



**NCSB
2024**

Conference Proceedings

**22nd Nordic Conference on
Small Business Research**

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Preface

The 22nd Nordic Conference on Small Business Research (NCSB2024) was organized in Turku, Finland on May 29-31, 2024. NCSB conference is one of the oldest conferences in entrepreneurship and small business research in the world, with the first conference being held already in 1980. Since its inception the NCSB conference has been a biannual event in the Nordic tradition characterized by an open atmosphere that encourages the exchange of ideas between researchers within the field of small business and entrepreneurship. We were happy to host 92 participants at this year's conference – from different parts of the Nordics and beyond!

Before opening up for the conference participants, on Wed 29 May we had a very interesting Doctoral Consortium day with 20 prominent PhD researchers discussing the PhD journey when it comes to supervision, publishing, research. The students also got to learn from the experiences of a recent PhD graduate: Post-doc researcher Anna Elkina. The Doctoral Consortium was chaired by Professor Ewald Kibler from Aalto Business School, and the small group discussions about the student research proposals were facilitated by Professor Carina Lomberg, Professor Maija Renko, Professor Jarna Heinonen, Senior Research Fellow Pekka Stenholm and Professor Ulla Hytti. Thank you all who joined the Doctoral Consortium.

There were 101 abstracts submitted to this year's conference either to one of the six special tracks or to the open track. In the final programme, there were 65 papers presented. We were fortunate to have a great team of track chairs involved who did a splendid job in reviewing and organizing interesting tracks and sessions. Thank you so much Arto Ojala, Birgitte Wraae, Bram Timmermans, Carina Lomberg, Claus Thrane, Daria Kautto, Elli Verhulst, Ewald Kibler, Gry Agnete Alsos, Helle Neergard, Jonas Gabrielsson, Karin Berglund, Lise Aaboen, Martin Senderovitz, Martina Battisti, Max Velguth, Michael Breum Ramsgaard, Niina Nummela, Sanna Ilonen, Simon Jebsen, Tamara Galkina, Thomas J. Howard, Timur Uman and Ulla Hytti.

The keynote speakers of the conference were professor Maija Renko from DePaul University, Chicago, the US and Professor Eero Vaara, Saïd Business School, University of Oxford, the UK. Professor Renko discussed "Supporting entrepreneurs from the ground up: lessons from a local ecosystem of entrepreneur service organizations". Professor Vaara's talk opened up "narrative perspectives in organization and entrepreneurship research". Both keynote speakers have a close relationship with Finland, as both are

Finnish and have completed their education in Finland with splendid careers now abroad. The plenary programme included also Meet the Editors" Session to discuss and learn about publishing and expectations of different entrepreneurship journals with Professor Martina Battisti (Associate Editor for *International Small Business Journal* and for *International Journal of Entrepreneurial Behavior & Research*), Professor Ulla Hytti (Associate Editor for *Entrepreneurship and Regional Development*, Research editor for *Entrepreneurship Education and Pedagogy*) and Professor Ewald Kibler (Associate Editor for *Journal of Business Venturing Insights*).

There were three awards given during the conference dinner at Manilla. Two awards were given for the Best Doctoral Research proposals for Julia Voss on her proposal: "From Macro to Micro: Unraveling the Interplay of Gender, STEM Entrepreneurship, and Innovation" and for Simbarashe Takawira on his proposal: "Leveraging network ties: How Sharing Economy firms address formal institutional voids". The Best Paper Award was given to Maud van Merriënboer and Patrizia Hoyer for their paper "Hero or victim? Translocational (be)-longings of a woman migrant entrepreneur". Congratulations to all the winners!



NCSB2024 award winners together with Ulla Hytti, Ewald Kibler and Pekka Stenholm.

This conference proceedings publication brings together the 9 full revised papers submitted for the proceedings after the conference. They give you an interesting glimpse into the diversity of research and multiple perspectives of research presented during the conference. We trust that you will see a lot more of the papers presented published in journals, research books and dissertations in the years to come.

We wish to warmly thank you all for presenting your research and participating the 22nd Nordic Conference on Small Business Research. Until next time!

NCSB2024 Organising Committee,

Ulla Hytti, Pekka Stenholm & Oskar Aaltonen

University of Turku, School of Economics

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INTERACTIONS AND SUSTAINABLE ENTREPRENEURIAL ECOSYSTEM IN A SMALL TOWN SETTLED BY FINNS IN BRAZIL

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Abstract

The article aims to understand how actors and factors interact in the entrepreneurial ecosystem of a small town, favouring the emergence of sustainable entrepreneurship in the hotel sector. The research was a single case study of an inn with an exploratory qualitative approach, with empirical data collected through interviews in Penedo, a neighbourhood of Itatiaia, in the interior of Rio de Janeiro, Brazil. Penedo was settled by Finnish immigrants in 1929. Triangulation was performed through document analysis and non-participant observation. It was found that the Nordic influence is manifested in different businesses in the locality, and sustainability emerges from the interactions that take place within the entrepreneurial ecosystem of Itatiaia. Sustainability actions in the company studied generate benefits for the community, and sustainable entrepreneurship is present in its sustainable business model. The main limitation of the study was the number of cases studied, only one.

Keywords

Entrepreneurship; sustainable entrepreneurial ecosystem; interactions; sustainable entrepreneurship; small towns.

Introduction

Research topics related to entrepreneurship have gained importance in recent decades. Studies on the impacts of entrepreneurship and sustainable entrepreneurial ecosystems for the achievement of economic, social, and environmental goals are considered the fourth wave of entrepreneurship studies (Volkman et al., 2021).

Entrepreneurial ecosystems (EEs) are elements or structures that share resources and disseminate knowledge, acting in networks to provide institutional and political support (Stam, 2015; Stam & van de Ven, 2021). Ecosystems are regionally inserted in large or small towns, metropolitan or rural areas, regions, or even countries (Cao & Shi, 2021; Theodoraki et al., 2022; Wurth et al., 2022).

Although most elements of entrepreneurial ecosystems are linked to a physical territory, they are not isolated spatial systems with no ties to their “interior” or to each other. Theodoraki and Catanzaro (2022) state that entrepreneurial ecosystems should not be treated as isolated units with political-administrative boundaries. If this happens, they warn that there may be an inadequate understanding of how entrepreneurship-oriented relationships should be organized by physical spaces.

Entrepreneurship studies in small towns focus on small businesses and are gaining notoriety and a perception of global importance, since they are responsible for the economic development and rejuvenation of these locations, which are home to a considerable part of the population in

different countries and regions (Roundy, 2017). Previous research on entrepreneurial ecosystems has prioritized studies in large cities (Cowell et al., 2018; Roundy, 2017).

The aim of this study was to understand how actors and factors interact in a small-town entrepreneurial ecosystem, fostering the emergence of sustainable entrepreneurship in the hotel sector in Penedo, a neighbourhood in the city of Itatiaia, a small town in the interior of the state of Rio de Janeiro, Brazil, which was settled by Finnish immigrants in 1929 and still retains traces of Finnish and Nordic culture as tourist attractions. This study will fill research gaps that state that more empirical research is needed on the phenomenon of entrepreneurial ecosystems (Kansheba & Wald, 2020), especially those that do not fall within major urban centres (Cowell et al., 2018; Roundy, 2017), focusing on interactions rather than parts of ecosystems (Feld & Hathaway, 2020), reading interactional dynamics in advanced or emerging economies (Cao & Shi, 2021) of tourist destinations located in different regions (Bachinger et al., 2020), to learn about entrepreneurs' external linkages (Motoyama & Henderson, 2022), and to identify the unique system and relationships (Stephens et al., 2022).

The research was carried out by means of a single case study, with an exploratory, empirical qualitative approach, in the hotel sector in the city of Penedo, examining how entrepreneurs interact with actors and factors in the entrepreneurial ecosystem to promote the long-term sustainability of their business and how the social and environmental conditions of the locality are improved with sustainable actions that have a social and environmental impact.

Three common themes emerged from the data: (i) improving the quality of products and services offered with increased customers and revenue, (ii) improving the quality of life of employees, and (iii) increasing the perception that enterprises provide a better quality of life for employees, customers, and the community. These themes emerged as answers to the research question formulated: how do actors and factors interact in a local entrepreneurial ecosystem in a small town, favoring the emergence of sustainable entrepreneurship in the hospitality sector?

Theoretical framework

The theoretical framework covers the main constructs of the work: (i) entrepreneurship, (ii) sustainable entrepreneurship, (iii) sustainable entrepreneurial ecosystem, (iv) interactions in the entrepreneurial ecosystem.

Entrepreneurship and Sustainable Entrepreneurship

Based on Venkataraman (1997) and Shane and Venkataraman (2000), Shane (2003, p. 4-5) emphasizes that entrepreneurship “involves discovery, evaluation, and exploration of opportunities”. All of this is integrated into the entrepreneurship process that aims to “introduce new goods and services, organizational forms, markets, processes and raw materials through organizational efforts that did not exist previously” Shane (2003, p. 4–5).

There are several classifications for entrepreneurship, and Baumol (1990) categorizes it as productive, non-productive, and destructive. Productive entrepreneurship is related to the creation of companies with a high growth rate and, because they are successful, they generate many jobs. Non-productive entrepreneurship is associated with companies created more as a lifestyle or as a supplementary income for the entrepreneur, and therefore do not have rapid growth or great job opportunities. Destructive entrepreneurship is related to the exploitation of economic opportunities in potentially monopolistic markets.

In the economic field, entrepreneurship is studied from different perspectives, highlighting the perspective of regional growth associated with successful entrepreneurial practices and plays an important role in the economy of several countries (Acs et al., 2017; Cavallo et al., 2019), contributing empirical evidence of a positive macroeconomic impact (Neumann, 2020).

In the social field, Zahra and Wright (2016) emphasize the importance of the added social value of entrepreneurial activities for society, which needs to be rethought and redefined. The following are five pillars on which the evolving social role of entrepreneurship can support and have its impact: (i) connecting entrepreneurial activities to other social efforts to improve quality of life, achieve progress, and enrich human existence; (ii) identify ways to reduce the dysfunctional effects of business activities on stakeholders; (iii) redefine the scope of entrepreneurial activities as an academic arena; (iv) recognize the social multiplier of entrepreneurship; and (v) pursue a combined value at the organizational level, centred on balancing financial, social, and environmental wealth creation.

One of the recent subdivisions of entrepreneurship is sustainable entrepreneurship, which “is a field that is in its infancy” (Cohen & Winn 2007, p. 30) and “focuses on preserving nature, supporting life and community, seeking perceived opportunities to create future products, processes, and services for economic and non-economic gains for individuals, the economy and society” (Shepherd & Patzelt, 2011, p. 142).

In Cohen & Winn's (2007, p. 30) studies of market imperfections, opportunities, and sustainable entrepreneurship, they mention that “market imperfections are sources of opportunity”, and “the necessary innovations are likely to come from entrepreneurs who can identify opportunities to earn income while addressing environmental and social challenges thus venturing towards the so-called triple bottom line” (Cohen & Winn 2003, p. 30), which brings markets to a state of equilibrium. This recent way of thinking about business as sustainable promotes social wellbeing and makes it possible to “make profits while reducing economic behaviour that degrades the environment” Dean & McMullen (2007, p. 50).

Shepherd and Patzelt (2011) distinguish research on sustainable entrepreneurship from sustainability or sustainable development. They say that, for there to be sustainable entrepreneurship, there needs to be development in three sectors: people, economy and society, simultaneously. Thus, isolated studies on climate change in each period are only related to sustainability if there is no simultaneous development of these sectors. Similarly, they emphasize that there is no sustainable entrepreneurship if the studies are related to environmental issues but do not involve the discovery, creation, or exploitation of future goods, processes, or services. They also point out that research on sustainable development and unsustainable entrepreneurship occurs when the link between what is sustained and what is being developed does not involve the discovery, creation, or exploitation of future goods, processes, or services.

Sustainable Entrepreneurial Ecosystem (SEE) in Small Towns

After the 2008 global financial crisis, entrepreneurship became more widely discussed, and the concept of an entrepreneurial ecosystem gained enormous popularity in the fields of research, policy, and practice (Wurth et al., 2022). Entrepreneurship is a collective activity, and entrepreneurial ecosystems perform two functions: (i) to provide business resources closer to entrepreneurs; (ii) create a favourable environment for access to these resources. Ecosystem research shifts the focus of the founder's study to the broader environment that encompasses both the founder and his or her organization (Spigel, 2020).

The concept of entrepreneurial ecosystem (or entrepreneurship ecosystem) is recent (Malecki, 2018) and is the result of a historical evolution of entrepreneurship (Rocha & Audretsch, 2022), and there is still no widely shared definition (Stam, 2015), although most concepts emphasize the combination or interaction of actors and stakeholders through networks that produce shared cultural values that support entrepreneurial and business activity (Malecki, 2018).

Because it is a new topic and because scholars in the area have used similar principles at the beginning of their discussions, the literature on entrepreneurial ecosystems has expanded rapidly and has attracted a lot of attention from professionals, researchers and, in particular, public policy makers who aim to understand and explain the phenomenon of entrepreneurship in an ambitious way from a systemic or ecosystem perspective (Alvedalen & Boschma, 2017; Cao & Shi, 2021).

Stam and Spiegel (2016, p. 1) define entrepreneurial ecosystems as “a set of interdependent and coordinated actors and factors to enable productive entrepreneurship in a given territory”. With this, they emphasize that entrepreneurial ecosystems have an inherently geographic perspective that focuses on the cultures, institutions, and networks that develop in a region over time, and that entrepreneurial activity that results from the ecosystem is a process through which individuals create opportunities for innovation.

For Stam and Spiegel (2016), the opportunities taken advantage of will create value for the company and for society and will appear as a result of the entrepreneurial ecosystem, with entrepreneurial activity being an intermediate result of the system. Entrepreneurship as a new value creation by its agents is the result of every entrepreneurial ecosystem that shares its focus on creating added value within a given region, according to the regional development literature (Acs et al., 2017).

In recent decades, development based on entrepreneurship and/or the entrepreneurial ecosystem has received the attention of researchers (Malecki, 2018; Stam & Spiegel, 2016) that can study it with different approaches: (i) for large urban centres (Stephens et al., 2022; Thompson et al., 2018); (ii) for small towns (Motoyama & Henderson, 2022; Roundy, 2019); (ii) for rural areas (Aguilar, 2021; Miles & Morrison, 2020).

Motoyama and Henderson (2022) emphasize the possible difference in the economic dynamism of small towns when compared to large cities and the local action of the entrepreneurship phenomenon, although extra-regional links have already been observed.

Roundy (2017) states that small-town entrepreneurial ecosystems are based on the work of a variety of disciplines, including regional studies, urban economics, and entrepreneurship. As the entrepreneurial ecosystems of small towns are different from the ecosystems of large urban centres, Roundy (2017, p. 240) argues that these differences justify they’re being a new construction and defines them as: “a community of individuals, social structures, institutions and cultural values, located in a city of limited scope, scope or size, whose interactions produce entrepreneurial activity”.

According to Nwachukwu and Ogbo (2012, p. 95), “small and medium-sized enterprises are of significant importance for the growth, development and industrialization of many economies around the world”, both in cities and regions and in countries. For this reason, they assign the following responsibilities to dynamic small and medium-sized enterprises: (i) generating new

jobs, (ii) reducing poverty; (iii) stimulate economic activities; (iv) improve the standard of living of employees and their families.

For this study, a conceptual framework was built to consider the entrepreneurial ecosystems of small towns with tourist attractions. The model suggests a conceptual framework that describes the structure, components, and mechanisms that allow entrepreneurial opportunities to be recognized, discovered, created, and/or actualized based on the specificities of the entrepreneurial ecosystem.

The theoretical model developed considers specific properties of the Sustainable Entrepreneurial Ecosystem of Small Towns, as well as consistent similarities and differences between it and the Entrepreneurial Ecosystem of Large Urban Centres, as these differences represent advantages and disadvantages for both models.

Unlike the Entrepreneurial Ecosystem model of Stam and van de Ven (2021) whose result is Productive Entrepreneurship, as it is aimed at stakeholders in the High Performance business sector, Bachinger and others (2020) consider that the result of the entrepreneurial ecosystem in tourism is the Development of Sustainable Destinations, as the model of Stam and van de Ven (2021) does not apply to tourist destinations due to the fact that companies in the tourism segment not be considered as high performance.

For this reason, the focus of this study is classified as non-productive entrepreneurship, according to the classification of Baumol (1990), presented above.

Figure 1 shows the components of the entrepreneurial ecosystem in five layers: (i) Local History and Heritage, (ii) Structural Conditions, (iii) Systemic Conditions, (iv) Outputs, and (v) Outcomes.

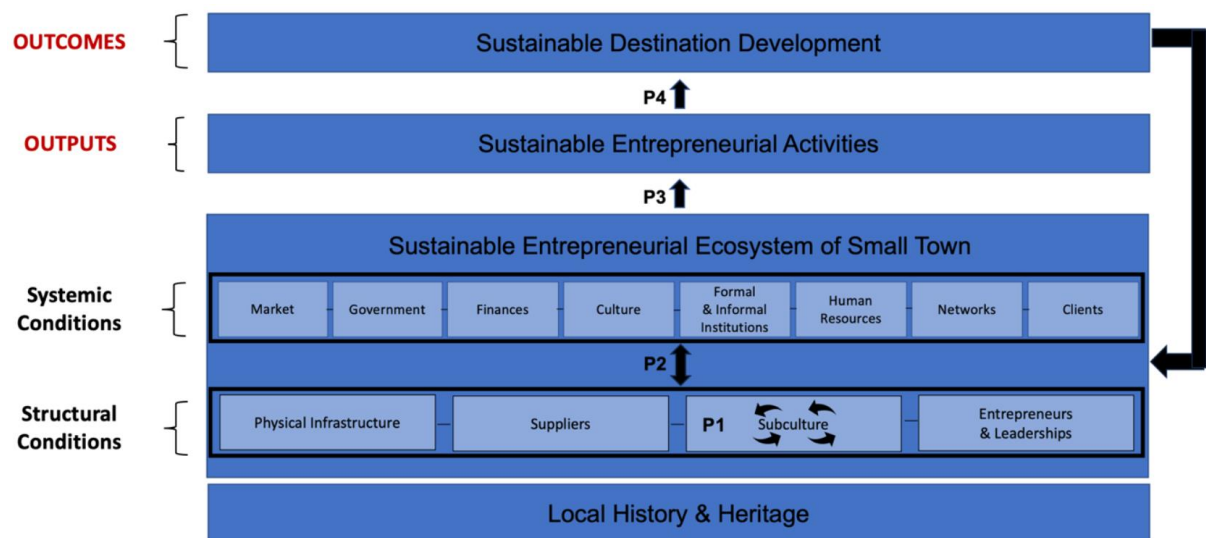
In addition to the components, four propositions are identified for this study.

P1 - The Nordic influence manifests itself in relation to everyday business issues.

P2 - Sustainability arises from the interactions between actors and factors in Itatiaia's entrepreneurial ecosystem.

P3 - Sustainability actions in local companies generate benefits for the community.

P4 - Sustainable entrepreneurship is present in sustainable business models of companies in the Penedo neighborhood.



Source: prepared by the authors, based on Isenberg (2010; 2011), WEF (2013), Stam (2015), Isenberg & Onyemah (2016), Stam & Spiegel (2016), Spiegel (2017), Roundy (2017 and 2019), Bachinger et al. (2020), Bedo et al. (2020), Stam & van de Ven (2021), Bachinger et al. (2022).

Figure 1: Theoretical model.

The Local History and Heritage layer includes issues of past entrepreneurship, cultural history, heritage, and demographics of the region/city's population.

Structural Conditions include (i) Physical Infrastructure, (ii) Suppliers, (iii) Subculture, and (iv) Entrepreneurs and Leadership. Structural Conditions are the basis of EE, where important material and personal attributes of the ecosystem are integrated, from which entrepreneurial activities are idealized and where they are executed.

Systemic Conditions are the heart of the ecosystem and include (i) Market, (ii) Government, (iii) Finances, (iv) Culture, (v) Formal & Informal Institutions, (vi) Human Resources, (vii) Networks, and (viii) Customers. The presence of these components and the interaction between them and between the components of the Structural Conditions predominantly determine the success of the ecosystem.

The Outputs include Sustainable Entrepreneurial Activities, situations related to the entrepreneurial processes of the sustainable ecosystem.

The Outcomes of EE in this theoretical model are the Sustainable Destination Development. Each of the five layers and their respective components will be described in more detail below.

LAYER 1 - History and Local Heritage

Bedö et al. (2020, p. 1151) state that “much of the literature exploring ecosystems has conducted historical reviews of sites and/or regions”, and Harper-Anderson (2018) emphasizes the importance of a region's history when examining the components of an entrepreneurial ecosystem.

According to Villegas-Mateos (2021), the most recent definition of EE that is strongly related to geography is that of Stam & Van de Ven (2021, p. 811) who define it as “all interdependent actors and factors that allow and restrict entrepreneurship in a given territory”.

LAYER 2 - Structural Conditions

The Structural Conditions include the structuring elements of the ecosystem and will support the actors and factors that will make up the Systemic Conditions. The Structural Conditions will be comprised of (i) infrastructure, (ii) suppliers, (iii) entrepreneurs and leaders, and (iv) subculture issues.

Each of the Structural Conditions will be presented below.

Physical infrastructure. Audretsch and Belitski (2017) emphasize the importance of entrepreneurial ecosystems having a good infrastructure so that interconnections and linkages are facilitated, and opportunities are recognized by ecosystem actors.

In addition, Stam and van de Ven (2021), following Annoni and Dijkstra (2013), consider that the physical infrastructure should be evaluated in terms of potential accessibility by road and rail, as well as the number of passenger flights.

Suppliers. The studies by Raposo and others (2022) attested that cooperation with suppliers in entrepreneurial ecosystems has a positive impact on the sustainability of businesses with more inclusive growth.

Entrepreneurs and Leaderships. For Kansheba and Wald (2020, p. 948), “entrepreneurs are the focal point of the system”, and Audretsch and Belitski (2017) emphasize that entrepreneurs can succeed or fail, but even stories of failure generate greater growth for societies that consider them as part of the entrepreneurial process.

Local leaderships are essential to boost entrepreneurial ecosystems. Stam (2014) states that leadership is critical to maintaining a healthy ecosystem, with leaders committed to the region, while Stam and van de Ven (2021), building on Sotarauta and others (2017), emphasize that leadership provides guidance for collective action.

Subculture. Mentioning that regional studies have linked the role of culture, the creative class, and entrepreneurship, in the article Amenities, subcultures, and entrepreneurship, Audretsch and others (2021) highlight that “situations related to subculture should be at the center of entrepreneurial ecosystems” (Audretsch et al., 2021, p. 571). Based on Hebdige (1995) and Schouten and McAlexander (1995), subculture was defined by Audretsch and others (2021, p. 576) as “distinct groups in society that are bound by alternative perceptions, values, and beliefs regarding life as the sociocultural or mainstream establishment.”

For Dhoest and others (2015), the subculture can encourage entrepreneurial activities from the perspective that it encourages people to think outside the box and experience the new, the different, while Audretsch and others (2021, p. 576) emphasize that “subcultural scenes are a better indicator for local entrepreneurship than the previously tested ‘conventional’ traits of popular cultural amenities” because they generate new and different opportunities. “It may be the specific type of culture, i.e., the subculture, that is the main ingredient to generate entrepreneurial activity” (Audretsch et al., 2021, p. 583). As a result, the subculture gains relevance as an investment that promotes entrepreneurship.

LAYER 3 - Systemic Conditions

Systemic Conditions integrate actors, factors and support institutions that are indispensable to the functioning of EEs. In this model, they are composed of (i) market, (ii) government, (iii) financial institutions, (iv) culture, (v) support institutions, (vi) human resources, (vii) networks, and (viii) customers.

Market. The market component is composed of existing consumers and potential consumers who, in addition to buying products and services, promote them in their networks and with the revenue from these sales, cash flows are generated to maintain the economy in the Thai et al. (2023) location.

According to the World Economic Forum (2013), the market can be divided into internal and external and is composed of companies of different sizes: large/medium/small with individual, organizational or governmental customers.

Government. Cohen (2006) highlighted the importance of entrepreneurship for local and global economies, as well as the interest of federal, regional, and local governments in promoting a favourable climate for entrepreneurship through tax fees and incentives and the elimination of the ‘red tape’ usually associated with applying for permits and licenses.

