, 10(3), pp.1-10.
- Skute, I. (2019) 'Opening the black box of academic entrepreneurship: a bibliometric analysis.' *Scientometrics*, 120(1), pp.237-265.
- Villani, E., Linder, C. and Grimaldi, R. (2018) 'Effectuation and causation in science-based new venture creation: A configurational approach.' *Journal of Business Research*, 83, pp.173-185.
- Volkman, C. and Audretsch, D. (2017) 'Entrepreneurship education at universities.' *International Studies in Entrepreneurship*, Springer International Publishing AG: 1-10.
- Zhang, Y., Wang, P. and Zhao, Y. (2022) 'Big Five Personality, Academic Entrepreneurial Motivation, and Academic Entrepreneurial Intention: A Research Method Based on Fuzzy Set Qualitative Comparative Analysis.' *Frontiers in Psychology*, 12, p.799770.

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