Finance. Stam (2014) emphasizes that access to finance is essential for business success and that lenders must be familiar with the processes and demands of the business community so that long-term uncertainties are removed, and Bedö and others (2020), building on Feldman and others (2005), state that access to venture finance is considered an essential component, and venture capital, along with human capital, are considered more difficult to acquire in resource-constrained contexts, while Stam and van de Ven (2021) emphasized that new and small businesses need this access to grow and survive. The importance of finance was also emphasized by Frimanslund and others (2023) who consider access to financial capital crucial for the development of entrepreneurial activities.

Culture. The ‘Culture’ component represents the entrepreneurial culture in the ecosystem region. Stam and van de Ven (2021) state, following Fritsch and Wyrwich (2016), that the culture of entrepreneurship (as an informal institution) reflects the degree to which entrepreneurship is valued in society.

Formal and informal institutions. Supporting institutions are the formal institutions and reflect ‘the rules of the game’ in society (Stam & van de Ven, 2021). For Stam (2014, p. 5), the provision of support services by intermediaries “can reduce the barriers to entry for new business projects and can accelerate the time to market of innovations”.

Human resources. According to Stam and van de Ven (2021), human capital is made up of the skills, knowledge, and experiences of individuals. Together with venture capital, human capital is difficult to acquire, especially in resource-constrained contexts (Bedö et al., 2020). For Stam (2014), a successful entrepreneurial ecosystem requires the presence of a diverse and qualified workforce.

Networks. Neck and others (2004) separated the networks into formal and informal. For Neck and others (2004) and Cohen (2006), formal networks can be composed of the following participants: (i) government and/or regional agencies, (ii) universities, (iii) professional and

support services (e.g., lawyers, accountants, consultants, suppliers), (iv) sources of capital (e.g., venture capitalists, business angels, and banks), (v) talent banks, and (vi) large corporations. Neck and others (2004) state that informal networks can be formed by (i) family members, (ii) friends, (iii) colleagues and (iv) informal relationships with similar companies, and Cohen (2006, p. 6) points out that “many new companies depend on informal networks for advice, guidance and moral support”.

Clients. They are the buyers of products or services in markets served by the entrepreneurial ecosystem. They can be residents or tourists, individuals or organizations.

LAYER 4 - Outputs - Sustainable business activities

For Stam and Spigel (2016, p. 2), entrepreneurial activities are part of the “process by which individuals create opportunities for innovation” and is the way out of the model discussed here. The innovations resulting from entrepreneurial activities will create value for society in the form of creating new jobs, generating more wealth and improving people's well-being, which will contribute to the development of a sustainable destination.

LAYER 5 – Outcomes – Sustainable Destination Development

According to Volkmann and others (2021), entrepreneurial ecosystem studies are considered prominent and drive an important stream of research on entrepreneurship, but little progress has been made in terms of promoting sustainable entrepreneurship and contributing to the Sustainable Development Goals (SDGs) set by the United Nations. Therefore, entrepreneurial ecosystems need to prioritize an explicit link to the SDGs by setting social and environmental targets.

Interactions in an entrepreneurial ecosystem

According to Autio (2016, p. 20), “entrepreneurial ecosystems are fundamentally systems of interaction made up of loosely connected, hierarchically independent, but mutually co-dependent stakeholders”.

The dynamic structure of EE needs to make explicit which elements and relationships are important at which stage and how they influence each other over time, as it is not always clear how the proposed elements in an ecosystem are connected and which interactions are most important (Alvedalen & Boschma, 2017). More forcefully, Bedö and others (2020) believe that a community's limited resources can limit interactions between community actors and factors. Stam and van de Ven (2021) state that, in an entrepreneurial ecosystem, relationships can be cooperative or competitive. The former “emerge among actors who can derive complementary benefits by integrating their functional specializations” (Stam & van de Ven, 2021, p. 811–812), while the latter “emerge as alternative business paths become evident and different entrepreneurs 'place their bets' and seek alternative paths” (Stam & van de Ven, 2021, p. 811–812).

Spigel (2017) also highlights that (i) cultural understandings, (ii) cooperation between companies, (iii) standardization of practices through knowledge sharing, (iv) dissemination of information on entrepreneurial opportunities, and (v) connection of entrepreneurs with financiers are facilitated in the region of entrepreneurial ecosystems and have attributes that provide resources and benefits for entrepreneurs and new ventures. These attributes can be broadly grouped into three categories: cultural, social, and material, based on how their benefits are created and managed, according to Spigel (2017).

Methodology

Case study research focuses on a contemporary real-world phenomenon (the ‘case’) and can be based on empirical investigation with qualitative techniques carried out in real contexts, particularly when the boundaries between the phenomenon and the context lack clear evidence (Eisenhardt, 1989; Yin, 2018).

The qualitative approach with the collection of empirical data from a single case study, with exploratory purpose and using the interview technique, was chosen based on the general objective of the research and the phenomenon to be studied in terms of procedural, interactional and contextual aspects.

For Yin (2018), the questions ‘how’ and ‘why’ are more explanatory and therefore lead to the use of a case study, as they make it possible to trace operational links over time, rather than being considered mere frequencies or incidences.

Yin (2018) states that there are five appropriate situations for choosing a single case study: (i) being a critical case, (ii) uncommon, (iii) common, (iv) revealing, or (v) longitudinal. The case of Little Sweden Inn was framed as a common case because it has lessons from social processes related to the Nordic culture of sustainability in business. Therefore, Little Sweden Inn's unique case study was chosen, since the company's business model is very much in tune with the business models of Nordic companies focused on sustainability.

The triangulation of the data was carried out as follows: (i) through the collection and analysis of empirical data from the agents of the entrepreneurial ecosystem of Itatiaia/Penedo-RJ; (ii) through the analysis of the company's own documentary data, such as flyers, publications on the company's website, as well as documents obtained from the Municipality of Itatiaia, such as the municipality's Master Plan; (iii) by detailed contextual analysis of the entrepreneurial ecosystem in Itatiaia; (iv) by non-participant observation and analysis of the local context by the researcher.

The interview was conducted through semi-structured questions with a flexible approach, as recommended by Bosworth & Farrell (2011), lasted an average of forty minutes, with a single meeting and was held on the premises of the inn.

The context of Itatiaia and Penedo

The study was carried out in the city of Itatiaia-RJ, Figure 2, a small town in the interior of Rio de Janeiro, with two distinct tourist attractions: (i) the Itatiaia National Park (the first National Park in Brazil, founded in 1937) and (ii) the Penedo neighbourhood, created by Finnish immigrants in 1929, but which maintains aspects of the Finnish subculture to this day.



Figure 2: Map showing the Itatiaia, Penedo and Itatiaia National Parks. (Source: Google Maps.)

Itatiaia was chosen mainly due to the following contextual characteristics:

(a) because it is a small town - estimated population of 32,312 inhabitants, according to IBGE (2024). The classification of a town as small can vary slightly, but those with fewer than 50,000 inhabitants are considered ‘small towns’ (Atkinson, 2019); (b) because it has, especially in Penedo and the National Park, specific characteristics of a tourist destination – tourist attractions, extensive hospitality services (hotels and restaurants) and local businesses aimed at tourists. Based on the classification adopted by Silva (2004) for tourist scenarios in Brazil, Fagerlande (2015) classifies Penedo in the division of European scenarios; (c) for its remarkable growth as a tourist centre in the last three decades - Fagerlande (2015) highlights the constant growth of hotels and inns in Penedo, especially from the 1990s onwards; (d) for having, according to Isenberg's (2010) model, actors and factors of a small-town entrepreneurial ecosystem.

The report of the case study presented below, from Little Sweden Inn, was prepared based on interviews with the owner of the establishment: the interviewee was MRE, woman, +60, daughter of the founders, with higher education, owner and administrator.

Little Sweden Inn - Case Study

Little Sweden Inn was built in 1955 and was initially called Chacara das Duas (Farm of the Two), as it belonged to two Finnish women who arrived in Rio de Janeiro, Brazil, in the 1950s to work as massage therapists. They bought the land in Penedo and years later decided to transform the inn that operated on the farm into an inn.

In the 1960s, a Swedish couple, like good Nordics in search of a “sommarmstuga” in Penedo, bought the farm.

In 1988, the name of Chacara das Duas (Farm of the Two) was changed to Little Sweden Inn, when it started to be managed by the couple's daughter, who is the current owner and manager of the inn, who is inspired by Great Sweden in its decoration, cuisine, values and traditions. In

2007, the Jazz Festival was created, a jazz club next to the inn's restaurant with a regular schedule of performances by musicians from the Rio-Sao Paulo axis on Friday and Saturday nights. The inn has an architectural environment reminiscent of the Nordic countries, especially Sweden.

"We painted the houses a shade of red that is very common in the countryside, both in Sweden and Finland." (MRE)

"We started serving typical Swedish food: breakfast has an all-Swedish bakery and at other meals the restaurant serves typical Nordic dishes, including the traditional köttbullar." (MRE)

Values linked to the Nordic peoples

Values and aspects of Nordic culture, especially Swedish culture, are present in the inn at different times of daily life: (i) in decisions regarding the inn's activities, (ii) in the way employees and guests behave, (iii) in the way they work, (iv) in the internal and external decoration of the inn's accommodations. A statue of Dana's Horse was placed in the central courtyard of the inn as a symbol of Swedish culture, (v) on the restaurant's menu, (vi) respect for nature, (vii) activities that promote well-being, such as saunas, massages and walks through the woods inside the inn; (viii) in the musical activities of the Jazz Village.

"The inn follows the Nordic concept of healthy eating, seasonal food and the use of local suppliers."

"We are the only restaurant in Penedo that has a vegetarian and vegan restaurant next to our restaurant." (MRE)

Economic Actions

(i) Excellent location, Nordic cultural issues, quality and a wide variety of components available to guests in or near the inn is the main strategy to raise funds and maintain economic sustainability with a high occupancy rate.

(ii) Participation in events with other partner companies in the region. For example, the event that took place with Enoteca Penedo, in June, combining jazz, wine and Nordic cuisine.

(iii) The musicality of the Jazz Village, even during the pandemic, was not interrupted, only adapted to meet the safety standards established for the pandemic period.

The Jazz Village offers cultural attractions and has a regular weekend program.

"The Jazz Village is not a shop that sells goods and souvenirs, but attracts tourists interested in the sophisticated music program and Nordic culture." (MRE)

(iv) The slogan of the Jazz Village is "the best of music, close to you." Jazz is also a heritage of Nordic culture, especially Swedish. National and international celebrities have performed at the jazz club, as well as at a music school in Örebro, Sweden.

"It was a great victory that we managed to get through the Covid-19 pandemic with all employees at work, without sending anyone away, without creating any unemployment." (MRE)

"Tourism and entertainment were the areas most affected by the pandemic. Those who work in the performing arts and musical arts were hit the hardest because no one could leave their homes. We kept the shows as long as possible, respecting the issue of

distance.” (MRE)

“You can do a lot of things without leaving your home, but you can't go online. You can even listen to music online, but not live. Our product is live music.” (MRE)

Social Actions

(i) *Value respect for others.* “Compassion, tolerance, and belief in the equal worth of all people” are Nordic culture beliefs used at Little Sweden Inn.

“Valuing the workforce is also a concept that comes from Nordic culture, where there is little difference between social classes. In a way, this positively affects the treatment and respect given to employees.” (MRE)

“We don't accept it when a guest mistreats our employees. Recently, a guest started mistreating our staff, yelling at one, yelling at another, so my daughter confronted him, 'Sir, please lower your voice, we don't allow people to yell at our staff.’” (MRE)

“We prioritize good relationships with our business colleagues. With the other hoteliers, we have a very open relationship, with a lot of companionship, a lot of support.” (MRE)

(ii) *Valuing well-being with healthy activities.* Saunas provide well-being by helping to cleanse the skin, increasing blood circulation, relieving pain, and helping to relax the body in stressful situations. The practice of sauna use was brought to Brazil by the Finns, and the first Brazilian sauna was built in Penedo.

“It didn't exist here, and it was incredible. It is one of the most traditional and healthy practices of the Nordic peoples. The Finns, Swedes, Danes and Norwegians use this ritual a lot.” (MRE)

(iii) *Valuing local suppliers.* Keeping suppliers active and vibrant in the supply chain is a key component of lasting business sustainability. Valuing local suppliers has at least three main benefits: reducing local unemployment, cutting procurement costs, and offering fresher, healthier produce.

Among the products purchased in the region, the following were mentioned: trout, craft beer, blackberries, traditional and organic honey, wonderful cachaca, cheeses and wines.

“We always prioritize local producers, which is also a trend in the new Nordic cuisine to use local produce or produce, the closer the better.” (MRE)

“We buy a lot of products from Serrinha, Mauá, Penedo, Itamonte and the south of Minas Gerais.” (MRE)

Results

The results of this study will be analysed based on the four propositions established and listed in the theoretical model of the Sustainable Entrepreneurial Ecosystem of Small Towns with tourist attractions and with the existence of the subculture element as a factor in the structural conditions of the ecosystem, as shown in Figure 1.

Proposition 1 (P1) - The Nordic influence manifests itself in relation to everyday business issues.

This proposition is true, which was proven by the interviewee's answers associated with the following question: **how does Nordic influence manifest itself in your business?**

At the Little Sweden Inn, values and aspects of Nordic culture, especially Swedish culture, are present in the inn at different times of daily life: (i) in decisions related to the inn's activities, (ii) in the way of proceeding between employees and between employees and guests, (iii) in the way of working, (iv) in the internal and external decoration of the inn's accommodations. A statue of Dana's Horse was placed in the central courtyard of the inn as a symbol of Swedish culture, (v) on the restaurant's menu, (vi) respect for nature, (vii) activities that promote well-being, such as saunas, massages and walks through the woods inside the inn; (viii) in the musical activities of the Jazz Village.

Proposition 2 (P2) - Sustainability arises from the interactions between actors and factors in Itatiaia's entrepreneurial ecosystem.

This proposition is true, which was proven by the interviewee's answers associated with the following question: **how does sustainability emerge from interactions within the sustainable entrepreneurial ecosystem of Itatiaia?**

At Little Sweden Inn, sustainability arises from the need to compose a sustainable offer, with the traditions and values learned from the family of Swedish origin, from the imperfections of the market and from the use of material and personal resources obtained in the region itself.

Proposition 3 (P3) - Sustainability actions in local companies generate benefits for the community.

This proposition is true, which was proven by the interviewee's answers associated with the following question: **what are the sustainability actions in local companies and what are the positive effects for the community?**

Through the actions adopted and observed at Little Sweden Inn, the community benefits in several ways: (i) the construction of a small sewage treatment plant at the pousada and the composting of organic waste helps to keep the forests, rivers and waterfalls in the region within sanitary and environmental standards; (ii) prioritizing purchases from local suppliers helps the local economy.

Proposition 4 (P4) - Sustainable entrepreneurship is present in sustainable business models of companies in the Penedo neighbourhood.

This proposition is true, which was proven by the interviewee's answers associated with the following question: **what does sustainable entrepreneurship encompass in Penedo?**

It can be said that Little Sweden Inn develops sustainable entrepreneurship, with actions in the economic, social and environmental fields if we analyse the business model as a whole, but if we analyse the projects developed in isolation, we will see that they develop sustainable actions and are involved with issues related to sustainability and sustainable development in the region, but they do not develop sustainable entrepreneurship programs in their complete design.

Discussion and conclusion

It is assumed that the actors and factors of an entrepreneurial ecosystem interact in a harmonious and dynamic way to make the ecosystem vibrant. Similarly, sustainable entrepreneurial actions are expected to reflect the interactions between elements of structural conditions and systemic conditions. This study aimed to understand how actors and factors interact in the entrepreneurial

ecosystem of a small town, favouring the emergence of sustainable entrepreneurship in the hotel sector. It was found that even almost a hundred years after the arrival of the Finns, the Nordic influence is still manifested in the city's business, sustainability emerges from the interactions that take place within the entrepreneurial ecosystem of Itatiaia, the sustainability actions in the company studied generate benefits for the community, sustainable entrepreneurship is present in the sustainable business model in Penedo. The small number of cases studied is a limitation of the study. Future research may be carried out with more companies in the hotel sector and in other sectors in Penedo or in other small towns with strong tourist attraction and strong influence of a subculture.

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RESILIENCE PROCESS IN INTERNATIONAL ENTREPRENEURSHIP OF NORDIC FIRMS IN A VUCA CONTEXT

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Abstract

The global business environment is growing increasingly volatile, uncertain, complex, and ambiguous (VUCA). Since survival in challenging environments requires increased innovativeness, firms urgently need to improve their capacity for corporate entrepreneurship (CE). An empirical focus on Sub-Saharan Africa provides a natural laboratory to study this while allowing to address the general lack of business research in African contexts. This research therefore explores IE by Nordic and European companies in Tanzania by means of an inductive, mixed-method multiple-case study.

Keywords

Entrepreneurship Action, VUCA, International Entrepreneurship, International Business.

Statement and Declarations

In terms of competing interests, neither author has any direct or indirect financial or non-financial interests related to this research.

Introduction

External events, characteristics, and context can enable but also constrain entrepreneurial agency (Davidsson et al., 2020). As the global business environment is growing increasingly volatile, uncertain, complex, and ambiguous, or VUCA (Mack et al., 2016), there is a general need to improve our understanding of venturing in precarious and uncertain settings (Bullough & Renko, 2017).

More specifically, challenging environments emphasise the need for risk-taking behaviour by a firm when they venture internationally through international entrepreneurship (IE) (Zahra, 1993), to innovate and gain a competitive advantage (Sebora & Theerapatvong, 2010). Following McDougall (1989) seminal definition of IE as *firms engaging in international business*, researchers in strategic management and entrepreneurship have shed valuable light on different aspects of this important topic, as summarized in e.g., the literature review by Gholizadeh and others and others (2022). However, significant research gaps persist with regards to understanding IE in its context, both across different institutional environments and as a process unfolding over time (Gholizadeh & Mohammadkazemi, 2022).

Intended to help address these gaps, this paper builds on qualitative accounts of international entrepreneurship in Tanzania, complemented by secondary data as detailed later. This empirical focus enables us to shed light on IE in a VUCA context while also helping to alleviate the general lack of business research in African contexts (Barnard et al., 2017). The latter theoretical contribution is important because most research on entrepreneurship, including IE, is based on data from the USA, UK, and other developed countries such as Finland (Baier-Fuentes et al., 2019; Pinto et al., 2017). If you focus attention on specific parts of IE research such as IE opportunity, there are only 2 articles from Africa (Gholizadeh & Mohammadkazemi, 2022). This calls for the attention to environments that are left out, such as developing countries, which represent 75% of world trade participants (Institute of Policy Studies, 1998).

Managerial decision-making is strongly influenced by the challenges managers face, which vary across environmental contexts (Manalova et al., 2002). This implies that empirically lop-sided research will always struggle to provide a balanced view of reality, which constitutes a challenge in terms of developing generalizable knowledge. Indeed, there are many examples where theories developed in the frame of Western economic models have not applied in other contexts, including China (He et al., 2018), and notably, African countries (Barnard et al., 2017). The practical relevance of our empirical study is starkly accentuated by projections that over 50% of global population growth in the next 30 years will be in Africa (United Nations, 2021), with concomitant long-term economic and social potential if current challenges can be overcome (World Bank, 2020).

The specific aim of this paper is to explore the interlinkages between international entrepreneurship and external factors in a context that can be characterized as VUCA. This places the focus of our inquiry firmly on *international* venturing (Gholizadeh & Mohammadkazemi, 2022), which is known to pose additional challenges for firms compared to domestic venturing, particularly in developing-country contexts (Yiu et al., 2007). It is set in the theoretical framework of resilience during an unexpected external event (Duchek, 2020).

Our primary unit of analysis is the firm, here focusing specifically on foreign-owned Tanzanian firms. Foreign-owned firms tend to be at the very frontline of the local-global tensions typical of international business (Birkinshaw, 2000; Bouquet & Birkinshaw, 2008), facing a constant need to balance local customer needs and operative requirements with parent firm targets, guidelines, product portfolios, and expectations to engage in activities such as knowledge sharing and ‘sensing’ (Doz et al., 2001; Kostova et al., 2016). Local firms are also restricted in their innovation process by parent firm business requirements (Bouquet & Birkinshaw, 2008). As we will show later, this limits the scope of their resilience.

Focusing on IE in foreign-owned Tanzanian firms allows us to answer the following research question: *When a local external context can be characterised as VUCA, how does it influence the international entrepreneurship of foreign-owned firms through their resilience process?* Our answers shed light on IE in VUCA contexts and adds to the yet very limited research on international venturing into Africa. What is unique about our paper is that it captures data as an unexpected event is unfolding in a VUCA context.

In the following, we review relevant literature on (1) international entrepreneurship, (2) challenges faced by corporate entrepreneurship and entrepreneurs in times of disruption/crisis, with a specific focus on VUCA contexts, (3) the business context of sub-Saharan Africa and specifically Tanzania, explaining why the latter can be characterized as VUCA, and (4) we look at the resilience process in international entrepreneurship in a VUCA context. We then proceed to account for our methodology and results before presenting conclusions and a range of recommendations for international entrepreneurs, the firms in which they operate, and the countries that host them. Throughout the latter discussion, we balance our focus on a specific empirical context with prudent generalization of VUCA contexts more generally, thus generating takeaways applicable to a broad range of contexts in the increasingly uncertain world of today.

Literature review

International entrepreneurship

A key aim of all firms is to gain and sustain competitive advantage, and IE is a means towards this end (Rocha et al., 2017), that becomes more important as the external uncertainty rises (Etemad, 2020). McDougall and Oviatt (2000) conceptualized international entrepreneurship as a merger between two research paths, entrepreneurship, and international business.

Tabares (2021, p. 325), building on McDougall's (1989) definition, underlines that IE over time has evolved from entrepreneurial activities – innovation, venturing, and/or strategic renewal – to a focus on “*dynamic process or behaviour of discovering, evaluation, and exploitation of opportunities across national borders*” (our italics). Opportunity is rooted in the discovery of new means-end relationships (Venkataraman, 2000). This is different from the international business literature focus on profit seeking behaviours across borders (Reuber et al., 2018). Dana and Wright (2004, p. 4) described the process of venturing across border as to “obtain various elements of value added from wherever in the world they may be most efficiently obtained, combine or assemble them in whatever location may be most cost effective, and then distribute them to wherever appropriate demand conditions exist, almost without regard to national boundaries.” From our point of view, the reason a firm would seek to internationalize to a location is not solely profit seeking behaviours but a diverse set of reasons dependent on an objective.

In being oriented as a process towards an objective, IE is a product of the interaction between the firm's internal and external environment or context (Rocha et al., 2017). In firms with foreign ownership, this dialectic between internal and external is often complemented by a tension between local and global, partly aligned and partly at odds with the previous. Canonical international business theory (e.g., Bartlett & Ghoshal, 1989) suggests that a network of sister companies outside the local context may provide a local firm with significant advantages in terms of knowledge, widely recognized as one of the most important and strategic resources of a firm (Grant, 1996), with concomitant increases in innovative capability. However, it is also common for foreign-owned firms to find their flexibility hobbled, their resources sapped, their local credibility diminished, and their own entrepreneurial initiatives strangled by corporate requirements and the dynamics of what is happening with sister companies (Bouquet & Birkinshaw, 2008).

The dual-edged nature of these tensions must be emphasized. Local knowledge may enable the firm to identify and exploit entrepreneurial opportunities that would go unnoticed by outsiders, potentially yielding hit products that can be leveraged also by other sister firms. But equally, strong local networks and loyalties may result in overcommitment to products, services, and courses of action that do not stand up to rational corporate scrutiny. In any case, the influence of local context upon IE is likely to be perceived differently by local firms than by their foreign owners.

International entrepreneurship and contextual disruption

Davidsson (2015) defines external enabling factors as the “the aggregate-level circumstances—such as regulatory changes, technological breakthroughs, and demographic shifts—which may affect a variety of new venture creation” (Davidsson, 2015, p. 677). Both formal dimensions of institutional frameworks, such as rules and regulations, and informal dimensions such as norms

and values, may act as external enabling factors (Peng et al., 2009). In this positive view, such collective factors create space for entrepreneurship action. It has been pointed out that different institutional environments favour different types of opportunities and evoke different challenges for firms (Young et al., 2018). But little has been written on what happens when the external forces which are meant to be enablers are in reality disruptors – specifically, how different types of external enablers combine to trigger disruption to entrepreneurial action.

Environmental and contextual changes can be disequilibrating forces on the entrepreneurial process (Davidsson et al., 2020), with a particularly strong impact on small and medium-sized enterprises (SMEs) and international entrepreneurship (IE) (Baier-Fuentes et al., 2019). For example, referring to the notion of knowledge as a strategic resource of the firm, scarcity of knowledge (or information, a building block of knowledge) creates uncertainty (Townsend & Hunt, 2019) and raises the cost of doing business. In an environment where the ability to pay for a product is already a challenge, such increased costs may constitute a significant further detriment to the viability of a business. Likewise, environmental drivers are important for foreign market expansion, and constant environmental change leads to an unwillingness to engage in international expansion (Torkkeli et al., 2018).

No business context is completely devoid of change, and all complex change processes are to some extent unpredictable. However, what is specific to VUCA contexts is that they are characterized by an overabundance of unpredictable and discontinuous change. The concept of VUCA emerged as institutions were moving away from long term stability and equilibrium towards a state of constant change, verging on chaos (Yarger, 2006). In a process-oriented approach such as IE, the elements of VUCA can be structured on two dimensions, as illustrated in Figure 1: *knowledge* about a situation and the *predictability* of the results of an action in that situation (Bennette & Lemoine, 2014).

Table 1: Identifying events in the four VUCA categories (Bennette & Lemoine, 2014, p. 1)

How well can you predict the results of your actions? Poorly → Well	Complexity	Volatility
	Characteristics: The situation has many interconnected parts and variables. Some information is available or can be predicted, but the volume or nature of it can be overwhelming to process.	Characteristics: The challenge is unexpected or unstable and may be of unknown duration, but it's not necessarily hard to understand; knowledge about it is often available.
	Ambiguity	Uncertainty
	Characteristics: Causal relationships are completely unclear. No precedents exist; you face “unknown unknowns.”	Characteristics: Despite a lack of other information, the event's basic cause and effect are known. Change is possible but not a given.
How much do you know about the situation? Little → Much		

Sub-Saharan Africa and Tanzania as VUCA business contexts

The current African context has been described as an “intense” industry setting (Torkkeli et al., 2018) characterised by high competition, an unforgiving and tough business climate and a low level of opportunity generation (Abubakar et al., 2018). The fast-changing dynamics of African institutions, cultures, politics, and demographics means that many African markets are described as VUCA contexts to a prominent degree (Barnard et al., 2017). Due to the concentration of research towards developed countries, little information exists on how corporate entrepreneurs – or indeed managers overall – work in such environments (Pinto et al., 2017). At the same time, it has been argued that Africa is so vast and diverse that knowledge acquired in one market is not directly applicable to others (Ferrucci et al., 2017), and generalizations from one country setting to others can only be made with caution. Therefore, within the broader region of sub-Saharan Africa, we focus on one specific country: Tanzania. We specifically focus on foreign owned firms in Tanzania going through an unexpected external event.

Tanzania has previously been classified as a least developed country (LDC) (United Nations DESA, 2020), but in 2020 joined the ranks of middle-income countries (World Bank, 2020). Since the 1970s, Tanzania has gone through constant change of its economic model between a free market and a closed market with significant weight given to state institutions (Economic Development and Institutions, 2018), unlike the consistent economic models pursued in Nordic countries such as Sweden (Kjellberg, 2019). This has seen Tanzania giving a lot of weight and power to formal institutions and state operated businesses. An example of the weight currently given to state institutions is the Tanzanian’s government active fight against corruption. The implementation is under the Prevention and Combating of Corruption Bureau (PCCB) led by military personnel under the President's Office (Prevention and Combating of Corruption Bureau, 2017). Still, in a recent study among foreign-owned firms active in Tanzania, its business environment was associated with “pervasive harassment, bureaucracy and rent seeking behaviours affecting operations, profitability and souring general experiences of investing in the country” (REPOA, 2020, p. 1).

International Entrepreneurship and Organizational Capabilities in a VUCA context

As a merger between entrepreneurship and international business (McDougall & Oviatt, 2000), the internationalizing process of a firm needs a competitive advantage strong enough to overcome the liability of foreignness (Dunning, 2000; Rugman, 1981). In an environment such as Tanzania, a firm needs to leverage its intangible resources which are hard to replicate by competitors (Knight & Cavusgil, 2004; Kotha et al., 2001). These resources would integrate and reconfigure its environment (Lin & Wu, 2014). In Tanzania, firms overcome unanticipated challenges through resilience (Torkkeli, 2021; Zahra, 2021). Williams et al defined resilience “as the process by which an actor (i.e., individual, organization, or community) builds and uses its capability endowments to interact with the environment in a way that positively adjusts and maintains functioning prior to, during, and following adversity” (Williams et al., 2017, p. 742).

This process view highlights the capabilities used by firms in practice while internationalising to Tanzania. In the process of internationalising a firm can encounter unexpected events, whether they be volatile uncertain complex or ambiguous, VUCA (Van Tulder et al., 2020). When looking at the “unexpected” while internationalising to a VUCA context, Tanzania, there are a set of capabilities that bring about organisational resilience (Duchek, 2020). Duchek in her 2020 paper conceptualised the processual capabilities as three stages, figure 2, consisting of Anticipation, Coping and Adaptation (Duchek, 2020). It is in this theoretical framework we

base our paper on. The process of resilience while internationalising in the VUCA context of Tanzania in the quest of a specific objective.

We can link this with the paper “Exogenous shocks and MNEs - Luciano Ciravegna 2023” and say it is also termed as Exogenous shocks “While each disruption or shock has several unique characteristics and is situated in a particular context, its consequences are increasingly experienced worldwide. Terms such as the already mentioned “New Normal” (Ahlstrom et al., 2020), VUCA (volatility, uncertainty, complexity, and ambiguity) world (Van Tulder et al., 2020), DDD (disruption, division, and displacement) (Creed et al., 2022), and non-market risks (Oetzel & Oh, 2015; Oh & Oetzel, 2022b) have all identified the characteristics of these shocks and have become common vocabulary in the IB literature.”

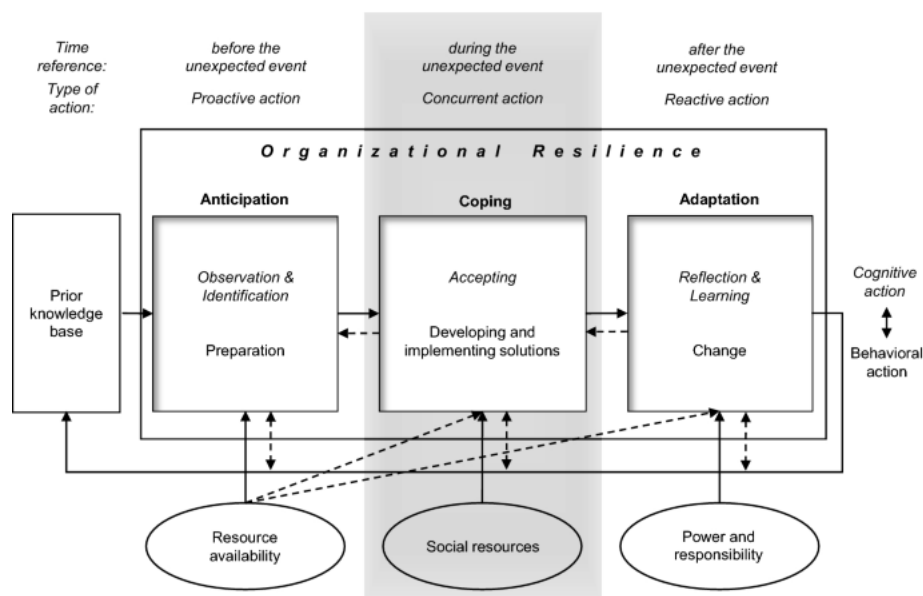


Figure 1: Conceptualization of organizational resilience (Duchek, 2020)

In Tanzania, the role of resilience (Bullough & Renko, 2013; Bullough et al., 2014) can mean the success or failure of the firm in achieving its objective. There are two competing resources in an internationalising firm. The ones at local level and ones at the corporate level (foreign owners). With two competing resources, a key consideration is how can the local firm gain adequate support from the larger and more superior resource from the foreign owners through a challenging environment (Birkinshaw et al., 1998).

Summary of the literature review

To sum up, as firms are turning to IE to gain and sustain competitive advantage, IE’s process orientation towards action and the market brings about tension between their internal and external environment. This tension can be exacerbated by the disruptive nature of VUCA contexts. Specifically, the challenges of operating in VUCA contexts increase tensions within the firm, make knowledge acquisition more difficult, and may result in serious obstacles to entrepreneurial action. This is prominent when the firm is going through a resilience process, brought about by an unexpected event, and needs additional resources internally. The focus of extant publications on developed countries, combined with the increasing prevalence of VUCA contexts, underline the need for in-depth research on the latter, here exemplified by Tanzania.

We now proceed to discuss our methodology, with an emphasis on how we have solved the data collection challenges that constitute such a formidable block to a richer conceptual understanding of business and entrepreneurship in VUCA contexts.

Methodology and Data

Data collection

Given the limited literature on international entrepreneurship in the African context, we adopt an inductive multiple-case study approach (Eisenhardt et al., 2016). This method is suitable for research that seeks to answer a “how” question with variance in the data (Langley & Abdallah, 2011).

To address the data collection challenges typical of empirical research in VUCA contexts (Bullough & Renko, 2017), we triangulate available relevant quantitative secondary data with qualitative primary data. More specifically, our secondary data stem from a recent survey undertaken among foreign-owned firms in Tanzania. Our primary data was collected in the form of semi-structured interviews in existing foreign-owned ventures with a long history in Tanzania and in Africa, which fulfilled the criteria of IE as explained earlier in this paper. These two data sets are first described in more detail below, and we then proceed to explain how we analysed them.

Secondary data

The secondary data we draw upon to provide a broader context for our primary interview data stems from a survey of foreign owned firms in Tanzania by an independent locally based research institution, Research on Poverty Alleviation (REPOA). The survey was commissioned by the Nordic embassies in Tanzania in 2019 to highlight the challenging local business context. It drew upon a sample of 105 foreign-owned firms that had been operating in Tanzania for 11 years or more (REPOA, 2020). We consider this number relatively low against the background that the REPOA (2020) survey had foreign embassy backing and the total number of foreign-owned firms operating in Tanzania is probably in the several thousands. An investment climate assessment by the World Bank on Tanzania in 2004 used 246 foreign owned firms (World Bank, 2004). Exact figures of total foreign owned firms in Tanzania are not available. Both this and the relatively limited response rate count among the many indications we encountered during our study of the significant challenges associated with business research in VUCA contexts, where trust is often low, risks are high, and reliable information is difficult to come by.

The REPOA (2020) report contains descriptive statistics on size, ownership, employees, area/s of operation, revenue, and profitability of the sampled foreign-owned firms. In combination with our own primary data consisting of in-depth interviews in 12 foreign-owned SMEs operating in Tanzania (see next section), we believe this offers a window to generalise across the SME size spectrum of foreign-owned firms in Tanzania.

Primary data

The second data set consists of primary data in the form of semi-structured interviews in 12 foreign-owned firms in Tanzania, complemented by 1 semi-structured expert interview with an embassy representative with deep insight into the Tanzanian activities of firms from the country they represented. Making a total of 13 interviews. This part of the data collection was carried

out to get as much first-hand insight as possible into the implicit and explicit challenges of IE in a VUCA context. This part of the data collection process was highly challenging due firstly to the bureaucratic nature of formal institutions in Tanzania, and secondly to distrust among local people of relative strangers asking questions. As we see it, both challenges are closely linked to how government policy is implemented in Tanzania.

Before even being allowed entry into Tanzania, a researcher needs their research approved by a government institution (The United Republic of Tanzania, n.d.). Upon completion of this step, access to firms was gained through the first author's personal networks, based on the following criteria: (1) firms with a long history in Tanzania, capturing as much of the macro-level timeline as possible at the firm level, and (2) willingness among top-level management to give interviews. Especially the latter criterion severely limited our sample due to the nature of our research and the sensitivity of the formal institutions of Tanzania towards any sort of criticism. Even on the condition of strict confidentiality, the boundary conditions of the data collection limited the number of willing participants to 12. Of these, 8 were interviewed on site in Tanzania and one over Skype due to schedule conflicts. Throughout this part of the data collection process, it was evident that the respondents felt that government policy provided a limited scope for explicit criticism. As one of our respondents said:

"I have to be careful with what I tell you, I do not want to appear critical of the government." (Firm-A)

Such a comment was not a one-off and it was very clear in the interviews that circumspect language was consistently being used to mask the true nature of events.

Of the 12 firms that participated in the interviews, all were headquartered outside of Tanzania. All the sampled firms could all be described as SMEs following a business-to-business (B2B) strategy, with other businesses as their primary customers. The limited pool of foreign-owned firms in Tanzania in combination with the strict confidentiality requested by respondents forces the removal of information that could identify individual firms. E.g., industry sector and exact location of the sample firms' corporate HQ cannot be divulged, as the combination of these would make it obvious which company is being referenced. A summary of the interviews with these caveats considered is presented in Table 1.

In addition to the interviews with the firms, an expert interview was carried out with a representative of a Nordic embassy to get an overview of challenges facing European corporate entrepreneurs in African contexts and specifically in Tanzania. This interview shed valuable additional light on our research questions, but to clearly demarcate it from the company interviews, it is listed last in all tables below.

Table 2: Interview Participant Matrix

No.	Place	Organization (Type)	In Tanzania (Years)	Company HQ	Length Of Interview (Minutes)
1	Tanzania	A (Subsidiary)	20+	Sweden	32
2	Tanzania	B (Subsidiary)	10 – 20	Switzerland	42
3	Tanzania	C (Take over)	10 – 20	Tanzania	60
4	Tanzania	E (Subsidiary)	20+	Sweden	39
5	Tanzania	F (Subsidiary)	10 – 20	Norway	46
6	Tanzania	G (Subsidiary)	20+	Denmark	52
7	Tanzania	H (Subsidiary)	10 – 20	United Kingdom	32
8	Skype	I (Subsidiary)	20+	Finland	46
9	Skype	J (Subsidiary)	10 – 20	France	45
10	Skype	K (Start Up)	10 – 20	Australia	45
11	Skype	L (Subsidiary)	10 – 20	United Kingdom	55
12	Skype	M (Subsidiary)	10 – 20	Norway	48
13	Tanzania	D (Embassy)	-	Nordic	37

Due to the economic differences between the two environments, most of the interviewed firms were SMEs by developed country standards (European Commission, 2003), but in the local standards were considered large firms (United Republic of Tanzania, 2003). A comparison of the standards is in Table 2.

Table 3: Comparison of European Union vs Tanzania SME classification

	European Union		Tanzania	
Category	Employees	Balance Sheet	Employees	Capital Investment*
Micro	0–10	≤ € 2 million	1–4	≤ €19,742
Small	10–50	€2m - €10m	5–49	€19,742–€70,948.70
Medium	50–250	€10m - €43m	50–99	€70,948.70–€283,794.78
Large	250 +	€43m +	100 +	€283,794.78 +

*Exchange rate used as at Dec 2019

Interview protocol

The semi-structured interviews were designed to look at background, risk and uncertainty, product offering and context-specific challenges to bring out as much as possible the behavioural dynamics of the firms in the local context. The overarching theme was asking the respondents to differentiate risk and uncertainty through current examples of challenges faced by the firm. This helped to draw out the different aspects of risk and uncertainty faced but also for the interviewee to contextualise a volatile or ambiguous situation. A detailed interview guide is provided in Appendix 1. In accordance with established protocols for qualitative research, the interviews were recorded and complemented by detailed field notes taken during and after the interviews.

Data analysis

The interviews were transcribed shortly after the interviews to incorporate the notes taken during the interview while they were still fresh. Transcribing was done using a transcribing

software called Trint, with all transcripts being thoroughly checked and details corrected by the first author.

After initial transcription, the interviews were analysed the first time on a case-by-case individual basis to identify individual experiences. Then the cases were analysed jointly to identify experiences that were shared across of all firms. This first round of analysis was carried out with a focus on perceived challenges and risks (divided into commercial vs. government-induced), to highlight which one of these two challenges could be seen as the primary driver of the VUCA nature of the Tanzanian business environment. The commercial challenges and risk were further broken down into three sub-categories: Market Size, Market Growth and Offering. Similarly, the government-induced challenges and risks were broken down into the following categories: Government's Aims, Communication Style, and Decision-Making Process.

Commercial challenges and risks were found to be the primary challenge. All the interviewed corporate entrepreneurs experienced significant risks related to small market size and the problems of an offering that was felt to be overly advanced in relation to Tanzanian needs. As to market growth, some differentiation could be observed, as Firm B felt that the growth of its market was limited by the purchasing power of the population, which was low. Secondary were challenges and risks induced by government policy. All respondents felt significant risks to be associated with information asymmetry and political decision-making processes. Government decisions would be made without clear and concise communication leaving companies facing ad hoc fines for noncompliance without notice. Where there was communication, there was no consultation, just a decision that would apply retrospectively. Some variation could be observed in terms of the effects of government's aim which all felt was biased towards raising revenue. Two firms did not see the government's revenue generation incentive as a challenge, as their market base consisted of the ruling party's voting base which provided very quick feedback when prices were too high.

Having identified the prime challenge as commercial, at the next stage of the data analysis we analysed the data on the dimensions of VUCA (Volatility, Uncertainty, Complexity, Ambiguity) as pertaining to the overall business environment in Tanzania. This analytical approach yielded a matrix of shared experiences related to corporate entrepreneurship challenges in the Tanzanian context. This matrix is presented in Table 4 below.

Table 4: Detail Description of Findings from Interviews laid on the VUCA model.

Or-gani-za-tion	Commercial		Government	
	Volatility	Uncertainty	Complexity	Ambiguity
A	Sells a premium quality product. Affordable only to a small section of the market. The situation is understandable due to the purchasing power of the market. Increasing competition from cheaper Chinese offering.	Facing competition not only from European rivals but also cheap Chinese rivals. At the same time the premium product at a global level is moving towards digitalisation while the local market does not demand it.	The firm is governed by 23 regulatory bodies. Each one with a specific legal framework with overlapping mandates with other regulatory bodies. (The United Republic of Tanzania, 2017)	Ad hoc rulings in parliament and judiciary, which are not in line with the market, have left the firm wondering on best course of action and reinventing their standard operating procedures.
B	Offers B2B services that rests on the demand of the final consumer. The final consumer is not growing enough to cover the increasing cheaper competition.	There are new entrants to the market while the existing players have excess capacity due to advance technology and efficiencies in management.	The firm is governed by 20 regulatory bodies. Each one with a specific legal framework with overlapping mandates with other regulatory bodies. (The United Republic of Tanzania, 2017)	Overnight policy change on a process that has been a long-held tradition without consultation.
C	The service provided by the respondent is reliant on the country's internal market acting as catalyst to subsidise the final offer to B2B clients. The internal market is subject to income and weather fluctuations.	Competition with the respondent is both internal and the international market increasing the number of entrants and innovations.	The firm is governed by 27 regulatory bodies. Each one with a specific legal framework with overlapping mandates with other regulatory bodies. (The United Republic of Tanzania, 2017)	Political ruling on the handling of a major product reduced the firms offering by 30%
E	Is continuously trying to reduce overheads to remain profitable and provide the service to a wider range of customers. This is brought on by the minimal consumer expenditure of the average person (~\$80 per month)	Normally in a market that is saturated such as this sector in a country the main players are limited to around 3. Tanzania is an exception with 5 prominent global players all competing for the same saturated market.	The firm is governed by 20 regulatory bodies. Each with their own legal regulatory framework such as permits. (The United Republic of Tanzania, 2017)	The firm is struggling whether to invest or not, due to the lack of clarity of what will happen with the next generation product offering which is under the authorisation of government.
F	Trying to negotiate a contract where the partners in the negotiation have never negotiated such a contract before.	Strong competition built on what the respondent perceives as non-ethical means.	The firm is governed by 23 regulatory bodies. Each with their own legal regulatory framework such as permits. (The United Republic of Tanzania, 2017)	There is no industry yet there is constant review of taxes and contract agreements and introduction of restrictive laws without consultation.
G	Without their main customer, who does not pay on time, the market is small and reliant on donor funds from other nations.	The respondent experienced no competition in the market for their product. But their product was too advanced for the market and its requirements. Leaving them open to an entrant who offers what is demanded in the market at a more tolerable price.	The firm is governed by 25 regulatory bodies. Each with their own legal regulatory framework such as permits. (The United Republic of Tanzania, 2017)	New tax laws which are implemented overnight without warning or room for adjustment
H	The product offering is too advance for the market. Ideally, due to the economic and infrastructure conditions of	The respondent does not have a strong competitor in the local market due to	The firm is governed by 21 regulatory bodies. Each with their own legal regulatory	The respondent is not affected by the political climate of the market.

	the market there is a need to go two or three generations back with the product.	their ability to offer product and after sales services.	framework such as permits. (The United Republic of Tanzania, 2017)	
I	If one of their customers pulled out, the market that is left is too small to operate profitably in.	The market for new technology is small and its adoption will take time. Furthermore, the merger or pulling out of one of its customers shrinks the market exponentially while retaining its high number of competitors.	The firm is governed by 20 regulatory bodies. Each with their own legal regulatory framework such as permits. (The United Republic of Tanzania, 2017)	The firm is struggling whether to invest or not, due to the lack of clarity of what will happen with the next generation product offering which is under the authorisation of government.
D	Did acknowledge that the products offered by the country they represent are of higher price point than the market is accustomed too.	There is great uncertainty as the firms into Tanzania are entrants from the global level and not solely on the local level. Leaving the priorities of the two levels misaligned.	Has acknowledged that companies represented in Tanzania must go through several permits to be able to operate. In the Forestry sector alone which they represent it is 38 permits.	Changes in laws are quick through emergency parliament sessions and without consultation with firms or sector regulating bodies.

Findings

According to the REPOA (2020) survey, the current global economic uncertainty reflects on the Tanzanian business environment, resulting in few of the surveyed ventures experiencing profitability growth. The theme of the Tanzanian business context being very challenging to navigate also recurred during our interviews. It was not the actual government policies that were being brought into question, but rather the way they were implemented:

“If you look at employment, taxes and pension and these kind of things. So, it’s not the weight of the actual, let’s say, taxes themselves. The burden is more in all the discussion, uh, that we have with the tax office with TRA [Tanzania Revenue Authority] ...” (Firm-A).

“The problem at the moment [that] I think many companies are experiencing is that the implementation of [policy] is heavy handed at the moment in order to increase the tax base. and uh so the law, the empowerment of government agencies at the moment means that. Normal Compliance risk becomes super high risk because the punishments for noncompliance are far in excess of the punishments that are applied in most economies.” (Firm-J)

This theme of using words such as “discussions” and “heavy handed” runs throughout the data and is a common theme amongst all the respondents. In the interviews, language is being strategically used to point indirectly at treatment firms have suffered from the formal state institutions. The interaction with formal institutions is perceived to be made even more difficult by the seeming lack of consistent information:

“It is difficult to get information...and to be sure that that information does not change. The next day.” (Firm-C)

To deal with this unknowing of actions taken by formal institutions one firm hires a specialised team to handle the 27 regulatory bodies and their accompanying “heavy handed” spot checks. Much of this cost is absorbed in-house to relieve *ambiguity* in their compliance with formal institutions. The ambiguity is caused by the fact that one regulation or law can have more than

one mandated agency thus creating a confusing matrix of cross functionality for compliance. On top of which regulations can change overnight without consultation. The normal flow of causal relationship does not exist. A firm cannot precisely say what caused or necessitated an inspection from a formal institution. A dimension of how foreign-owned firms were coping with this ambiguity is by demanding much higher rates of return than in their home countries, of around 30% to 40%.

This environmental context of dealing with the local institutions, as challenging as it is, is however seen only as a secondary challenge.

“[Government challenges] varies from country to country... But by far the biggest [of] these things are insignificant. I would actually [say] insignificant compared to normal commercial risk and uncertainty” (Firm-I)

The primary challenge faced by the companies is commercial and is nested within the challenge of dealing with formal institutions. All the firms found the commercial challenges highly unpredictable and subject to change at any moment. Though the firms interviewed agreed that the market they were in was growing or had potential for growth, all of them experienced the same challenges, namely;

- Lower price points than in the home country.
- Strong competition.
- An offering that is advanced for the market compared to the home country.

These will be discussed next.

Small Market (Lower Price Points)

Most of the firms interviewed were business-to-business (B2B) firms. Even with this market dimension, however, the prices they were able to charge their customers were below their expectations relative to their home countries. This follows on from the fact that on the Tanzanian market, the final consumer in the chain has a low purchasing power. The African Development Bank defines the middle class in Africa to have a consumption level between USD 2 and 20 a day (African Development Bank, 2011). According to the Household Survey conducted in 2017 in Tanzania and published by the World Bank, only 253,440 people out of a population of 58 million have a purchasing power per day of USD 20 or more (World Bank, 2020).

This situation is representative of the middle class in Africa more generally. “About 60% of Africa’s middle class, approximately 180 million people, remain barely out of the poor category. They are in a vulnerable position and face the constant possibility of dropping back into the poor category in the event of any exogenous shocks” (African Development Bank, 2011, p. 1). We argue that this fact contributes strongly to the *Volatility* dimension of VUCA in the Tanzanian context, as it affects what firms can charge consumers and indirectly has a knock-on effect on the cost for services those firms can afford.

“[People] who can fly in Tanzania, the number of people that can fly in Tanzania is, limited to a certain number.” (Firm-B)

This is in turn tied to a certain heavy-handedness by the local government in terms of generating revenue, since only a small amount of the public pays a large portion of the taxes (World Bank, 2015). The environment around revenue incentive by the government of Tanzania constrains

the ability of firms to lower their prices or direct resources towards innovation. As one respondent explained, they would like to lower their prices but due to revenue incentives by the formal institutions, the percentage of tax on a product sold was 55%.

“A further enquiry of [the] perceived effects found that authorities, particularly the Tanzania Revenue Authority (TRA), are seen to have found it difficult to balance between own operational targets (mainly revenue targets) on one hand, and providing space for businesses to operate within the confines of the law on the other.” (REPOA, 2020, p. 18)

This may be attributed to the difference in classification of an SME between Tanzania and developed countries such as Europe. This distinction is important as it further incentivises formal institutions to target international ventures which in the local context are classified as large firms. In cases where the international venture is an SME both in the developed and developing context, it is still targeted and treated harshly by local regulators due to the perception of being large and wealthy (REPOA, 2020).

Strong Competition

“There's competition now where it wasn't there in the past” (Firm-B)

There are many players in the local market all going for the same group of customers who can afford to pay. Competition is normally seen as a good thing but in the context of a very small customer base, it helps create a volatile environment. As stated above, the Middle Class of Africa is vulnerable to poverty due to exogenous shocks (African Development Bank, 2011, p. 2). This translates to customers in the B2B sector merging or dropping off, reducing the size of the market for the respondents considerably in an event.

“you've only got five or six targets in country. and uh you know, it's the main operators ... So then if one goes down, then that can be a quarter of your potential customer base gone. Or two of them come together. You may find yourself in an environment where you had virtual monopoly of their [capital and operational expenditure] spend. You may suddenly find that you have 50 percent now and you are competing with the other two themselves [used to have] a monopoly. For [us], it's quite [challenging] because you have a small number of customers. The strategic relationships are very small in number.” (Firm-I)

Firms were actively engaged in innovating current operations in Tanzania at the time of the study, although experiencing significant disruption as documented below. The firms interviewed wanted to stay in Tanzania but as the challenges intensified it was increasingly more difficult to justify current ventures.

“We still want to be in Tanzania, perhaps we have been this company's first [venture] that we opened in Africa” (Firm-G)

Firm G moved away from government-led projects to environmentally sustainable projects which is both a global and local level issue. They still experienced challenges in this new entrepreneurial action at the local level as the market was not large enough to sustain their previous 149 employees. Entrepreneurial action towards environmental sustainability was also

pursued by Firm J by trying to cater to the product demands of the local market through a decentralised product offering from both global level and the local government.

In the REPOA survey of 105 Nordic ventures in Tanzania 62% were aged 11 years or more, yet only 40% would recommend Tanzania as a destination for international venturing. This may correlate with the finding that only 40% remained optimistic about future prospects in Tanzania and a third indicating their desire to cease operation as a whole. As negative as this sounds, the firms that remain in Tanzania “see the planned departures by others as opportunities to consolidate their own market shares and presence.” (REPOA, 2020, p. 23). This highlights further the issue of strong competition in a small market. The idea of the competition leaving leaves a sense of opportunity for the firms that remain as they can increase their customer base without waiting for the size of the customer base to increase.

All the firms had a strong emotional connection with Tanzania magnifying the intensity of any decision in the future. The length of time in Tanzania and their continued strong emotional connection despite a disruption highlights the passion and perseverance of their entrepreneurship orientation (Gerschewski, Lindsay, & Rose, 2016), in a challenging context.

An Advanced Offering

The offering by the firms is considered too advanced by the firm itself at the local level. Out of the 9 primary interviews all agreed that the local market is competitive. More than half went on to say that their firm’s offering is too advanced for the local market. From the point of view of those interviewed, they see the local market as not advanced enough for the technology offered at the global level.

“If we went stepped back, a generation of [product] development and used the [products] that were maybe 1 percent less efficient, but you could keep them running on a shoelace and a cable tie... that's what I still think the market is the markets there for it the customers want it. But they also [they] desperately need the reliability rather than the efficiency.” (Firm-H)

“In Tanzania, ... the customers are very much [want] control, which is understandable because there's a lot of risk. There's a lot of theft [of products]. There is a lot of [risk of] accidents. There is, uh, there's a lot of those things. So while we are much more focused on our digital, digital tools, , they [want control] what we are set out to do is to enhance performance [with digital products].” (Firm-A)

Firm A is from Sweden where corporate HQ is driving towards digitisation of the physical product. Such digitalisation enhances performance and increases efficiency, but the local market only cares about one digital aspect, tracking. The rest of the digitalisation process increases the cost of purchase for the customer which is exasperated by the purchasing constraint of the market.

A similar example of this situation is the mobile sector in Tanzania, where 2G and 3G networks in developed countries are being phased out by 2025 (Remmert, 2020) while in Tanzania 70% of customers are on a 2G network (Vodacom, 2019). Mobile phone related product development at a global level focuses on 4G and higher, but that overlooks the 3G and lower spectrums at the local level in Tanzania.

This dynamic creates a tension between product development at the global level and CE at the local level. One of the factors is the relatively small size of the Tanzanian market in monetary value compared to the global or even home country market. When it comes to product development, local CE takes a secondary role to global CE.

Thus, in VUCA terms, our data suggest that a combination of an advanced offering and intense competition increases *Uncertainty*. An advanced offering makes a firm reliant on the final consumer who may be highly susceptible to exogenous shocks, while a high level of competition implies a continuous intensity of efforts on a small market. This combination generates strong uncertainty because it means that the market situation can change unpredictably at any moment but is not certain to do so.

Figure 2 below summarizes our mapping of the challenges of corporate entrepreneurs in the Tanzanian context onto the VUCA typology.

Table 5: VUCA challenges as experienced by corporate entrepreneurs in Tanzania

How well can you predict the results of your actions? Poor → Well	Complexity	Volatility
	Characteristics: The situation has many interconnected parts and variables. Some information is available or can be predicted, but the volume or nature of it can be overwhelming to process.	Characteristics: The challenge is unexpected or unstable and may be of unknown duration, but it's not necessarily hard to understand; knowledge about it is often available.
	Example in Tanzania: Government regulations can cause a firm to be subjected to more than 40 permits and 20 regulatory bodies.	Example in Tanzania: The size of the market in Tanzania, and what it can afford to pay, is small and susceptible to existential shocks.
	Ambiguity	Uncertainty
	Characteristics: Causal relationships are completely unclear. No precedents exist; you face "unknown unknowns."	Characteristics: Despite a lack of other information, the event's basic cause and effect are known. Change is possible but not a given.
	Example in Tanzania: Political decisions made by the political elite of Tanzania result in laws and policies that are ad hoc and without consultation with the market.	Example in Tanzania: Competition is strong in the country with product launches that are advanced. Making the prediction of entrepreneurial action by local firms hard.
	How much do you know about the situation? Poor → Well	

Discussion and conclusion

The aim of this paper was to explore the interlinkages between international CE and external factors in VUCA contexts. To sum up our findings, we conclude that the primary day-to-day challenges experienced by the corporate entrepreneurs in our Tanzanian sample are commercial challenges, but that for many of the interviewed entrepreneurs and firms, these challenges border on the existential – and that is because they are nested in the ambiguity of the actions of

formal institutions, who implement blanket laws and regulations *ad hoc* without taking on board input from firms.

This highlights how CE, or existing firms' entrepreneurial activities (Zahra, 1996) are highly susceptible to changes in the external context, and that in VUCA contexts, external changes are far from always benign enabling factors spurring new venture creation, as some have suggested (Davidsson, 2015). The latter perspective is certainly also relevant, but in a world that can increasingly be described as VUCA due to major external shifts such as technological change, climate change, and concomitant rising nationalism and mass migration, it would be naïve to solely focus on that. How different types of external factors combine to trigger disruption to entrepreneurial action is equally if not more relevant.

This study helps redress the imbalances highlighted by Baier-Fuentes and colleagues (2019) by bringing forth empirical findings on CE in an African context (Barnard et al., 2017; Bennette & Lemoine, 2014). Our empirical work – including the significant challenges we ourselves faced in procuring first-hand data without compromising the security of the firms or the author handling the data collection – amply demonstrates why these imbalances persist. However, given the massive population growth expected in Africa over the next 30 years (United Nations, 2021), it is imperative to increase our knowledge of the challenges facing economic development in that context. As our study shows, these challenges are not only quantitatively different from what received management wisdom from the Global North would suggest – and often by orders of magnitude – but also qualitatively different, in terms of wholly different stakeholders and priorities being involved.

Our study supports the view that foreign-owned firms are at the frontlines of local-global tensions (Birkinshaw, 2000; Bouquet & Birkinshaw, 2008; Bullough & Renko, 2017), and must constantly balance local needs and requirements with those of their parent firms. What is striking in our data is what a struggle this entails in the Tanzanian context, and thus possibly also in other VUCA contexts. Our findings highlight that even if CE is a firm-level concept, seen up close in a VUCA context it also becomes personal, in several senses of the word. Firstly, questions related to personal risk are integral to our empirical work; secondly, many of our respondents in the firms personally felt strongly about their firms' commitments to the Tanzanian market and existing local stakeholders, as well as its future business potential. From a parent firm perspective, it is understandable that units in VUCA contexts cannot be run at a loss for prolonged periods of time, but successful corporate entrepreneurship will require careful calibration of balance sheet considerations against existing business commitments and strong future potential. This deliberation can be viewed in terms of March's (2002) classic distinction between exploration and exploitation: which will be seen as which in a VUCA context, and on what criteria?

The first part of our two-pronged research question can thus be tentatively answered as follows. When a local external context can be characterised as VUCA, it influences the corporate entrepreneurship of foreign-owned firms not only by disrupting business as usual at the local level, but also by acting as a catalyst for disruption within the firm by pitting local needs against global objectives. The dynamics associated with foreign ownership limits these firms' ability to exploit gaps in the local market to the full, thus creating internal barriers to the corporate entrepreneurship process.

As for the second part of our research question, concerning how firms' entrepreneurial responses to local context-related challenges are influenced by foreign ownership, we note that

the parent firms in our sample by and large adhered to traditional Global North management criteria, meaning they strove to maintain a balance between reasonable profitability in the short term, honouring commitments to existing customers and other stakeholders, and maintaining corporate citizenship and employee wellbeing standards considered normal in their respective home country contexts. A corollary of such Global North management criteria is an emphasis on business ethics and staff safety and not solely profit maximisation.

Firm G has a strong ethics background due to its background and HQ. Yet it has to deal with a local business way of life where it is encouraged to provide gestures of goodwill to officials in order to partake in a formal contract tendering process. The firm refuses to partake.

This strategy might not be followed by all, as has been noted in the context of Chinese-owned firms that emphasise profit maximisation through state political motivations (Alon et al., 2014). A different sample could yield a different result; exploring this opportunity constitutes an obvious avenue for further research.

Another suggestion for future research is the interplay between the firm level and the individual level, especially in terms of where important decisions are made – at firm or individual level? The “discussions” between firms and local formal institutions documented in our data are in fact not held at firm level, but between individuals who face informal institutions (norms and values) and navigate these as best they can, based on personal experience and insight. The challenges associated with dealing with these informal institutions may affect the degree of entrepreneurship action by the individuals in the firm.

Firm G as above had its staff interrogated by the military of Tanzania on possible corruption charges even though the firm itself has a strong ethics background and avoids projects which do not align with its values. Staff were detained for days without any representation or freedom to leave.

Considering such personal risks, a final important question is what makes individuals persist with CE in VUCA contexts such as Tanzania? This question offers a promising link to the literature on entrepreneurial resilience (Bernard & Barbosa, 2016):

Firm C faced 5 years without any sign of profitability and daily spot checks from formal institutions since the change in administration of the Tanzanian government. That changed in 2021 after a change in administration once again.

These caveats and suggestions for future research notwithstanding, the present study sheds important light on CE in VUCA contexts and adds to the as yet very limited research on international venturing into Africa. Though this paper highlights challenges there is a reason for optimism in entrepreneurial action in the VUCA context. According to the REPOA survey, 62% of firms surveyed had length of operations of more than 10 years which was like all firms directly interviewed by the author. Despite the challenges in the environment there is still perceived sense of advantage to be gained in being the firm that finds solutions to those challenges. In a sense this is backdrop that embodies success when undergoing entrepreneurial action.

The alignment of future opportunity in country where international entrepreneurship is happening at both level levels starts the process of resilience to overcome unexpected events.

Appendix 1: Semi Structured Interview Questions

Theme 1 - Context

- Interviewee's personal background ("Please tell me about your own background – how did you end up working for Company X here in Country Y?")
- Background and present situation of local operations in Country Y ("How would you describe the history and current position of your company here in Country Y?")
- Local operations in their corporate context ("How does the local operation here in Country Y fit into the bigger picture of your parent company's operations?")

Theme 2 – Microfoundations of the company's operations in Country Y

- Can you please elaborate in more detail on your operations here in Country Y? Which issues/challenges stand out as having the biggest impact on your business?
- In concrete practical terms, how do you go about handling these issues/challenges? (Follow-up question for each major issue/challenge: Who does it? Why that person? Are they successful, in your view? Why/why not? In what sense are they successful?)
- Entrepreneurial initiative,

Theme 3 – The business environment in Country Y

- Can you please reflect on how you see the business environment here in Country Y?
- Follow-ups: How has it developed over time? How does it compare to other business environments you are familiar with? How does it compare to other business environments that your parent company operates in? Can you provide examples?

Theme 4 – Uncertainty and risk

- Can you please reflect, from your own perspective, on the notions of "uncertainty" and "risk"?
- What meanings do these words carry in the context of your company's business activities?
- What meanings do they carry in the specific context of Country Y?
- Can you give examples of uncertainty and risk, respectively, in the context of a) establishing, b) running your business in Country Y?
- How were these instances handled in practice? Why?

Closing question:

- Reflecting back, what haven't we yet talked about that would be important to get a full picture of the issues we have covered so far?

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ON MAKING SENSE OF RESEARCH COMMERCIALIZATION AND ENTREPRENEURSHIP AMONG NATURAL SCIENTISTS

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Abstract

Universities are expected to solve societal challenges and bring value to the society through knowledge transfer and innovations, for example. This implies interaction with businesses and research commercialization as well as scientists taking steps towards entrepreneurship. Research on academic entrepreneurship and research commercialization acknowledge tensions between academia and business. At the same time, the ways in which individuals inhabiting these two different spheres interpret them remain scarcely studied. We explore the sensemaking processes of natural scientists narrating their work in which science and business are (supposed to be) combined in different ways, and ask *how natural scientists make sense of research commercialization and entrepreneurship*.

Drawing mainly from interview and learning reflection materials collected in the frame of a Nordic Centre of Excellence research programme, ‘NordAqua’, we focus on individuals in academia and the stories they tell about their work and collaboration with industry. Our study provides new insights on the complex-perceived relation between academia and business, and contributes by offering an enabling researcher-centred entrepreneurial narrative with new nuances and layers on entrepreneurship and related motives.

Introduction

Universities create new knowledge and transfer it to the benefit of the society. Universities are expected to solve great societal challenges and wicked problems, such as climate change and saving the planet for future generations. This implies increasing collaboration and interaction with the society, which creates pressure for scientists to focus on research and to be open to different types of social engagement, including entrepreneurial and research commercialization activities (Rosenlund & Legrand, 2021).

Research on academic entrepreneurship has widely reported tensions between academic ethos and commercial business values (e.g., Merton, 1973; Stankiewicz, 1986), stemming from differences between academic and commercial systems. Although recent studies suggest that researchers’ entrepreneurial and scientific activities do not necessarily collide but rather can be aligned to serve different goals of academia and business and related stakeholders (e.g., Creed et al., 2021), there is a need to better understand the ways in which researchers themselves make sense of research commercialization and entrepreneurship.

Existing literature recognizes the three university tasks: research, teaching and the third task of socio-economic development (Clark, 1998 and later Etzkowitz et al., 2000). However, studies merely focus on university level issues, such as goals and strategies, performance and accountability, management and incentives, and culture for collaboration (Creed et al., 2021) in executing the university tasks, while the ways in which individuals facing the two different spheres of academia and business in their work interpret them have remained scarcely studied. Furthermore, it does not matter how well universities are organized to undertake entrepreneurial activities if people working in academia do not adopt it (Paasio, 2022), and therefore, more research

should focus on individual level perceptions and interpretations without neglecting the agency and introspection of scientists engaging in entrepreneurship (Bousfiha, 2020).

In this study, we investigate the narration of natural scientists as they talk about their collaboration with industry and exposure to entrepreneurial and commercial activities in contributing to solve societal challenges and wicked problems while conducting their research endeavours in the frame of collaborative research programme. Work in academia is typically considered quite distinct from the work in business, thus creating ambivalence to those academics who collaborate with industry. Through (immanent) sensemaking (Sandberg & Tsoukas, 2015), the academics can be seen to try to cope with this uncertainty, aiming at “*creating order from confusion*” (Weick, 1995) and “*constructing new meanings*” (Maitlis & Christianson, 2014). In this frame, we explore the sensemaking processes of natural scientists narrating their work in which science and business are (supposed to be) combined in different ways. More specifically, we ask *how natural scientists make sense of research commercialization and entrepreneurship*.

Empirically we draw from a Nordic Centre of Excellence research programme called ‘NordAqua’, which is an arena to link basic and applied research with an attempt to put pieces together in solving challenges related to transition from the linear to circular bioeconomy based on the suitable use of land and water resources in the field of aquatic photoautotrophs (algae and cyanobacteria) in Nordic countries (Allahverdiyeva et al., 2021). In this context, the natural scientists have engaged in a variety of entrepreneurial activities related to algae biotechnologies. By drawing attention to individuals in academia and the stories about their work and collaboration with industry, our study provides new insights on the complex-perceived relation between academia and business. Based on our study we identified four narratives (an academic narrative, a narrative of two contrasting worlds, a narrative of someone else’s cup of tea, and an entrepreneurial narrative) in researchers’ sensemaking processes that all confirm the grand narrative of the tensed-perceived relation between academia and business, concerning particularly commercialization of research findings and entrepreneurship. The entrepreneurial narrative, specifically, contributes to the literature on academic entrepreneurship by offering *an enabling narrative on entrepreneurship* in the academia and bringing new nuances and layers on interpretation of entrepreneurship and related motives from the researchers’ perspective (see Bozeman et al., 2013). Based on our findings we argue that there is a clear need to demystify the phenomenon of entrepreneurship and business among natural scientists to pave way for more impactful research and sustainable innovations as well as more multifaceted academic careers.

Academic entrepreneurship and immanent sensemaking

Academic entrepreneurship as a concept has been used narrowly to refer to a firm that exploits university intellectual property (IP) or patented inventions generated by university research (Di Gregorio & Shane, 2003). Wider conceptualization encompasses also new venture creation by an individual who is a (former) university student or a university student (see Djokovic & Souitaris, 2008) or a company that is based on university-developed knowledge by academics or with an equity participation of the parent university, or both (Bolzani et al., 2021). Furthermore, academic entrepreneurship may imply also firm creation outside formal university IP system by self-employed students and staff, including professionals such as consultants or lawyers (Fini et al., 2010). For non-business scholars, academic entrepreneurship may simply refer to private-sector business in general rather than entrepreneurship *per se* (Heinonen & Hytti, 2007). It is also possible to push the understanding of academic entrepreneurship beyond economic activity, and towards entrepreneurship as social change (Steyaert & Hjorth, 2008), which

further expands the conceptualization to refer to “*all kinds of entrepreneurial activities carried out in academic context, including entrepreneurship education, research commercialization, and the extension of university-industry and university-society relationship more widely*” (Eriksson et al., 2021, p. 1).

Studies have approached academic entrepreneurship from different perspectives – e.g. higher education policy and administration, entrepreneurial universities, student experiences of academic entrepreneurship, and academics becoming entrepreneurs – which together outline the rich landscape of the phenomenon. By exploring how natural scientists make sense of research commercialization and entrepreneurship this study focuses mainly on individual perspectives of academics engaging with businesses and entrepreneurship but touches also upon the student experiences thereof as some NordAqua researchers were in process of pursuing their PhD studies.

Interest in entrepreneurship and research commercialization activities in universities has expanded since academic entrepreneurship is considered as a channel for transformation and empowerment at individual and social levels (Farny et al., 2016). Prior studies have focused on contextual factors, scientists’ motivations and disciplinary effects when attempting to understand who creates academic venture and collaborates with business as well as why and how such takes place (Abramo & D’Angelo, 2021). Furthermore, related barriers, relationships between university and business as well as cultural differences have been highlighted (Rossoni et al., 2023) when exploring why it may be difficult for many academics to relate to entrepreneurship. There are studies on micro-, meso- and macro-level factors explaining academic entrepreneurship (e.g. Muscio & Kitagawa, 2024), but such studies do not capture the ambivalence and tensions of those academics who collaborate with businesses. Entrepreneurship and academia are often positioned as counterpoints and the discourse around academic entrepreneurship becomes easily ideological concealing also movements around everyday practices in universities (Eriksson et al., 2021).

Previous research indeed reveals an existing grand narrative of two contrasting worlds: science and entrepreneurship are typically considered as two separate spheres even though both are recognised critical elements in solving wicked problems. Sensemaking (Weick, 1995) provides a theoretical lens to reach such uncertainty. For instance, in the context of higher education, there are studies that convey many interpretations and multivocality around the theme by illustrating university personnel’s ambiguities related to university’s entrepreneurial transformation (Paasio, 2022) and student’s entrepreneurial experiences at the university (MacNeil et al., 2021).

Sensemaking is a cognitive, dynamic, social, and reciprocal process directed at creating order from confusion and chaos (Weick, 1995). Oftentimes, sensemaking is considered episodic-deliberative (Maitlis & Christianson, 2014; Sandberg & Tsoukas, 2020; Weick, 2010) and is triggered by distinct, episodic interruptions of organizational activities, for which the meaning is ambiguous, or outcomes are uncertain. This view holds that sensemaking aims at achieving a feeling of order, clarity, and rationality, and once that is achieved, sensemaking stops, i.e., sensemaking has distinct starting and ending points (Ala-Laurinaho et. al., 2017.) A prominent portion of sensemaking research concerns various crisis situations, in which sensemaking relates to moments of uncertainty that disrupt and violate existing mental constructs. For example, Weick’s (1990; 1993) work includes crisis management and later, Maitlis and Sonenshein (2010) expanded this approach toward sensemaking in the context of organizational change in general. More recently, attention has been drawn to the temporal orientation of sensemaking,

and in particular, whether sensemaking is understood as episodic in the sense that it is triggered by particular disruptive events (Sandberg & Tsoukas, 2015; Weick, 1995; Weick et al., 2005), or as a continuous, ongoing process (Gephart et al., 2010; Maitlis & Christianson, 2014). Sandberg and Tsoukas (2015) introduced the notion of immanent sensemaking in order to allow for non-episodic ongoing sensemaking. Accordingly, they suggest that sensemaking does not only occur in episodes when ongoing activities have been disrupted but rather, “*is immanent in absorbed coping: It takes place simultaneously with actors’ responses to a situation as it unfolds*” (Sandberg & Tsoukas 2015, p. S25). In this study, we use the sensemaking lens to explore natural scientists’ narration on their academic work and how its relation to business world.

Methodology

This study is positioned within an interpretive research realm, drawing on qualitative methodology. We adopt a social constructionist perspective in which language is at the centre of attention (Berger & Luckmann, 1966). From the social constructionist perspective, the understanding of the world depends on people’s perceptions, connotations, emotions, and motives about the world they live in (Dyson & Brown, 2005), and language is considered essential in the process of knowledge production. Apart from being a means of describing and representing the world, language is also a way of constructing the world and a form of social action (Burr, 2015). Since we are interested in the meaning making and sense making processes related to perceived tensions and differences between academia and business within a selected group of natural scientists, the role of language is essential in this study, and our analysis has a particular focus on narration and descriptions about the study participants’ academic work and collaboration with industry.

Data and data collection

The NordAqua programme was delivered through a consortium of 10 Nordic universities and research institutes along with 10 industrial partners and several societal stakeholders. NordAqua was led by the University of Turku (UTU), Finland and financed by the NordForsk Bioeconomy program (2017–2022). NordAqua draws from algae biotechnologies combined with a circular economy approach, achieved by the integrated removal of water pollutants, and recycling natural resources. NordAqua’s unique approach for sustainable development was to focus on aquatic photosynthetic organisms, which are characterized by fast growth rate and efficient photosynthesis, to convert solar energy and CO₂ into energy-rich chemicals. (Allahverdiyeva et al., 2021). In addition to their research and stakeholder activities, NordAqua scientists were exposed to entrepreneurship and research commercialization via short workshops and discussions run by NordAqua entrepreneurship scholars.

As the leader of the Work package on Entrepreneurship the lead author with a background in business studies and entrepreneurship particularly, has been involved in NordAqua from the very beginning. Her responsibility was to expose the NordAqua scientists to entrepreneurship and to pave way for their commercialization activities and entrepreneurship both of which were included in the NordAqua proposal already at the outset. This included also studying commercialization, entrepreneurship, and industrial collaboration in an interactive research process (Svensson et al., 2007) within the NordAqua community.

As a Work package leader of the NordAqua the lead author participated in partner meetings and related scientific discussions and shared her research findings on commercialization and entrepreneurship with NordAqua scientists. In 2018 partner meeting, an afternoon learning intervention/workshop with lean start-up method was organized to expose the NordAqua

researchers to entrepreneurial problem solving and activities. The discussions were recorded and group exercise materials documented. The lead author also served as a mentor for three junior scholars from NordAqua who were interested in industrial collaboration and entrepreneurship as a part of their career. The summaries of the discussions were documented by the mentees and shared with the mentor to follow-up the developments. Furthermore, NordAqua scientists were offered an opportunity to participate in ‘Entrepreneurship for Research Professionals’ Learning Camp organized by the UTU graduate school for PhD students. Two junior scholars/doctoral students loosely related to NordAqua participated to the one-day Learning Camp (with a follow-up wrap-up session) and provided their learning reflections thereof. All these interventions and activities provided beneficial pre-understanding on the phenomenon studied and were used to form the case of NordAqua and to support the analysis.

Finally, six interviews with eight NordAqua researchers were conducted in fall 2018 – fall 2020 from 5 (out of 10) NordAqua partners in Finland, Sweden and Norway. Four researchers were individually interviewed and in two interviews two researchers working together were interviewed at the same time. The reason for the two interviews taking place in tandem was the possibility to access a larger number of researchers during the NordAqua meetings with extremely tight schedule. The interviewees were from three different universities with varied positions (2 professors, 1 senior researcher, and 2 junior researchers) and from sectoral research institutes (3 senior researchers) (Table 1. for interviewees and learning reflections). The NordAqua research activities ranging from more academic basic research to more applied research were well covered by the selected interviewees and learning reflections.

Table. 1. Interviewees and learning reflections

Interviewee	Position of an interviewee	Organisation	Country
Frank	PhD. senior researcher	University	Sweden
Larry	Professor	University	Norway
Maria and Jasmine	PhD., senior researcher	Research institute/ Foundation	Norway
Mary	PhD. senior researcher	Research institute	Finland
Yrsa	Professor	University	Finland
Anne and John	Junior researchers	University	Finland
Learning reflection			
Alice	PhD student/junior researcher	Research institute	Finland
Leo	PhD student/junior researcher	University	Finland

Each interview lasted about 1–1,5 hours and covered the following themes: research team and one’s role in the team, exposure to commercialization, entrepreneurship, and industrial collaboration as well as future prospects thereof. All interviews were recorded and transcribed. The qualitative interview material was used as primary research data in this paper complemented by the other documented materials providing preunderstanding of the NordAqua programme in terms of commercialization, entrepreneurship, and industrial collaboration. Both authors read all materials carefully and focused on the ways in which the interviewees made difference between science and business in their talk when describing their work.

Data analysis

We found narrative inquiry particularly relevant (cf. Polkinghorne, 2007) because we were interested in the ways in which natural scientists make sense and give meaning to research commercialization and entrepreneurship in the context of their research work – thus, their narration was in the focus. In conducting the analysis, instead of confining ourselves to any particular method, we took inspiration from several methods, ideas and techniques that are used in narrative research. For instance, we organised the data in categories, concepts, and themes (Braun et al., 2017; Thomas, 2006).

In the analysis, we took into account several aspects of the narrative by focusing on the content, structure, and form of the narrative, that is, *what* is being said and *how* it is said (Riessman, 1993; 2008). We were particularly interested in possible tensions and ambiguities when organising and interpreting the research data. Rather soon, we started to distinguish certain patterns in the contents, structures, and forms of the study participants narrations, which then led us to the identification of four narratives illustrating their understanding of entrepreneurship and research commercialization activities.

The analysis was conducted in tandem by both authors: in the beginning, we familiarised with all the data by ourselves and afterwards, shared our perceptions to gain a mutual understanding of the setting. Then, the data were divided in two, and we focused on analysis individually, yet maintaining a dialogue along the way in order to have a consensus on coding and categorising. In the end, the interpretation of the results was a collaborative process, during which we discussed the findings and revisited the data when necessary.

Findings

We were able to identify four narratives depicting how natural scientists make sense of research commercialization and entrepreneurship. Accordingly, *an academic narrative*, presumably a familiar and comfortable account to the study participants, dominated the discussions. A *narrative of two contrasting worlds* has a focus on many differences between academia and business whereas *a narrative of someone else's cup of tea* points out a prevailing understanding of research commercialization not being among the primary duties of an academic. Finally, *an entrepreneurial narrative* expresses the study participants' tentative interest towards business elements and an emerging understanding of their instrumental value. Such opportunity-driven perception of entrepreneurship can be seen as a counternarrative to the prevailing understanding, i.e., the grand narrative of academia and business being separated arenas with tensed relationship. Next, we will discuss the identified narratives more in-depth.

An academic narrative

A tone that emerged naturally and spontaneously among the study participants was named *an academic narrative*. It was effortlessly recognisable and dominant in all discussions. It seems that an academic territory is familiar and safe for the study participants irrespective of their career phase, and during the discussions, it was comfortable for them to be therein: “*I'm doing research for my doctoral dissertation and see myself now as an academic researcher.*” (Leo). A distinct feature in this narrative is “a science talk”, a typical language of a researcher, in which accurate narration is used with detailed descriptions of various processes, procedures, measures, methods, and tools that are necessary in researcher work. It includes also detailed depictions and informative examples of diverse scientific projects. These narrations often

portrayed – perhaps due to a strong life science perspective? – a rather stereotypical picture of research and science.

Sometimes, the scientific content was explained in a more general and commonplace manner, for example, John chooses to depict his work employing relatable concepts of environmental sustainability: *“My research was dedicated to understanding how the biomass produced could have some valuable compounds or some distinguished components that would make it more desired for the aquaculture feed. [---] So, this has some benefits regarding the environment.”* In a similar vein, Frank gives a concrete example of his project: *“So basically, the idea is that we should not see these [algae] as pollutants or as problem for the environment, but we should see it as resources.”*

Another part of the academic narrative includes description of work and processes in a university and research institution, which are considered unique and thus distinct from the work in business. The following narrative of two contrasting worlds will further describe these perceived differences.

A narrative of two contrasting worlds

It seems that natural scientists working in academia or in research institutes consider their scientific work distinct, which differs from the work in business. Indeed, “business” that unfolds as industry work, research commercialization and entrepreneurship in the natural scientists’ narration, is located afar from their everyday – in another world, perhaps? Such positioning came out in accounts that we named *a narrative of two contrasting worlds*, in which the study participants first positioned themselves in the scientific realm and then, from that particular position, explained their low involvement and scant interest in entrepreneurship and research commercialization by highlighting fundamental differences between those two (opposite) arenas. Leo, for example, considered them clearly conflicting for himself: *“I see the conflict in the interests of entrepreneurial and scientific self.”* They talked about different philosophies that underpin science and business as well as the diverse motivations and expectations that drive people working in these fields:

“I started working on algae because I believe that they are really good for the environment.” (Frank)

“It’s a little bit of coincidence that I sort of ended up with things that could be commercialized [---]. So, it’s not a driving force for me. My research is curiosity-based or trying to figure out things or improve things.” (Larry)

“Instead of publish or perish they have patent or perish, maybe.” (Larry)

In this narrative, scientists are seen as searchers of new (innovations and solutions), motivated by inquisitiveness and the thirst for knowledge, whereas business world has a completely different basis and value system. Interestingly, Yrsa acknowledged and even praised the possibility to combine basic and applied research in her work and gain, thus, a more holistic understanding of the phenomenon: *“I have so much of an advantage compared to my previous colleagues who are still completely in fundamental research, and they don’t see what we see...the bigger picture.”* She then tells that although she might sometimes fancy something else than working in academia, it is still more for her: *“Here I am still more comfortable, perhaps it’s again the comfort zone.”*

A further separating element is the language that the study participants use: the glossary of science is considered very different to the one of business. Science talk, though detailed and convincing, is not seen appealing enough, and thus, “*The language should change, to make it simpler and more attractive*” (Anne), and as John was advised: “*Don’t go too much into the science details*” when applying for funding.

A narrative of someone else’s cup of tea

Another perspective – that of an arm’s length – highlighting the separation of research and business worlds points out the challenges of combining these two and the study participants’ preference for the former. We call it *a narrative of someone else’s cup of tea*.

In the discussions, both scientific and business activities were considered not only disconnected but also hard work and time consuming. Therefore, combining these essentially separate parts that even alone are demanding is not an option, but rather, one must choose the preferred focus. The study participants keep further distance from the business world by stating their choice clearly: “*I’d rather focus on science and research.*” (Anne) and “*I think it’s already interesting to be a researcher.*” (Jasmin). Some junior researchers, however, expressed some interest towards industry and business, and found the NordAqua programme convenient to bolster such a desire. Anne, for example, described her current situation in NordAqua in the following way: “[---] *it’s a collaboration of both industry and science partners*”, which she saw as a great opportunity to get to know more about business work and the business world in general.

Scientific work was considered pervasive and time consuming, leaving only little time for other activities, and since the study participants generally preferred science to business, research commercialization was not considered to be their cup of tea. It was thus offered to others, such as Technology Transfer Offices (TTOs) and other integrative actors or units working between academia and business. Working in-between is seen to require certain capacity, for instance specific linguistic abilities: someone that speaks another language as science must be translated in a simple and interesting enough way: “*Since they [TTO] have been working with the industry, they maybe sort of speak their language*”. (Larry)

We also found that entrepreneurship was seen to be better suited for younger scholars who might be eager to learn and gain experiences. A senior researcher claimed having observed such young scholars for whom she believed entrepreneurship was relevant, trendy, and attractive and something their organisation wanted to encourage them to pursue:

“In our organisation young are more interested in... There are Slushes and those science talks, so it seems that the message has been somewhat understood. that one could do also that [start as an entrepreneur].” (Mary)

For Mary entrepreneurship was something worthy of striving for although not for herself and at least not right now, but perhaps at the later phases of her career, just before or when retiring.

An entrepreneurial narrative

During the discussions, the study participants also talked about entrepreneurship and research commercialization. These themes were not spontaneous but deliberate, as the discussion was directed towards these, by asking for instance, in which circumstances entrepreneurship would become an option for the study participants. We noticed in these “forced” accounts that we call “*an entrepreneurial narrative*” a twofold perspective that challenges the grand narrative of

academia and business world being contradictory and apart from each other: a tentative interest towards business elements and an emerging understanding of their instrumental value.

In this narrative, entrepreneurship was considered an opportunity, and Mary, for example, despite of her personal characteristics and hesitation, saw some opportunities in entrepreneurship even for herself in case she would no need to worry about her finances:

“Well, it could be interesting, but I do not know if I can, I am not that a kind of a person... but perhaps as a bridge towards retirement, like the last five years or something, to do something totally different, if I would not have any loans anymore and could just cope with less income, so that it would not imply any risk, that I can consider... I could then also transfer my competences to something...” (Mary)

The study participants also referred to other preconditions and less risky situations when they could consider starting up a business. Such circumstances included for example an excellent idea and a trustworthy team to secure a profitable business and a possibility to gain a decent living without a need to make any sacrifices:

“...if I have a trustworthy person next to me who has more knowledge in those kinds of things, and we put our knowledge together and backup each other. In that case it's ok but in others, I'm not brave enough to start from zero.” (Yrsa)

In addition to the study participants' tentative interest toward business elements the entrepreneurial narrative addressed an emerging understanding of their instrumental value. First, it is considered important for a scientist to understand the basics of business particularly in the context of research and science interface. Second, it is assumed that without commercialization activities research inventions remain hidden in academia and do not make a desired impact in the society, as Alice concluded “...entrepreneurship could be in some cases the only way for me to bring some planet saving idea to the market.” For her, entrepreneurship is not a matter of career choice but a means to “do real actions that could save our planet” by creating new technologies or implementing them in practice. She acknowledges the limited resources and career perspectives in academia and pragmatically considers entrepreneurship as an alternative. Similarly, the limited university resources push the research participants to collaborate with businesses in order to upscale their inventions. Larry claims “...but you don't get there without the industry” and continues that scaling up needs financial resources, infrastructure and volumes and is, thus, impossible for a university to do by itself. Eventually, business collaboration is needed also for fund raising purposes in order to be able to conduct any research at all:

“There's no university in Scandinavia that can do complete drug development, they don't have the budget for that. So, we can do the early parts, but then we need to sell ourselves to the industry, in a way, to complete the drug development processes.” (Larry)

Furthermore, the participants explain that many financiers demand researchers to collaborate with business to secure the dissemination of research findings and to intensify knowledge transfer during research projects. Accordingly, the entrepreneurial narrative seems to have a very pragmatic stance with a clear instrumental value. Perhaps it is not possible at all to conduct such research without business collaboration. In their talk the identified instrumental value interestingly reaches beyond oneself, academia, and business by highlighting the importance of saving the planet in which entrepreneurship is considered to have a role to play.

As demonstrated above, each narrative sheds light into the phenomenon from a different perspective, yet they are partially overlapping. Together, these narratives expose the study participants' sensemaking processes and add to our understanding of how natural scientists interpret an expanding demand to engage with research commercialization activities and collaboration with industry. In addition, the detected narratives illustrate their interpretations of both science and business and draw attention to their tensed-perceived relation, and finally, even challenges such perception. Furthermore, the number of narratives indicates that the understanding related to entrepreneurship and research commercialization is not univocal among natural scientists but instead, there are different, simultaneously existing conceptions.

Discussion and conclusions

This study was set to investigate *how natural scientists make sense of research commercialization and entrepreneurship*. Theoretically we build on academic entrepreneurship and immanent sensemaking and empirically draw from a NordAqua Nordic Centre of Excellent research programme which links basic and applied research in the field of aquatic photoautotrophs in solving challenges related to transition from the linear to circular bioeconomy.

Our study demonstrates that entrepreneurship and research commercialization are mainly *absent themes* or a *non-issue* among natural scientists. These were seldom mentioned spontaneously, and the study participants distanced themselves from these. According to them, there were (too) many differences between academia and business life to combine them conveniently and research commercialization is (hopefully) someone else's job. Three out of the four identified narratives confirm and repeat the grand narrative of the tensed-perceived relations between academic and business systems and ethos (e.g., Merton, 1973; Stankiewicz, 1986) but also of the related opportunities (e.g., Creed et al., 2021).

The fourth narrative has a different perspective: it challenges the grand narrative by seeing the reality in a more multifaceted way. Consequently, the entrepreneurial narrative provides fresh insights that take into account diverse individual nuances, motives and contexts in a way suggested by Bozeman and others (2013), for example. In the "forced" discussions when specifically asked or otherwise directed the discussion towards entrepreneurship and research commercialization we were able to identify sub-narratives that demonstrate first, a tentative interest towards business elements under certain circumstances and pre-requisites and second, an understanding of their instrumental value. These sub-narratives make it possible and even useful for scientists to engage with entrepreneurship although they may take a remote stance to the phenomenon to start with.

Our study contributes, thus, to the literature on academic entrepreneurship by offering *an enabling narrative on entrepreneurship* in the academia. The study further contributes by *providing a researcher-centered account with diverse motives on entrepreneurship and research commercialization* which are scarce in existing literature (Bozeman et al., 2013). An entrepreneurial narrative of this study is yet another alternative narrative on entrepreneurship and start-up world complementing the narratives found in previous studies: namely start-up entrepreneurship as credibility (Moilanen et al., 2021), celebration of success (Katila et al., 2019) or rebellion (Koskinen, 2020) for example. Similar to Moilanen and others' narrative (2021), our entrepreneurial narrative constructs entrepreneurs as non-heroic actors who struggle with the expectations of becoming more business savvy.

Furthermore, our findings on the instrumental value of entrepreneurship in saving the planet highlights the understanding of entrepreneurship “as a positive economic activity” and “as social change” as suggested by Steyaert and Hjorth (2008; Hjorth & Steyaert, 2021). Entrepreneurship is not solely economic activity but extends beyond it even to building new futures and “saving the planet”. Steyaert and Hjorth (2008) refer to collective mobilisation as a way to connect academic research with societal challenges. Although our study focusses merely on individual perspective of natural scientists on making a difference through entrepreneurship, the very notion of connecting resources of academia and business for a greater purpose of solving wicked problems such as climate change and building new futures, provides fresh insights to the literature on academic entrepreneurship, particularly in the context of natural sciences and bioeconomy.

Our study has clear implications for university educators and researchers as well as policy makers. It is important to increase interaction and communication between natural sciences and entrepreneurship in order to promote academic entrepreneurship and research commercialization. Such collaboration should be considered as a natural element in modern university research and education to secure knowledge transfer from university to business and to improve impact of research in the society. Entrepreneurship and business aspects should be embedded in programmes aiming to basic and applied knowledge creation and innovation by natural scientists, such as NordAqua, to demystify the phenomenon of entrepreneurship and business. This is important in paving ways for new more impactful research and sustainable innovations as well as more multifaceted academic careers.

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THE LEARNING OUTCOMES OF AN ENTREPRENEURSHIP EDUCATION PRACTICE

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Abstract

Entrepreneurship education (EE) is an expanding field in higher education globally, employing diverse practices to produce various learning outcomes. These outcomes, intentional or not, are crucial for assessing the effectiveness of EE and guiding improvements in higher education. This paper explores the learning outcomes pursued in EE, focusing on cognitive, psychomotor, and affective domains as defined by the tripartite model of learning. Studies show that learning outcomes are interrelated and significantly influenced by the teaching approach, with practical, experience-based pedagogies yielding stronger entrepreneurial learning outcomes. Different types of EE courses lead to varied learning outcomes based on the students' initial entrepreneurial intentions and motivation. This paper is based on an ethnographic case study of an intensive international EE program. It reveals the different learning outcomes of university students, contributing to the understanding of EE's impact. This research offers insights for planning and evaluating EE practices in higher education.

Introduction

Entrepreneurship education (EE) continues to be a growing part of higher education studies globally, and it is implemented with different practices. These EE practices produce learning outcomes, whether intended or unintended. Learning outcomes should be measured to assess the effectiveness of education and guide the improvement of EE in higher education.

In this paper, I examine what kind of learning outcomes are pursued in one entrepreneurship education practice. Here, practice is defined as the enactment of the activities and interactions that constitutes entrepreneurship (Neck & Corbett, 2018). I use the term learning outcomes to define what the students actually learned. My research question is simple: What kind of learning outcomes of the tripartite models of learning are students expressing during entrepreneurship education practice?

Entrepreneurship education has gained increasing importance in higher education. This significance arises not only from its possible role in the venture creation process but also from the recognition of its value in fostering a broader range of entrepreneurial skills. The broad view of entrepreneurship education concentrates on education that equips students with entrepreneurial competencies applicable beyond business contexts, fostering a general entrepreneurial mindset. (Lackéus, 2015.) These competencies are beneficial for the employability of students (for example Cascavilla et al. 2022). Blenker and others (2011) described four different paradigms of EE: educating student to create new ventures; educating student to transform ideas and knowledge into initiatives that will create economic growth; facilitating entrepreneurial energy for social change and facilitating an entrepreneurial mindset in everyday practice.

There are some previous studies about learning outcomes in entrepreneurship education. Nabi and others (2017) made a significant systematic literature review of the impact of entrepreneurship in higher education and searched for the outcomes of entrepreneurship education. They used a teaching model framework to analyse the different outcomes and created seven different types of outcomes: attitudes and emotions, skills and knowledge, feasibility, intention, business

start-up, performance, and socio-economic impact and other, which included for example satisfaction and attitudes towards the entrepreneurship education programme. Wong and Chan (2022) classified the learning outcomes of entrepreneurship education programs to three different groups: learning outcomes a) affecting the institution, b) affecting the person and c) affecting the society.

Decker-Lange and others (2022) argue that even though universities have made quite significant investments in entrepreneurship programs, “the scope, relevance and usefulness of entrepreneurship education are still questioned”. As Jones and Iredale (2010) addressed already in 2010, a fundamental question still is how we can measure the value of entrepreneurship education when it is seen broadly. What can students gain from entrepreneurship education practices in higher education? Research suggests that the impact of entrepreneurship education programs on attitudes as well as on behaviour is equivocal, as studies suggest both positive and negative outcomes (Nabi et al., 2017, p. 278).

In my research I did an ethnographic case study during one-week intensive international entrepreneurship education practice with four students at university of applied science in February 2024. I collected the data by observing and discussing with the students and reflecting their written texts during and immediately after the practice. This study contributes to a better understanding of learning outcomes which are an important part of the entrepreneurship education practices. Yet, this area is under researched. As a key result I will find out what kind of learning outcomes are expressed during and immediately after the chosen entrepreneurship education practice. My pilot study is not just targeting on finding out the learning outcomes but to develop further the methodological approach for studying learning outcomes with ethnographic methods. The findings of this study can be useful at practical level when planning and evaluating different entrepreneurship education practices in higher education. The more careful interest on learning outcomes of can bring us closer to the attractiveness and meaningfulness of entrepreneurship education and though lead us to improved practices.

This paper illustrates the understanding of learning outcomes and their examination in entrepreneurship education. Initially, I will introduce the theoretical framework, focusing on the key concepts of learning outcomes and how they have been examined in the field of entrepreneurship education. The methodological section will follow, detailing the principles of this study. Following that, I will delve into the results, noting that the field of learning outcomes is versatile. As a key result I show how different learning outcomes were seen in this entrepreneurship education practice. The paper concludes these findings, and potential directions for future research. The aim of this paper is to provide empirical evidence of the learning outcomes developed in the analysed entrepreneurship education practice. Study’s exploratory nature and small sample size does not enable transferable conclusions to be drawn. However, the paper provides valuable insight into the experience of a small number of students and provides guidance for future research in this area.

Learning outcomes

Learning outcomes can be defined in various ways. They may either express what students are expected to achieve in their learning (Kennedy et al., 2007) or describe what learners can do, know or feel at the conclusion of EE practice, which actually might be a different thing than what teachers intended to teach (Allan, 1996). The components in the teaching system, including the used teaching methods and the assessment, must be aligned to the learning activities assumed in the intended outcomes (Biggs, 2003). Hadjianastasis (2017) found out in his study

of HEI teachers in UK, that this is often not the case and that by learning outcomes teachers of HEI mostly meant a syllabus.

Learning theories (Bloom, 1956) separate affective learning from cognitive and psychomotor/skill-based learning. Cognitive outcomes are split into conceptual knowledge and technical skills. Cognitive outcomes can be defined as knowledge, skills, competencies, personal attributes and abilities. Cognition refers to a class of variables related to the quantity and type of knowledge and the relationships among knowledge elements. (Kraiger et al., 1993.)

Skill-based learning outcomes are skills related to the entrepreneurial process. They are the acquisition of practical skills that are required to complete specific tasks of entrepreneurship, for example create your business model or do the pitch for investors. These previous examples were connected to business aspects of entrepreneurship, and it is a bit more challenging to find the skill-based learning outcomes when we talk about entrepreneurship as a broad skill. Gibb (2002) describes the entrepreneurial behaviours and skills to include seeking opportunities, taking initiatives/acting independently, solving problems creatively, making things happen, dealing with uncertainty, flexibly responding, negotiating a deal successfully, taking decisions, presenting confidently and managing interdependence successfully. These entrepreneurial skills are well suitable also for entrepreneurship when it is defined broadly.

Affective learning is connected to attitudes, behaviours and values and involves the learner emotionally (Shephard, 2008). The affective domain includes a range of outcomes, such as motivation, self-esteem, enjoyment of self-efficacy. Attitudinal outcomes are related to inner growth, self-awareness and changing values and motivational outcomes to goal setting, disposition, and self-efficacy. (Kraiger et al., 1993.) Another model groups affective learning outcomes into motivation, emotional responses, self-concept, and resilience (Tereoka et al., 2021). The integration of affective outcomes is crucial as they deeply influence both the learning process and the entrepreneurial spirit. There is complexity in affective learning outcomes, as some negative affects can lead to positive learning outcomes (Chik et al., 2024).

It is good to notice that even when following some kind of typology, the learning outcomes are not discrete but interrelated and changes in one learning outcome may imply changes in another (Kraiger et al., 1993). Changes in cognitive outcomes could for instance co-occur with changes in affective outcomes (Núñez Castella et al., 2014). Affects play an important role in mediating and transforming knowledge into actions and our behaviour is influenced by multiple affective, as well as cognitive, factors (Chik et al., 2024).

The tripartite models of learning have been used in some studies concerning the learning outcomes of entrepreneurship education. Mets and others (2017) and Kozlinska and others (2020) measured the learning outcomes of entrepreneurship education using a tripartite framework, which includes cognitive, affective, and skill-based learning outcomes. They discovered that all these different learning outcomes are significantly intercorrelated. Mets and others (2017) defined affective outcomes to be entrepreneurship-related attitudes, volition and behavioural preferences. Kozlinska and her colleagues (2020) were not yet able to determine whether practices should begin with affective or cognitive components. On the other hand, Ilonen and Heinonen (2018) emphasized that cognitive learning outcomes provide the foundation for achieving affective learning outcomes – and that it's easier to reflect on your own relationship with the learning subject when you know what it is all about.

The manner in which entrepreneurship is taught does matter concerning the impact produced by entrepreneurship education (Cascavilla et al., 2022). Entrepreneurial learning outcomes are stronger when a practice-oriented entrepreneurial teaching pedagogy is used and entrepreneurship education teaching process needs to have practical experience in it, either during prior entrepreneurial efforts or through practical-oriented entrepreneurship education activities (Hahn et al., 2017). Schultz (2022) study two different types of entrepreneurship education courses: Business plan course (supply-demand model) and Lean Startup Camp (competence model) and found out that students gain very different learning outcomes depending on the course's type. Business plan course increased the interest in general entrepreneurial activity of students with initially low entrepreneurial intention. Lean Startup Camp, on the other hand, attracts students who are already highly motivated and is effective in fostering their startup projects. (Schultz, 2022.) The study of Ilonen and Heinonen (2018) revealed various affective learning outcomes of university students in an entrepreneurship education course.

Methodology

To answer the research question, a qualitative approach was chosen primarily in order to generate a rich and detailed picture about students' experiences and learning outcomes. This study employs an ethnographic case study approach, focusing on data collected over a one-week intensive international entrepreneurship education practice. This practice was meant for higher education students across all disciplines who were interested in entrepreneurship, cybersecurity and/or sustainability. Entrepreneurship was the wide theme whereas the cybersecurity and sustainability were the subthemes. The objective of this practice was to be an immersive, fun week of activities to foster students' entrepreneurial skills and give them the opportunity to meet fellow students from 10 different universities. The practice included teambuilding exercises, hackathons, and other activities to encourage student's entrepreneurial mindset and skillset along with cultural, health and social activities.

Most sessions began with a lecture or some other form of knowledge-based information about the subject. After these short introductions, students worked in groups to form ideas, solve problems, and make presentations. The objective was to apply the acquired knowledge in practice as soon as possible after the lecture. Due to the short timeframe, the projects were still in their very early stages, and broader customer-based research was not feasible. Consequently, the ideas were somewhat dry and stilted, despite the emphasis on problem-based learning and student-centeredness throughout the process. The results of the hackathon were also presented to a group of business life mentors and local entrepreneurs at the end of the second day. Additionally, the practice included some very creative exercises, such as building your own entrepreneurial leadership mindset using a set of Legos.

The intensive one-week international entrepreneurship education practice was held in February 2024 and the higher education students formed multinational teams. The students came from ten different nations of Europe, but my study focus was just with the four students from Finland. Target group students were all from different areas of Finland and all from different fields, from health care to engineering and students at same university of applied science, but from different campuses. The students hadn't met before and neither had I met them before their recruitment. Age of students varied from 22 to 33. Only one of the students was male and he was the youngest one. Three females formed a strong group and spent their free time together even though all the group work was done in different separated groups. The male was more active with international students and formed new friendships with several group members.

My official role was to be a “mentor” for these four students that formed my target subject. After arriving, we got information that the mentors from each participant country were not allowed to help the students with their tasks. We could only help them with practicalities and give them courage in different phases of the week. For me this gave a good opportunity to implement the observation. All my students were in different groups, so I observed only these four groups during the study week.

The data comprises observations and discussions with these students. I collected information by observing and engaging in discussions with the students, as well as analysing their written and discussed feedback both during and immediately after the practice. The primary focus of this research is on the students' perceived learning outcomes. I feel that the results would be very different if I had not been part of the week and would just interview the students after the practice. Now I was able to be with the students and “see” their learning and feelings during the process.

The method for assessing the students' learning outcomes involved aligning theoretical frameworks with collected data. Beginning with a theoretical foundation, I structured the data collection according to categories derived from this theoretical background. Utilizing a tripartite model, the learning outcomes were classified into cognitive, skill-based, and affective categories (e.g., Mets et al., 2017). These categories of learning outcomes then served as the basis for organizing the collected data. All the material was in Finnish, so first it was translated into English. Then the data was analysed to these three themes. Next, I will present the results of this ethnographical case study.

Results

Cognitive learning outcomes

First, I start with the cognitive outcome, which includes the knowledge obtained about entrepreneurship. These types of learning outcomes are the easiest to identify through testing and traditional exams. Since these methods were not used in the assessment of this practice or research, they were evaluated during the observation process. The practice included short lectures and knowledge-based sessions about business modelling and business plans using the business model canvas. These sessions covered the development and innovation of new products and services, opportunity recognition, and, to a small extent, the evaluation of business opportunities. Due to the short timeframe, many aspects of entrepreneurship such as financing, marketing, or legal issues were not covered at all. The main focus was on the early stages of the entrepreneurship and innovation process. The themes of the practice were entrepreneurship, cybersecurity and sustainability. For students these lectures in auditorium were quite familiar type of teaching, but some of them weren't big fans of that.

“Knowledge has certainly increased, but nothing specific comes to mind.” (N1)

In this case, the cognitive learning outcomes didn't achieve very much attention from the students, which is somehow surprising. Perhaps this is due to the entrepreneurial learning process of this practice. Even though there were lectures, they were quite short, and more emphasis was always given to the practical part of learning. Higher education has traditionally focused more on the cognitive domain of learning (Shephard, 2008), but here the focus was more on problem solving and group works. This might also be different from their day-to-day studies. The students describe this as followed:

“The trainings didn’t leave much of an impression. Not much new came up, well a little did, but the most important were language skills and teamwork. But I have learned problem-solving skills.” (N2)

The Business Model Canvas was not a familiar tool to anyone beforehand, but only two mentioned it while analysing their own experiences. Otherwise, the methods used were seen interesting, but the students didn’t reflect them as part of their learning.

“The Business Model Canvas and other methods used to develop the hackathon's business idea were productive and fast ways to generate ideas.” (N4)

The students also expressed the process of going deeper in their learning process and not to just follow the given instructions.

“Business model canvas was quite educational, as you got to write on the sheet, ideas kept coming and things started clicking into place the further we went. And at some point, the vision became so clear that we no longer followed the instructions but began to explore the idea more deeply.” (N2)

The theme of cybersecurity was new for all of the students and for that reason it had some mentions as obtained knowledge. For most of the students the theme of cybersecurity was clearly separated from the theme of entrepreneurship in their minds, but there was one student who combined it to entrepreneurship.

“The cybersecurity theme delved into entirely new subjects for me and served as a reminder of how cybersecurity must be considered in my own activities (in entrepreneurship).” (N4)

Skill-based learning outcomes

Skill-based outcomes include skills related to the entrepreneurial process. It is the acquisition of practical skills that are required to complete specific tasks of entrepreneurship – in this case for example Business Model Canvas or other creative problem-solving exercises. The first two days of the process a hackathon was carried out. This was a new model of learning for all four students of mine.

“The hackathon was a very nice model overall and I could use it myself in the future when I want to quickly brainstorm some idea - thinking very broadly about things when given instructions to think about it from different sides and filling out different sheets. If you were to start your own project or business, you could think a little about the foundation for it in that way.” (N4)

The students conducted an early-stage innovation process, so the more concrete business-related skills of for example marketing and managing risks were not presented here. Only very few reflections of learning were expressed for example from pitching one student put it in words accordingly:

“I also have to present my work and justify my decisions in my studies and job, so I can take inspiration and example from XX’s presentation skills. A good sales pitch is very important.” (N4)

Right away at the beginning of the week students had to develop a new product or a service and to evaluate the pros and cons of their ideas. The working time was quite short as it was to be presented the very next day.

“Our team wasn’t really getting anything from outside the field into the idea because the ‘leader’ is from the same field as the idea. The idea isn’t really new, but the presenter was excellent, had marketing skills and managed to elevate the basic idea to a higher level and we won the prize.” (N4)

Because of the international teams where students came from different fields, the teamwork skills gathered extra attention also from students when the learning outcomes were considered.

“The biggest learning from the process relates to my group mates - although they were very different from me, in some traits the exact opposites, cooperation with them succeeded.” (N4)

Successful teamwork was also a big spirit lifter during the long and intensive days. Higher education students in Finland are quite used to do teamwork, and they want to encourage everyone to participate and be good team participants.

“Teamwork skills developed because there were many group activities. In the group, everyone gets their turn, and we encourage each other with a good spirit. Managed to bond with them and learn about their culture.” (N1)

All participants were not used to do teamwork with people coming from different cultures and before the event started, they expressed some concerns about this. However, when the teamwork started, the differences vanished, and the process started to roll forward.

“Everyone was quite similar regardless of the country; there were many things in common with them. A lot was learned from group work, understanding the importance of cultures in teamwork, and getting to work with different kinds of people - many different paths on how to do the same task.” (N2)

Teamwork didn’t advance without challenges. The participants had to individually resolve conflicts and to try to find the balance among people from different cultures. They felt that it was important to build up networks and keep good relations inside the team.

“There are stronger personalities in the group who tend to take on the leader’s role, but the group has firmly stated that this is teamwork and not one person can make decisions, things went well after that.” (N3)

Some of the participants took stronger roles in their teams during the process and started to lead their teams, when they were stuck with their ideation process.

“At some point the group work didn’t really progress, there were some problems with it. And I had to move the group forward when we were just stuck planning.” (N1)

It can be sometimes challenging to work with others who are different. Still, everyone needs to be a valuable team member and work across the teams.

“People take on different roles in groups, there's a clear leader role in the group and others somewhat watch from the sidelines, but everyone participates equally.” (N4)

During the hackathon of the first two days students worked in same groups. After that, the groups changed every day. This gave the students a good opportunity to evaluate the role of their own as well as others in teams.

“Every time the group changes, the group dynamics change too, sometimes you're a wall-flower, and sometimes the leader. And even if you start off quiet, then when one leaves and things change, you might become the leader.” (N1)

Other entrepreneurial skills that were encouraged in this process were dealing with uncertainty and the skill to adapt quickly to new and uncertain situations. The entrepreneurial process and structure of the process was also different of what the students were used to, and it encouraged certain type of action as a learning outcome.

“The whole concept was unfamiliar so that it became familiar. Now one could start building this model for different things, to see if there's a problem, there would be a different approach. Here you start building the process differently than you're used to. This being so intense, some really crazy ideas might come up, and that might work.” (N3)

This entrepreneurship education practice empathized practical approach and came closer to the idea of “learning-by-doing”. This was a good experience at least for one of the students who had difficulties to follow the lectures. He expressed his thoughts as followed:

“I didn't listen at all during the lecture, but once we started working in the group, the thoughts started flowing. Damn good that you got to do it yourself, you really learned and got the gist of it. The first time you saw the tasks, it was like, what the heck, but when you started doing, it took off from there.” (N2)

The students express many elements of skill-based learning and some of them also expressed the will to use what they had learned in the future. These practical abilities are directly applicable to real world tasks and one student also expressed the desire to use the learned skills when doing the real-life business ideation as an entrepreneur.

“The Business Model Canvas and other methods used to develop the hackathon's business idea were productive and fast ways to generate ideas. I will definitely use these methods in the future when I need to innovate something new. Out of sheer interest, it would be really fun to organize even a small-scale hackathon related to my field and develop a business idea for my field with students from different disciplines and countries. What all could come out of it...” (N4)

Affective learning outcomes

Affective learning outcomes are related to attitudes and values, motivation, self-concept, emotional responses and engagement. Here the focus was not on the business entrepreneurship, so the student intentions to become entrepreneurs was not the intended or perceived learning outcome. I will not go through the entrepreneurship as business related attitudes or behavioral preferences here, but I will concentrate on the broad type of entrepreneurial affective learning outcomes which were found.

The independence or autonomy of students increased during the week. Still the tolerance for uncertainty was quite weak and it did not improve so much over the week – the feedback emphasized the desire for clearer schedules, instructions and programs. But on the other hand, there was more uncertainty at the beginning about *"what this will turn into and whether others will understand, if I have to perform."* (N1)

Social confidence was one issue that raised from the action and comments of students. At first it was quite exciting and nerve breaking to start to work with new people from different countries. The organizer of the event had taken this into consideration, and the first tasks were about team building and relaxing with the Marshmallow challenge. During the week most of this initial awkwardness disappeared, even though some feelings of isolation remained.

"People are united by a common experience regardless of where they are from and their backgrounds – on the other hand, as a student of my field, I didn't feel part of the other students' group, I didn't have much to contribute." (N1)

The motivation of all the students were quite high from the beginning and it didn't collapse, even though there were some natural variations during the intensive week. There was clear determination to meet the objectives, and to succeed in the competition. When the semifinals of the hackathon were revealed, the levels of ambition and drive increased. But some understood, that with this entrepreneurial process, it is not about the outcome, but the process.

"Since there is also experience from working life, understood that this group work is not so serious, that the most important thing is not the outcome, but the process, where teamwork is encouraged. Focused on the skills on how to work in a group. Learned to take it more relaxed and did not start stressing about what if we don't finish this. Accepted that it will turn out however it turns out." (N3)

Self-belief and self-esteem were also issues that were raised concerning affective learning outcomes. During the practice, the students started to find their own place in the process and to accept more the differences between people from different background and also changed their own behaviour accordingly.

"This practice broadened my worldview, there are all sorts of different opinions and reasons why people do what they do, I tried to understand that." (N2)

The students do not express very strong tolerance to failure. Many times, they wanted "to play it safe" and chose the ordinary and not so innovative idea. Even though the organizers and mentors were trying to offer safe and supportive learning environment, the students took more pressure from outside assessors as well as fellow students. Some students noticed and expressed their doubts about their performance and idea during the process and were then surprised when the idea was rewarded.

"Maybe I should have thought like XX, and trust that doing things properly will carry us far. From now on, I will try to remember the importance of confidence and attitude in both my own projects and in group work." (N4)

With this kind of data collection, it is not possible to assess if the students increased passion for entrepreneurship or how much their entrepreneurial self-efficacy was developed. However, it

is possible to conclude that the entrepreneurial self-efficacy of some students increased and that after this one-week entrepreneurship education practice the students expressed and showed increased self-esteem and brighter view of their future, as this last quotation shows:

“Learned about oneself that one can survive and succeed out there in the world.” (N2)

Discussion and conclusion

Learning outcomes in higher education in the context of entrepreneurship education can be represented through a tripartite framework that integrates cognitive, skill-based, and affective domains. These outcomes are not isolated but interrelated, affecting one another dynamically. The research reveals that while cognitive outcomes provide foundational knowledge, skill-based and affective outcomes play a crucial role in transforming this knowledge into practical actions. This interaction suggests that a balance of cognitive, affective, and skill-based learning is essential for holistic educational experiences.

Studies have highlighted the importance of practical, experience-based learning approaches that resonate more profoundly with students, fostering both skill acquisition and affective engagement. The study of Tereoka and his colleagues (2021) reveals that programs that adopted a student-centred approach were effective at enhancing emotional responses among students. The findings of my research underscore the effectiveness of practice-oriented pedagogies where entrepreneurial skills are enhanced through real-world application.

The challenge remains to create educational environments that equally prioritize and effectively integrate these three learning domains, ensuring that students are not only knowledgeable and skilled but also motivated and adaptable to the complexities of the entrepreneurial landscape. This balanced approach is vital for preparing students to meet the demands of modern economies and personal development.

This study is devoted to the assessment of the outcomes of entrepreneurship education practice, but the data is gathered only from one example with a small number of respondents and though it cannot be generalized. There is a need for large-scale research regarding the learning outcomes of students in entrepreneurship education, which is required to develop transferable findings. The learning outcomes need more research in order to clarify that our practices effectively equip students with the critical skills, knowledge, and attitudes necessary for successful entrepreneurship – in its broad meaning. The evaluation of learning outcomes helps practitioners refine teaching methods to better align with the needs and foster innovation and creativity among students. Additionally, understanding these outcomes can guide the integration of cognitive, skill-based and affective learning aspects, enhancing students' overall educational experience and preparedness for real-world challenges.

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DEVELOPING HOLISTIC EDUCATIONAL PROGRAM FOR SOFTWARE ENTREPRENEURS: COMPREHENSIVE APPROACH TO PEOPLE, BUSINESS, DOMAIN, AND TECHNOLOGY SKILLS

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Abstract

This paper discusses and proposes an educational program designed to equip software entrepreneurs with a comprehensive skill set, addressing the rapidly evolving needs of the technology landscape. It emphasizes the integration of technical, business, people, and domain skills essential for navigating industry complexities and driving innovation. The theoretical framework combines systems thinking, experiential learning, constructivism, entrepreneurial ecosystem theory, innovation and design thinking, agile and lean principles, social cognitive theory, human-centred leadership, lifelong learning, and the Triple Helix model. The methodology employs interviews, surveys, and comparative analysis to tailor curriculum design effectively. Preliminary findings highlight a significant demand for this integrative educational approach, aimed at addressing prevalent skill gaps. We present a robust and actionable blueprint for educational institutions, policymakers, and industry stakeholders committed to fostering the next generation of software entrepreneurs.

Introduction

In today's fast-evolving digital age, the landscape of technology continuously reshapes the ways in which businesses operate and innovate. The exponential growth of technologies such as artificial intelligence, machine learning, and cloud computing has not only spurred new industries but has fundamentally altered existing ones. As these technologies advance, the need for adept software entrepreneurs who can navigate this complex and dynamic terrain becomes increasingly critical.

However, traditional educational programs often fall short of addressing the multifaceted needs of aspiring entrepreneurs in the software industry. These programs typically emphasize technical proficiency and theoretical knowledge while neglecting the equally essential business, people, and domain-specific skills that are crucial for entrepreneurial success. As a result, there is a noticeable gap between the capabilities of graduates and the expectations of the modern digital marketplace. For instance, a recent study (Joseph et al., 2023) indicates that the tech startups often feel adequately equipped in technical capabilities, but many do not possess the requisite business acumen and interpersonal skills necessary for long-term success.

This paper aims to outline a comprehensive educational program designed to bridge these gaps by nurturing a holistic skill set in software entrepreneurs. By delving into the four key pillars—People, Business, Domain, and Technology skills, see Figure 1—the proposed program intends to foster a generation of leaders who are not only technically proficient but also adept in strategic decision-making, effective communication, and industry-specific insights. Such a holistic approach is critical as it equips aspiring entrepreneurs with the competencies essential for thriving in a highly competitive and ever-changing business environment.



People Skills

Communication, leadership, team management.



Business Skills

Strategic thinking, financial acumen, market analysis.



Technology Skills

Coding, system design, emerging technologies.



Domain Skills

Industry-specific knowledge, regulatory understanding.

Figure 1: The Four Key Pillars

Through an integrative curriculum that emphasizes both experiential learning and theoretical study, the proposed program seeks to create a robust educational framework that supports the development of well-rounded software entrepreneurs. By addressing the significance of cultivating diverse skills and tailoring educational efforts to meet the complex demands of the software industry, this initiative aims to empower the next generation of entrepreneurs, enabling them to drive innovation and lead with confidence in the global digital economy. The program has been started and is in use at one ICT consulting company in Tampere area and as the program proceeds, we get valuable feedback to tune the program with the lessons identified and learned.

Theoretical framing

The theoretical foundation of the proposed educational program for software entrepreneurs is constructed upon a carefully selected amalgamation of educational and business management theories combined with years of experience in the software industry. This integration ensures a holistic development approach, fostering not only technical prowess but also entrepreneurial acumen and leadership qualities.

Systems Thinking: At the core of our educational framework is systems thinking, a paradigm that promotes an understanding of a system by examining the linkages and interactions between the components that comprise the entirety of that system (Arnold & Wade, 2015). In the context of software entrepreneurship, systems thinking aids in comprehending the complexities of starting and running a technology-driven business (Meadows, 2008). This approach enables entrepreneurs to see both the high-level overview and the interrelated effects of decisions and innovations on various parts of their business and the broader technology ecosystem.

Experiential Learning: To bridge the gap between theoretical knowledge and real-world application, the curriculum emphasizes experiential learning. This pedagogical approach involves methods like case-based teaching, simulations, and real-world projects that mimic the unpredictability and dynamism of the software industry (Kolb, 2014). By engaging in hands-on activities, students can acquire practical skills and learn from direct experience, enhancing their ability to adapt and innovate in live business scenarios.

Constructivism: This theory suggests that learners construct knowledge through experiences and reflections. The program encourages an active learning environment where students are not just passive recipients of information but are engaged in creating their understanding through critical thinking and problem-solving. This methodology is particularly effective in entrepreneurship education, where scenarios are often unique and require a deep, personal engagement with content.

Entrepreneurial Ecosystem Theory: Understanding the role of supportive environments in nurturing entrepreneurship leads us to incorporate the entrepreneurial ecosystem theory (Isenberg, 2010). This framework will be used to examine how different elements such as local economic conditions, availability of capital, access to mentors, and a network of peers influence entrepreneurial success. Our program aims to simulate such an ecosystem through its curriculum and partnerships, providing students with a supportive network from academia, industry, and government.

Innovation and Design Thinking: To cultivate creativity and problem-solving capabilities, the program integrates innovation and design thinking principles (Brown, 2009). This approach encourages students to think outside the box and develop solutions that are deeply empathetic to user needs. Through iterative prototyping and user feedback, entrepreneurs can learn to fine-tune products and services in alignment with market demands.

Agile and Lean Principles: The adoption of Agile and Lean methodologies teaches adaptability and efficiency, critical traits for any entrepreneur in the fast-paced tech sector (Poppendieck & Poppendieck, 2003). These principles emphasize the importance of an iterative process and responsive planning, which are crucial for quickly pivoting in response to market feedback or changes in the business environment.

Social Cognitive Theory: This educational theory underscores the importance of observational learning, social interactions, and cognitive processes in understanding human behaviour (Bandura, 1986). In our program, it supports frameworks for mentorship, peer learning, and the development of leadership skills, enhancing the social and psychological competences of entrepreneurs.

Human-Centered Leadership: Given the importance of leadership in entrepreneurial settings, the curriculum includes human-centred leadership theories. These emphasize emotional intelligence, empathy, and the ability to lead diverse teams effectively, which are crucial for managing a successful enterprise (George, 2003).

Lifelong Learning Paradigm: Lastly, recognizing the rapid technological changes that characterize today's world, the program stresses the importance of lifelong learning. This paradigm ensures that graduates not only adapt to changes but also continuously evolve their skills and knowledge base to remain relevant and innovative over time (Jarvis, 2007).

Triple Helix Model: The Triple Helix model of innovation, which involves collaboration between academia, industry, and government, forms a strategic part of our theoretical framing. It fosters a collaborative learning environment that enriches the educational experience and enhances the practical relevance of the curriculum (Etzkowitz & Leydesdorff, 2000).

By weaving these theories into the fabric of our curriculum, we aim to offer a program that not only imparts knowledge but also develops a comprehensive skill set in our entrepreneurs, preparing them to be pioneers of innovation and leaders in the global marketplace.

Methodology

The methodology for developing this educational program is designed to be rigorous and multifaceted, ensuring a comprehensive understanding of the needs and dynamics within the field of software entrepreneurship. The approach combines qualitative and quantitative research

methods to gather in-depth insights and statistical validation of the educational requirements and outcomes.

Qualitative Research

To better understand the needs, we've already conducted and continue conducting interviews with industry experts. These have been semi-structured interviews with a diverse set of stakeholders in the software entrepreneurship ecosystem, including successful entrepreneurs, venture capitalists, and academic experts. The interviews have explored their experiences, challenges faced, and the skills deemed most critical for entrepreneurial success. Continuing this work, a thematic analysis will be used to identify common patterns and unique perspectives that will inform curriculum development.

In addition to interviews, we are forming focus groups with prospective students. This is to ensure the program meets the needs of its intended audience. The focus group sessions will help uncover their expectations, learning preferences, and perceived gaps in current educational offerings. Data from these focus groups will be analysed using grounded theory methods to develop a curriculum that is both aspirational and practical.

Quantitative Research

To be able to further develop the program and continuously learn, we will set up surveys and perform comparative analysis:

- **Surveys:** When we get a bit further, broad-based surveys will be distributed to a larger audience within the tech entrepreneurship community. These surveys will collect data on a range of topics, including preferred learning formats, key skills lacking in current education systems, and the perceived importance of various entrepreneurial competencies. Statistical analysis, including factor analysis and correlation, will be employed to ensure that the data collected informs impactful educational design. In addition, we will share the information of the existence and structure of our program.
- **Comparative Analysis:** A comparative study of existing entrepreneurship programs globally will be undertaken at some point to benchmark our program against international standards. This analysis will help identify best practices and innovative teaching methodologies that could be adapted for our context. Data will be analysed using comparative statistics to identify trends and outliers.

Design-Based Research

In software industry, we've learned long time ago that iterations and increments are the tools that enable continuous improvement and learning. Thus, in the program we've incorporated the following aspects:

- **Iterative Design and Testing:** Following the collection and analysis of qualitative and quantitative data, a prototype of the curriculum will be further developed. This prototype will undergo several iterations based on feedback from a pilot group of students and instructors. This iterative process, a hallmark of design-based research, ensures that the program is continually refined to meet user needs and adapt to changing technological and business landscapes.
- **Longitudinal Study:** Once the curriculum is established, a longitudinal study is initiated to track the efficacy of the program over time. This study will assess the longterm impact of the educational program on the career trajectories and entrepreneurial success of

graduates. Data will be collected at multiple points post-graduation to evaluate the sustainability and adaptability of the skills acquired.

Ethical Considerations

All research activities will be conducted in accordance with ethical standards to protect the privacy and rights of participants. This includes obtaining informed consent from all participants, ensuring confidentiality, and the right to withdraw from the study without any consequences.

By employing this comprehensive methodology, the program aims to develop an evidence-based curriculum that not only addresses current educational gaps but also anticipates future needs and trends in the software entrepreneurship industry.

Current Trends and Technologies

As we develop a comprehensive educational program for software entrepreneurs, it is crucial to integrate and stay abreast of the current trends and emerging technologies that are shaping the global software industry. Below, these trends are discussed, outlining how the curriculum can prepare entrepreneurs to leverage the technological advancements effectively.

Emerging Technologies

The technology landscape is evolving with an almost incomprehensible pace (Schwab, 2017). The following aspects have already established themselves but certainly we'll see new ones – the list is not static and comprehensive:

- **Artificial Intelligence and Machine Learning:** AI and ML have been and are, as we speak, revolutionizing many aspects of the tech industry, from automating routine tasks to enhancing decision-making processes. The curriculum will include modules that provide foundational knowledge as well as advanced applications in AI and ML, preparing students to harness these technologies in building innovative solutions.
- **Blockchain Technology:** With its potential to transform data security and transactional transparency, blockchain is a critical area of focus. Courses will explore blockchain fundamentals, applications, and its impact on industries like finance, supply chain, and healthcare. Students will engage in hands-on projects to develop blockchain-based applications, understanding both its capabilities and limitations.
- **Internet of Things (IoT):** IoT connects physical devices to the internet, creating networks that gather and share data. By incorporating IoT into the curriculum, students will learn to develop IoT solutions and understand their implications in smart cities, home automation, and beyond.
- **Quantum Computing:** Although still in its nascent stages, quantum computing promises to surpass traditional computing power. An introduction to quantum principles and potential applications will be provided, ensuring that graduates are aware of and can engage with future developments in this field.
- **Edge Computing:** As a complement to cloud computing, edge computing processes data closer to where it is generated. This technology will be explored in the context of real-time data processing and its use in areas such as manufacturing, retail, and telecommunications.

Current Business Trends

On the business side, the most important trends are the following:

- **Remote Work and Digital Collaboration:** The shift towards remote work necessitates skills in digital collaboration and remote team management. The program will offer strategies for effective remote leadership and tools for managing distributed teams, preparing entrepreneurs for the modern workforce.
- **Digital Transformation:** This trend involves the integration of digital technology into all areas of a business, fundamentally changing how companies operate and deliver value to customers. Students will learn about strategies for digital transformation including the digital customer experience, digital marketing, and the digitization of operations.
- **Sustainability and Social Entrepreneurship:** Increasingly, businesses are expected to contribute to societal goals. The curriculum will cover sustainable business practices and the principles of social entrepreneurship, emphasizing how businesses can achieve profitability while also making a positive social impact.
- **Ethical Considerations in Technology:** As technology permeates more aspects of life, ethical considerations become more critical (George, 2003). Discussions will include data privacy, ethical AI, and the societal impacts of technology deployment, ensuring that graduates are prepared to make decisions that consider both technical and ethical dimensions.

Business trends are typically not as volatile and dynamic as the technology trends, but as we've all experienced with the last pandemic, also business trends can take fast turns.

Integrating Trends into the Curriculum

Each module will not only provide theoretical knowledge but also practical application through case studies, simulations, and projects that reflect real-world challenges and opportunities. Furthermore, the program will foster a mindset geared towards innovation and continuous learning, equipping students to adapt to future technologies and trends that emerge beyond their formal education.

Results and Impacts

The holistic educational program designed for software entrepreneurs is poised to deliver transformative results, not only for the participants but also for the broader software industry and entrepreneurial landscape. This chapter discusses the expected outcomes of the program and the potential impacts on various stakeholders.

The program structure, as of today, is presented in Figure 2. The structure and detailed contents are dynamically adjusted to meet the needs.

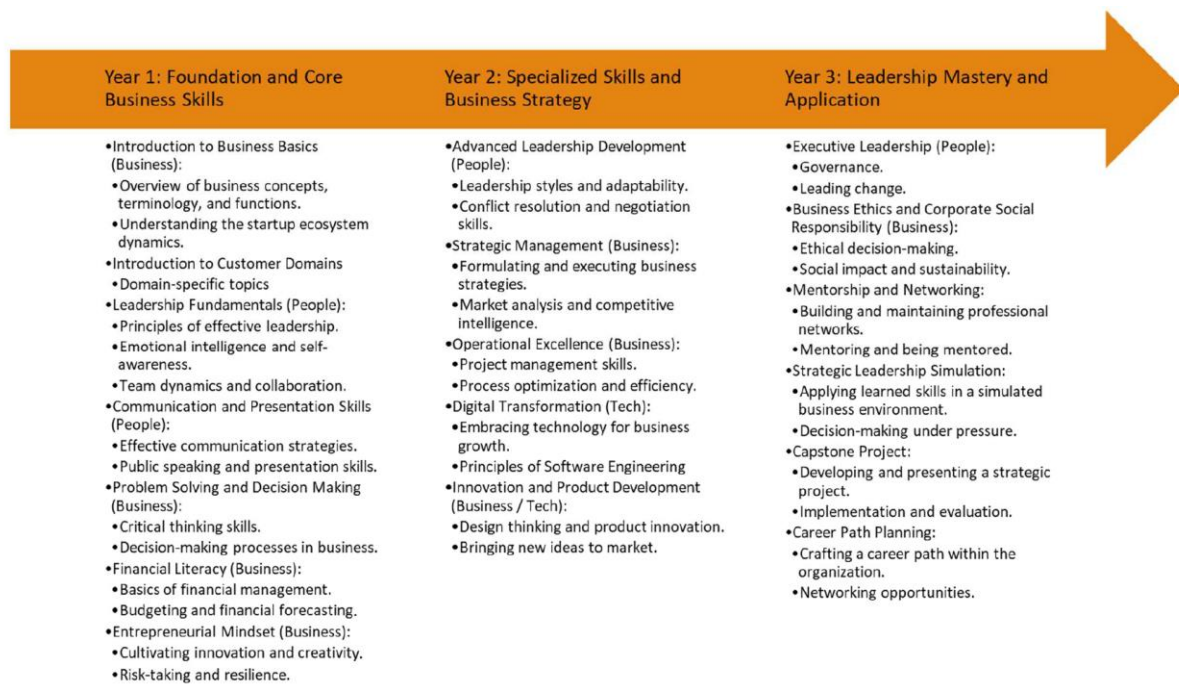


Figure 2: Educational Program Structure

Educational Outcomes

As the most important educational outcomes, we address the following:

- **Bridging the Skill Gap:** Graduates of the program will emerge with a rare and powerful blend of technical, business, and interpersonal skills. This convergence is expected to directly address the current mismatch between educational outputs and industry needs, significantly reducing the skill gap prevalent in the tech entrepreneurship sector.
- **Innovation in Product and Service Development:** Armed with cutting-edge knowledge and interdisciplinary skills, alumni are expected to lead the charge in innovation, developing products and services that not only meet market demands but also push the boundaries of what is technologically possible.
- **Leadership and Team Dynamics:** The focus on human-centred leadership and management training is designed to cultivate leaders who excel in diverse and dynamic environments. Graduates will be notable for their ability to manage and inspire teams, potentially revolutionizing the human resource landscape in tech industries by setting new standards for leadership.

Industry Impact

Catalysing Startup Success Rates: By equipping software entrepreneurs with a comprehensive skill set, the program is expected to increase the success rates of tech startups. Enhanced entrepreneurial skills will minimize the common pitfalls related to poor management and inadequate market understanding, leading to more sustainable business ventures.

Driving Technological Adoption: Graduates from the program will likely be at the forefront of adopting and implementing new technologies. This could accelerate the diffusion of innovations such as AI, IoT, and blockchain across industries, fostering a more rapid technological transformation of the economy.

Shaping Entrepreneurial Ecosystems: Alumni are expected to contribute not only through their enterprises but also by acting as mentors and investors within the entrepreneurial community. This would enhance the vibrancy and resilience of local and global entrepreneurial ecosystems.

Societal Impacts

For the success of the educational program, it is critical to understand how learning occurs in social contexts and to enrich program elements focusing on peer learning and mentorship (Bandura, 1986).

- **Promoting Ethical Tech Development:** With a curriculum that incorporates ethics and sustainability, the program aims to develop entrepreneurs who prioritize these values in their business models. This could lead to a new wave of ethically conscious businesses that consider the long-term societal impacts of their products and services.
- **Economic Growth and Job Creation:** As graduates launch and scale their ventures, significant economic growth and job creation are anticipated. This growth is not limited to the tech sector but extends to various ancillary industries, contributing to overall economic resilience and diversity.

Global and Cultural Influences

Fostering Global Tech Leadership: The international and culturally diverse nature of the program is designed to foster a generation of leaders who are comfortable operating across global markets. Graduates will be equipped to navigate international business environments, promoting cross-cultural understanding and cooperation.

Adapting to Global Challenges: With a curriculum that adapts to include current and future global challenges, graduates will be prepared to address issues such as global health crises, climate change, and international cybersecurity threats, positioning them as leaders in solving some of the world's most pressing problems.

Provocative Outlook

In the most optimistic and provocative scenario, the ripple effects of this educational program could initiate a renaissance in the tech industry, characterized by a surge of ethical, sustainable, and highly successful tech enterprises that not only dominate the markets but also redefine the norms of corporate responsibility and innovation.

Global Perspective and Localization

In today's interconnected world, the success of educational programs increasingly depends on their ability to transcend geographical and cultural boundaries. The holistic educational program for software entrepreneurs is designed with a global perspective, aiming to prepare graduates to operate in a diverse international market. Simultaneously, it recognizes the necessity of localization to address specific regional needs and cultural nuances. This chapter outlines the approaches and strategies to achieve these dual objectives.

Incorporating Global Perspectives

International Collaboration: The program will establish partnerships with universities and tech hubs around the world to foster a global exchange of ideas, resources, and best practices. These collaborations will enable students to gain international exposure and insights, preparing them for global challenges and opportunities in the tech sector.

Cultural Competence Curriculum: Modules on cultural competence will be integrated into the program to teach students how to effectively interact with diverse populations, understand international market dynamics, and navigate cross-cultural business negotiations. This training will be crucial for entrepreneurs looking to operate or expand their businesses globally.

Global Case Studies: The curriculum will include case studies from various countries, showcasing successful and failed tech startups in different cultural contexts. These case studies will provide practical lessons on how different strategies work in distinct regulatory and cultural environments.

Localization Strategies

Adaptive Curriculum: The program will be designed to adapt core content to local contexts, incorporating regional tech developments, market conditions, and cultural specifics. This approach will ensure that while the program maintains a consistent foundational curriculum, it remains relevant and applicable wherever it is offered.

Local Industry Input: Input from local industry leaders and entrepreneurs will be sought to tailor the curriculum to meet regional needs. This could involve guest lectures, mentorship programs, and partnerships with local businesses to keep the curriculum grounded in the local economic and cultural reality.

Language and Communication: Courses will be offered in multiple languages, and communication styles will be adapted to meet local preferences and norms. This flexibility will help break down barriers to learning and ensure wider accessibility and effectiveness of the program.

Challenges and Solutions

Cultural Misunderstandings: Potential cultural misunderstandings could pose challenges in implementing a globally diverse curriculum. To mitigate this, the program will employ culturally aware educators and provide cultural sensitivity training to all faculty members.

Balancing Global and Local Needs: Striking the right balance between global integration and local relevance can be challenging. The program will continuously evaluate and adjust its local offerings based on feedback from local students and stakeholders to ensure it remains appropriately aligned with both global standards and local expectations.

Scalability and Flexibility: Ensuring that the curriculum can be scaled and adapted without losing its effectiveness is critical. This will involve developing robust frameworks that allow for flexibility in content and teaching methods depending on the local context.

Visionary Goals

Ultimately, the program aims to create a flexible, adaptable educational model that serves as a benchmark for global software entrepreneurship education. By fostering an understanding of both global interconnectivity and local specifics, the program will equip future entrepreneurs with the skills necessary to innovate and succeed in a rapidly changing world.

Collaboration with Industry and Government

To ensure that the educational program for software entrepreneurs remains at the forefront of technology and business practices, it is imperative to foster strong partnerships with industry and government. These collaborations will facilitate real-world experiences for students and ensure that the curriculum reflects current trends and future needs. This chapter discusses the strategies for building these partnerships and the expected benefits.

Strategic Partnerships with Industry

Internship and Apprenticeship Programs: Establishing relationships with leading tech companies to offer students internships and apprenticeships will provide practical experience and help bridge the gap between academic theory and real-world application. These opportunities allow students to work on current projects, learn about new technologies firsthand, and understand the inner workings of successful companies.

Guest Lectures and Workshops: Inviting industry experts to deliver guest lectures and workshops will enrich the learning experience, offering students insights into cutting-edge practices and the challenges of the tech industry. These sessions will also provide networking opportunities, allowing students to connect with potential mentors and employers.

Innovation Labs and Tech Incubators: Collaborating with tech companies to set up innovation labs and incubators on campus will provide students with the resources to develop their ideas into viable products and businesses under the guidance of experienced entrepreneurs and technical experts.

Engagement with Government Agencies

Policy Workshops and Seminars: Partnering with government bodies to conduct workshops and seminars on tech policy, regulations, and compliance will prepare students to navigate the legal aspects of entrepreneurship. This collaboration ensures that graduates are well-versed in the requirements and implications of tech regulations.

Funding and Grants: Working with government agencies to secure funding for student projects and research initiatives can provide essential financial support for innovative ideas. This engagement can also involve guidance on how to successfully apply for government grants and understand the criteria for funding tech startups.

Advocacy and Community Engagement: Collaborating with local government entities to advocate for policies that support the tech entrepreneurship ecosystem. This partnership can help shape a more conducive environment for startups and foster community engagement through sponsored tech events and public discussions.

Building a Sustainable Model

Continuous Feedback Loop: Establishing a continuous feedback loop with industry and government partners will ensure that the curriculum remains relevant and responsive to the evolving needs of the tech sector. Regular reviews and updates of partnership goals and outcomes will help maintain the efficacy and relevance of these collaborations.

Joint Research Initiatives: Engaging in joint research projects with industry and government can lead to new insights and innovations. These initiatives can also provide data and case studies that enrich academic research and teaching materials.

Global and Local Synergies: Balancing global partnerships with local collaborations ensures that the program benefits from international innovations while remaining grounded in local industry and governmental contexts. This approach will prepare students to operate both locally and globally.

Vision for the Future

The goal of these collaborations is to create a dynamic educational environment where government and industry are not just supporters, but active participants in shaping a new generation of tech entrepreneurs. By closely aligning with these sectors, the program ensures that its graduates are well-equipped to lead and innovate within the tech industry, driving growth and contributing to societal progress.

Discussion and conclusions

This paper has presented a comprehensive educational program designed to equip software entrepreneurs with a holistic set of skills that balance technical proficiency with business acumen, leadership qualities, and a deep understanding of the technological landscape. Through the integration of advanced pedagogical theories, collaboration with industry and government, and a focus on global trends and local adaptations, the program aims to transform the educational landscape for future tech entrepreneurs.

Challenges and Potential Barriers

At least the following aspects can be seen as challenges and potential barriers in the implementation of the program:

- **Resource Constraints:** Implementing such a comprehensive program requires substantial resources, including qualified faculty, state-of-the-art technology, and financial investment. Securing these resources may be challenging, particularly in regions with limited educational funding.
- **Institutional Resistance:** The interdisciplinary and innovative nature of the proposed program might face resistance from traditional educational institutions. Overcoming this inertia requires strong leadership and the demonstration of the tangible benefits of the program to sceptical stakeholders.
- **Scalability:** While the program is designed to be adaptable, scaling it to different cultural and economic environments while maintaining its quality and impact is a significant challenge. Continuous evaluation and adaptation will be essential.

- **Rapid Technological Changes:** The fast pace of technological advancement means that the curriculum must be continually updated to remain relevant. This requires an agile and responsive approach to curriculum development.

Potential Solutions:

To tackle the challenges and potential barriers, the following solutions might be of value:

- **Partnerships for Resources:** Building strong partnerships with industry and government can help mitigate resource constraints by providing funding, expertise, and infrastructure.
- **Pilot Programs and Proof of Concept:** Implementing pilot programs can provide evidence of the effectiveness of the educational model, helping to overcome institutional resistance by showcasing success stories and measurable outcomes.
- **Modular and Flexible Curriculum Design:** Developing the curriculum in a modular way allows for easier adaptation and updating, helping the program scale across different regions and stay current with technological advances.

Visionary Outlook

The future of education for software entrepreneurs looks promising, with a shift towards more dynamic, integrated, and responsive educational models. The proposed program not only addresses the current needs of the industry but also anticipates future trends, preparing graduates to not only adapt to but also lead in a changing world. As this program matures and expands, it has the potential to foster a new era of entrepreneurial leaders who are well-prepared to tackle global challenges, drive innovation, and contribute positively to society.

In conclusion, the development of this educational program represents a significant step forward in the education of software entrepreneurs. It aligns academic rigor with practical experience, theoretical knowledge with real-world application, and individual achievement with societal benefit. By embracing the complexities and demands of the modern tech landscape, the program aims to cultivate a generation of entrepreneurs who are not just capable of adapting to changes but capable of leading them.

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ADOPTION OF THE ELECTRIC BUS IN SUSTAINABLE URBAN MOBILITY: SMALL BUSINESS INNOVATION AND THE MATURITY OF CITIES

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Abstract

The Brazilian National Energy Balance underscores transportation as the primary energy consumer and major contributor to atmospheric pollution. Despite escalating energy demand, Brazil relies heavily on fossil fuels, and its energy efficiency lags behind other nations. Electric buses offer a viable solution, boasting low greenhouse gas emissions and various socio-economic and environmental benefits, including noise reduction, enhanced air quality, cost savings, and job creation in the electric vehicle sector. Small business innovation is pivotal in this context, driving the development of technologies and solutions. Our research inquiry focuses on the impact of public policies on the technological maturity of electric bus adoption for sustainable urban mobility in Brazilian cities. Employing a multi-method approach, including the Analytical Hierarchy Process (AHP) and interviews with industry stakeholders, preliminary findings highlight the critical role of regulatory frameworks and incentives in enhancing cities' maturity levels, surpassing technological advancements and performance metrics in importance.

Keywords

Sustainable urban mobility, electric buses, smart cities, small business innovation, strategy.

Introduction

Smart cities use information and communication technologies to improve interaction between urban elements. Building smart cities is a complex challenge due to population growth and the need for efficiency and sustainability. A crucial aspect of building smart cities involves active societal participation and the adoption of innovative solutions, often driven by the strategic development of small businesses. Transportation stands out as a key sector, being a major consumer of energy and a significant contributor to greenhouse gas emissions. In Brazil, a nation heavily reliant on fossil fuels, particularly in the transportation sector, there's a pressing need for a shift towards sustainability. Unfortunately, the evolution of energy efficiency in this sector has been negative compared to global trends.

Considering the United Nations Sustainable Development Goals (SDGs), reducing greenhouse gas emissions becomes paramount. The Brazilian National Energy Balance highlights transportation as a major culprit in energy consumption and air pollution. To address this, the adoption of electric buses emerges as a competitive alternative. Electric buses not only contribute to lower greenhouse gas emissions but also offer positive social, economic, and environmental outcomes, including reduced noise, improved air quality, lower operational costs, and job creation in the electric vehicle sector. In addition, engaging communities early in the planning and implementation stages of electric bus projects fosters social acceptance from the successful integration of electric buses into urban transportation systems. This involves strategically deploying electric buses to serve diverse communities, including low-income neighborhoods, rural areas, and underserved populations. By expanding transit routes, increasing frequency, and

enhancing connectivity, cities can improve mobility options for residents with limited transportation choices, reducing disparities and promoting social equity.

However, challenges such as rapid vehicle acquisition, a lack of charging infrastructure, and limited funding hinder the widespread integration of electric buses. Overcoming these challenges necessitates comprehensive public policies that promote technological advancements, infrastructure development, and strategic investments. Embracing technologies like quick charging systems and high-capacity batteries is crucial to enhancing the efficiency and viability of electric vehicles in the transportation sector. In conclusion, the electric bus emerges as a pivotal component of a larger sustainable development strategy, demanding investments in technology, infrastructure, and well-crafted public policies for its successful implementation.

Within this context, our research question lies on the rationale that the transport sector is the largest consumer of energy, with heavy vehicles powered by fossil fuels (predominantly diesel) contributing to the increase in greenhouse gases, contradicting the SDGs. According to SENATRAN (2022), Brazilian buses fleet is 688,880 vehicles, and represents 0.6% of the country's total fleet of 115 million internal combustion (fossil fuels) vehicles. Total emissions in Brazil were 413.8 million metric tons in 2022, from which 45.6%, equivalent to 188.7 million metric tons, came from transport (IEA, 2024). Due to the lack of data, we had to use a deductive approach to calculate the emissions from buses within the transport sector. According to Safar (2009) buses emissions are comprised of several pollutants: carbon monoxide (CO), carbon dioxide (CO₂), nitrogen oxides (NO_x), high hydrogen content (HHC), and particulate matter (PM), hereafter simply emissions. Carbon Dioxide corresponds to 98.4% of total emissions. The author's study on a fleet of 225,510 diesel buses in Egypt showed total emissions of 85,849.4 tons/day, equivalent to 0.38 tons/day/bus. Therefore, one bus emits 138.7 tons/year. By deduction, the total emissions of Brazilian buses fleet of 688,880 vehicles are 95.5 million metric tons per year, correspondent to 50.6% of total transport emissions. This figure has a very significant impact on transport sustainability, as 0.6% of the fleet is responsible for 50.6% of total emissions.

The implementation of new technologies in the transport sector, such as the electric bus, is crucial for sustainable urban mobility solutions. However, the speed of implementation of these technologies depends on several factors, including public policies, price, interests involved, user aspects and geographic issues. In addition, small businesses are largely involved in technology development and are accountable for a large output of new technologies implemented in transport, which provide inputs for sustainable public policies. Hence, our research question is "To what extent can public policies influence the degree of technological maturity in the adoption of electric buses as a sustainable urban mobility solution in Brazilian cities?"

Electric buses in sustainable urban mobility are connected with the Nordic countries through their shared commitment to environmental sustainability, innovation, and quality of life. The Nordic countries, including Denmark, Finland, Iceland, Norway, and Sweden, are renowned for their strong focus on green initiatives, renewable energy, and progressive urban planning. Furthermore, the Nordics are at the forefront of technological innovation, including the development and deployment of electric vehicles (EVs). They have been early adopters of electric buses, implementing pilot projects and integrating them into their public transportation systems, and prioritize efficient and accessible public transportation as a cornerstone of urban mobility. Electric buses enhance the quality and reliability of public transit services, offering passengers quiet, comfortable, and environmentally friendly transportation options. Finally, electric buses align with the Nordic countries' ambitious sustainability goals and commitments to mitigate

environmental impacts. With their zero-emission operation, electric buses help reduce air pollution, noise pollution, and greenhouse gas emissions, improving air quality and public health in urban areas.

Rao (2024) corroborates with this rationale. According to the author, two of the three most sustainable countries in the world are Nordics, Denmark and Finland. Denmark rated first in the Green Living Ranking, fifth in the Environmental Performance Index (EPI), and fourth in the Green Future Index (GFI). Additionally, the nation has been at the top of the sustainability rankings for a long time. Denmark is ranked third in the Sustainable Development Report and has a low carbon impact. The Climate Act, enacted in Denmark in 2020, established targets to reduce emissions by 50% by 2025 and 70% by 2030.

Finland came in third in the EPI, sixth in the GFI, and second in the Green Living Ranking. The Nordic countries have continued to rule the sustainability domain, as evidenced by Finland's #1 ranking in the Sustainable Development Report. The nation is committed to become carbon neutral and has set a target of reducing greenhouse gas emissions by 80–95% by 2050. Nearly 70% of Finland is covered in forests, with roughly 17,000 square kilometres under strict protection.

Theoretical Background

Smart Cities

According to Alquino and others (2015), urban mobility is a critical issue, due to the increase in population and the increased use of natural resources. The solution to this issue includes transport system optimization, collaborative transport, less polluting technologies and cutting-edge technologies such as autonomous vehicles and buses. Furthermore, the smart city is made up of a system that uses information and communication technologies to improve interaction between the various areas of the city, including transport, infrastructure, public services and user service. According to Godoy (2013), electromobility is an efficient solution for reducing GHG, but Brazil still needs more incentives for the implementation of electric vehicles. Although the European Union has implemented directives to reduce primary energy, Brazil still needs effective public energy efficiency policies. Therefore, it is necessary to encourage new mechanisms to encourage the use of clean energy, especially in the non-energy consumer market, such as the goods and services industries. Urban agglomeration brings challenges to the planning, design, financing, execution, and operation of the mobility system, requiring new approaches (Teoh et al., 2018).

Transition to Sustainability in Sociotechnical Systems

Sustainability seeks development that meets current needs without compromising future generations. The co-evolution of the socio-technical system, composed of technology, markets, public policies and regulations, is essential to achieve sustainability (Geels, 2005). The transition to sustainability in urban mobility requires the participation of relevant actors and institutional, sociocultural, organizational, and technological changes (Loorbach, 2010). The socio-technical system covers energy, transport, housing, production, distribution, and use of technology, aiming to meet human needs (Geels, 2004). The insertion of technological innovations drives social changes and economic growth (Schumpeter, 1985; 2017). The sociotechnical transition is analysed at different levels, such as the multilevel perspective, and is favoured when stakeholders participate in learning processes with a systemic vision (Rotmans et al., 2001). The external

landscape, including pandemics and natural disasters, influences technological development and provides opportunities for new innovations. The regulatory regime, through legislation and public policies, controls the stability of technological niches (Geels & Schot, 2007). The electric bus is highlighted as a promising solution for a more sustainable society, reducing polluting emissions and improving air quality in cities. Furthermore, it brings long-term economic benefits, such as reduced maintenance and fuel costs (Geels & Schot, 2007).

TIPs – Transformative Innovation Policies

The electric bus is an opportunity to transform urban transport policies, driving the transition to a more sustainable society. Transformative Innovation Policies (TIPs) are important approaches to stimulate innovations in renewable energy and address regulatory and financial challenges (Haikola et al., 2021). Cooperation between different actors is essential in this transition process (Boni et al., 2019). Energy efficiency and the reduction of polluting gas emissions are advantages of using electric buses, contributing to the creation of smart, sustainable and efficient cities (Antunes et al., 2020; da Silva & Peres, 2022). The TIP must have socio-environmental objectives and involve all interested parties, in addition to integration of evaluation and methodological diversity (Haikola et al., 2021). Therefore, the adoption of the electric bus represents an opportunity to transform urban transport policies, moving towards a more sustainable and inclusive future.

The Energy Matrix

The Brazilian energy matrix is made up of several sources, being more renewable than the global matrix, with emphasis on oil and derivatives and hydraulic sources. The road sector is responsible for most of the energy consumption in the country. To promote sustainable development, the Brazilian government has implemented energy efficiency actions and programs aimed at improving the energy matrix, including encouraging the use of hybrid and electric vehicles. Electric propulsion is considered the best option for reducing greenhouse gas emissions and increasing energy efficiency in the transport sector. The Urban Mobility Law establishes guidelines for urban development and encourages the diversification of public and collective transport options in large cities. The implementation of innovative public policies is essential to promote a sustainable transition in urban mobility. Da Silva and others (2022) and Rosenbloom and others (2020) highlight the importance of these policies, which should encourage innovation and the origin of low-carbon technologies, aiming for a sustainable energy transition. It is necessary to prioritize mass transport through hybrid and electric vehicles, in addition to seeking synergistic and non-motorized solutions to reduce pollution. The diversification of public and collective transport options in large cities is essential to meet the growing demand of the population.

The electric bus is touted as one of the most promising solutions to transportation and environmental problems, due to its zero greenhouse gas emissions when powered by clean, renewable energy sources. The implementation of innovative and sustainable policies is crucial to promote the energy transition and improve the energy matrix in Brazil. Studies on the history of electric buses in the country are relevant to understanding the challenges and opportunities faced in implementing this technology, including overcoming technical, regulatory and financial barriers to large-scale adoption. The use of electric buses is one of the most promising solutions to achieve the objectives of a sustainable energy transition and a cleaner and more efficient energy matrix.

Small Business Innovation and Strategy Towards Electric Bus Technology Development

Small business owners must constantly innovate in changing environments that are marked by risk and uncertainty (Langu, 2022). Dealing with innovation requires a specific skill set, particularly in light of sociotechnical developments. Businesses should take advantage of specialized expertise for innovation driven by external factors, while internal limits often serve as hurdles to it (Eisenreich et al., 2021). Ecosystems must therefore incorporate components that foster entrepreneurship and innovation (Laceta & Könnöla, 2021). It is also essential to combine the ecosystems territorial approach with the complex (co) evolutionary umbrella, as in the electric bus technological innovation system (Scaringella & Radziwonb, 2018), driving emergent technologies into existing systems.

Autio and others (2014) claim that co-creation and ecosystem evolution drive small firm entrepreneurial innovation, which is focused on radical innovation. Entrepreneurs understand invention through narratives, which in turn control possibilities and/or practicality of innovations (Garud et al., 2014; Ghorbel et al., 2021). According to Guerrero and Urbano (2017), "effectuation," or the continuous search for opportunities for innovation, is therefore essential to innovation.

Small and large businesses working with the government and universities (triple-helix agents) to obtain resources and expertise verifies the improvement in innovation performance through R&D cooperation in developing nations, claim Khalid, Salykova, and Capar (2020). Znaniecki (1934) also discovered that a firm's energy efficiency and environmental performance were influenced by its environmental strategy, entrepreneurial innovation, and entrepreneurial orientation, all of which contributed to the coevolution process. Thus, the effect on the technology of electric buses.

The participants in a city technological innovation system, including the adoption of electric buses, contemplate the strategic ramifications of their choices. Small businesses area largely within such system and actively contribute to technology development. Moreover, transitions are driven by strategy. For the purpose of maintaining continuity in strategic action, we view strategy as intertwined with a firm's identity maintenance (Burgelman, 1983). Burgelman and Grove (2007) point out that a very small proportion of businesses maintain their independence across time, supporting the sociotechnical system and coevolutionary transitional tactics. A company's capacity to develop a strategy depends on the interaction between strategy practices and strategy processes (Burgelman et al., 2017; Mackay et al., 2021). Five fundamental components of strategy creation in the circular economy have been highlighted by Urbaniec and others (2021): market, technological, ecological, organizational and human resource-related, and legal. The strategic implications drawn from the multilevel perspective and coevolution of agents in technological innovation systems may be explained by the fact that emergent strategies are defined in terms of specific content and implemented without respect to intentions (Gruba et al., 2022; Mintzberg & Waters, 1985).

The multilevel perspective on emerging transition processes in renewable energy is introduced by Sutherland, Peter, and Zagata (2015), and by inference within the electric bus technological innovation system. They envisage the creation of a "flat" regime centred on the production of renewable energy. According to Hultman and others (2012), non-economic factors have a major impact on energy-related technological breakthroughs, and strategy is a supporting element for both methods. Sustainable development thinking in small business examines how strategy might manage social and environmental responsibilities to create profitability. It investigates

how combining sociotechnical methods, adaptive planning, and transition management might support the effective adoption of sustainability-focused innovations in a corporate setting (Almeida & De Melo, 2017). Gruba and others (2022) offer an analysis of the strategic implications of resource management in circular economy initiatives. In these projects, strategies are designed to optimize resource efficiency, and technology is employed to enable the successful execution of plans.

Methodology

In this study, we adopt the AHP (Analytic Hierarchy Process) by Saaty (1991, 2001). AHP is an analytical model that combines qualitative and quantitative analysis. Following the hermeneutic circle principle, qualitative data was collected, analysed, and gathered iteratively up to theoretical saturation, starting with an initial set of questions. The initial framework informs the semi-structured interview questions. The final data was methodically coded in accordance with the framework, enabling it to be verified, contested, or in certain situations, expanded (Gruba et al., 2022). We carried out 44 interviews in 2023, and 25 were validated. Table 1 shows the interviewees profile.

Table 1: Interviewees

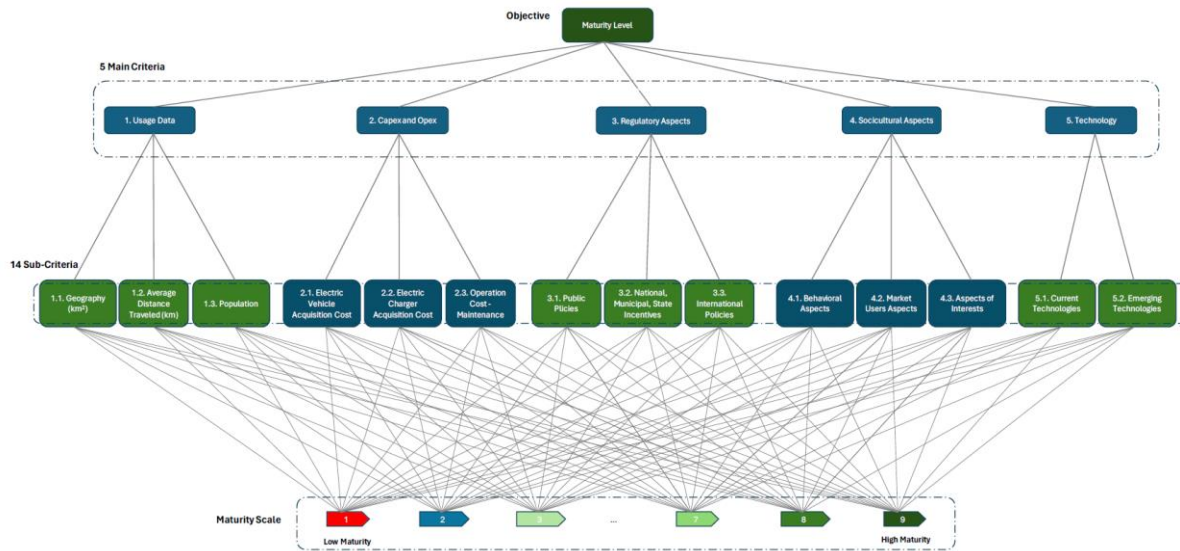
Occupation Area	Quantity
Public sector	6
Education	6
Research and innovation companies	3
Industry / company manufacturing parts / accessories for buses (traditional or electric)	3
Industries - other segments	3
Service company - other segments	2
Research institute	1
Industry / bus manufacturing company (traditional and/or electric)	1
Total	25

Source: The authors, from the analytical model.

The study considered two levels of criteria and respective sub-criteria. Peer assessment was carried out between all main criteria and between sub-criteria of the same clusters. The choice of criteria was based on a study by EPE (2020) on the implementation of electric buses in Brazil. Some of the criteria included were initial investment, fleet renewal, public incentives, usage data, average daily distance travelled, fixed and variable costs, vehicle acquisition and maintenance. Other authors also highlight the importance of public policy issues and user behaviour in the adoption of sustainable transport technologies (Geels, 2010, 2020; Grin et al., 2010; Olegário & Vaz, 2019).

Five criteria to assess cities' maturity level to adopt electric buses were employed: 1) Usage Data (geography, average distance covered by the bus, population); 2) Capex and Opex (cost of acquiring the electric vehicle, cost of purchasing the charger, cost of operation – Maintenance and Energy); 3) Regulatory Aspects (Public Policies, National, Municipal and State Incentives, International Policies); 4) Sociocultural Aspects (Behavioral Aspects, Market User Aspects, Interest Aspects); and 5) Technology (Current Technologies, Emerging Technologies). These were our parameters.

The five main criteria and 14 sub-criteria influence the adoption of the electric bus. Figure 1 and Table 2 show the AHP structure and analytical model for the criteria and sub-criteria.



Source: The authors, from the analytical model.

Figure 1: AHP Structure

Table 2: AHP Analytical Model Criteria and Sub-Criteria

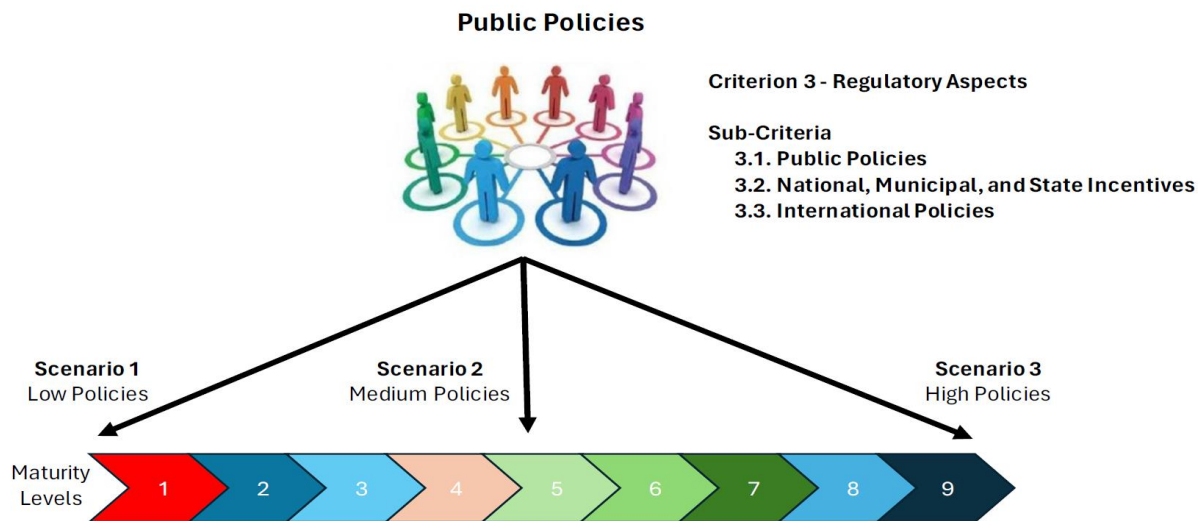
Criteria	Sub-Criteria
1. Usage Data	1.1. Geography (km ²) 1.2. Average Distance Traveled (km) 1.3. Population
2. Capex and Opex	2.1. Electric Vehicle Acquisition Cost 2.2. Electric Charger Acquisition Cost 2.3. Operation Cost - Maintenance and Energy (R\$/km)
3. Regulatory Aspects	3.1. Public Policies 3.2. National, Municipal, State Incentives 3.3. International Policies
4. Sociocultural Aspects	4.1. Behavioral Aspects 4.2. Market Users Aspects 4.3. Aspects of Interests
5. Technology	5.1. Current Technologies 5.2. Emerging Technologies

Source: The authors, from the analytical model.

Next, we have adopted a 9-level maturity scale to verify the technological maturity level of the Brazilian cities, as well as to measure each criterion and sub-criteria, as our main objective was to verify the level of technological maturity of Brazilian cities in relation to the implementation of electric buses in public transport, also shown in Figure 1. Assessing the level of technological maturity in cities is important to understand the challenges and opportunities in the evolution of smart cities. According to Aljowder, Thajba, Ali, and Kurnia (2019), technological maturity can be assessed through indicators that include the degree of penetration of technologies, the quality of public services and energy efficiency. Assessing the level of technological maturity

in cities can help identify investment needs and opportunities for collaboration between the public and private sectors.

The 1–9 maturity level scale was operationalized assigning indicator 1 as a low maturity and 9 as high maturity level. Regulatory aspects were central to the analysis. The maturity scale was applied concomitantly with the AHP technique with the purpose of evaluating to what extent each criterion impacts positively or negatively each city's level of maturity, divided in three scenarios for analytical purposes: Scenario 1, Low policies; Scenario 2, Medium policies; Scenario 3, High policies, as shown in Figure 2.



Source: The authors, from the analytical model.

Figure 2: 9-Level Maturity Scale

Therefore, the final model derived from the AHP analytical model consists of five main criteria and 14 sub-criteria and a 9-level maturity scale for each criterion and sub-criteria. Below are the respective descriptions and measurement using the maturity scale.

Sub-criterion 1.1. Geography (km²): According to Chen and Zhang (2020), the economic viability of the transport system with electric buses is higher in dense urban areas. According to the Bloomberg Finance L.M. study, *Electric Buses in Cities. Driving Towards Cleaner Air and Lower CO₂* (BNEF, 2018), large cities tend to have a greater average daily distance traveled by buses, which results in lower variable costs, higher yield, among other factors. For this reason, the larger the city, the greater the probability of having a greater daily average distance traveled, which reduces variable costs and increases bus performance. According to IBGE (2019), the smallest Brazilian city is Santa Cruz (MG) with 10 km², while the largest is São Paulo with 914.5644 km² of urban population. In this sense, a city of 150 km² or less was adopted as maturity level 1 of readiness in relation to geography. For equivalence to the maximum level, 9, of geography readiness, a value of 1,200 km² or more was adopted, scaling the other values between these extremes.

Sub-criterion 1.2. Average Distance Traveled (km): According to Olegario and Vaz (2019), the average distance travelled by electric buses is important when choosing the type of battery and recharging strategy. According to the Bloomberg Finance L.M. study *"Electric Buses in Cities. Driving Towards Cleaner Air and Lower CO₂"* (BNEF, 2018), larger cities tend to have an average daily commute of 300 km, while smaller cities have an average of 160 km. The

annual cost of diesel buses is lower than that of electric buses over short distances, but the longer daily average can increase the economic efficiency of electric vehicles. Charging infrastructure is also a critical factor in ensuring the viability of longer distance electric bus routes. Chen and Zhang (2020) emphasize that shorter distances can guarantee energy supply security and system reliability, especially in cities with little charging infrastructure. For this study, the scale was established based on the average distance travelled per passenger, ranging from 5 km/day for maturity level 1 to 21 km/day for level 9, in increments of 2 km.

Sub-criterion 1.3. Population: Population size is an important factor in the feasibility of implementing electric buses, as it affects the demand for public transport. According to Chen and Zhang (2020) and IBGE (2010), it is important to take population density and transport needs into consideration before deciding on implementation. The number of buses to be implemented depends on the size of the population and the objectives of the responsible company. If the intention is to serve a wider population, it is necessary to prioritize transport capacity and the efficiency of the charging network, while if the objective is to serve a smaller population, it is important to prioritize the flexibility and scalability of the transport system. According to the study, the implementation of electric buses will be easier in small cities, with less than 50,000 people, and more difficult in larger cities with more than 900,000 people. The maximum scale 9 will be assigned to small cities and the minimum scale, 1, will be assigned to large cities.

Sub-criterion 2.1. Electric Vehicle Acquisition Cost: According to the authors Chen and Zhang (2020), it is important to consider the acquisition cost when choosing the type of electric vehicle. According to the 2016 Greenpeace Clean Bus Dossier, the cost of an electric vehicle was around R\$ 820k (approx. US\$ 160k) to R\$1 million (approx. US\$ 200k), including financing costs. The MDIC (Ministry of Development, Industry and Foreign Trade) in 2018 estimates that the price of an electric bus can be compared, in proportion, with the traditional diesel bus, reaching a cost of 1.75 times more expensive. The ICCT (International Council on Clean Transportation) considered in 2019 that the cost of an electric vehicle is 75% more expensive than a traditional diesel vehicle. In this study, the average acquisition cost of R\$ 1 million (US\$ 200k) per vehicle was adopted, based on 2018 cost reference. The average cost was updated to R\$1.414 million (US\$ 280k). The lower acquisition cost, the better for the city. The readiness level will be maximum (9) if the cost of each bus is R\$ 1.1 million (US\$ 220k) or below.

Sub-criterion 2.2. Electric Charger Acquisition Cost: According to the MDIC (2018) report, the average cost of an electric charger is R\$ 226k (approx. US\$ 44k). The report points out that it is important to invest in high-capacity and efficient chargers to ensure the economic viability of the transport system (BNEF, 2018). In this study, a cost between R\$ 240k (US\$ 47k) and R\$ 250k (US\$ 49k) was adopted as the average price for the maturity level 5, with increments of R\$ 10k (US\$ 4k) for lower or higher levels of maturity, reaching a maximum cost of R\$ 280k (US\$ 55k) to R\$ 290k (US\$ 57k) at level 1 of the scale, and a minimum cost of R\$ 200k (US\$ 39k) to R\$ 210k (US\$ 41k) at level 9 of the scale.

Sub-criterion 2.3. Operation Cost – Maintenance and Energy (R\$/km): According to Chen and Zhang (2020), the operating cost of electric buses is generally lower compared to combustion vehicles, especially in relation to fuel and maintenance. The operating cost includes maintenance and energy. The average maintenance cost, according to the city of São Paulo (2019), is R\$ 0.73 (US\$ 0.14) per km driven. The energy cost was determined by the average yield of 0.95 km/kWh and the cost per kWh of the Azul tariff and off-peak hours (R\$ 0.45756, equivalent to approx. US\$ 0.09), resulting in a final cost of R\$ 1.2117 per km (US\$ 0.24). This value

is adopted as the maturity level 5, with increase or decrease of 5% for the other maturity levels, to reach the extremes of the scale.

Sub-criterion 3.1. Public Policies: According to IEA (2020), clear and coherent public policies are important to establish guidelines for the development and implementation of electric buses. Several authors argue that public policies are one of the main aspects influencing the success of implementing sustainable collective mobility projects. In this study, maturity level 1 corresponds to incipient public policies and level 9 corresponds to full-blown public policies for promoting and implementing urban mobility.

Sub-criterion 3.2. National, Municipal and State Incentives: According to Chen and Zhang (2020), fiscal incentives, such as tax exemptions and subsidies, are important to stimulate the development and implementation of electric buses. For this study purposes, maturity level 1 corresponds to the absence or few incentives, and level 9 corresponds to a wide range of incentives.

Sub-criterion 3.3. International Policies: According to C40 (2019), international cooperation is crucial for the development and implementation of electric buses. It enables the sharing of knowledge and technology and the harmonization of policies and regulations across the world. Maturity level 1 corresponds to a city no international policies and level 9 is a city that receives many international incentives.

Sub-criterion 4.1. Behavioral Aspects: According to Machado and Piccinini (2018), behavioral aspects of users are important to assess their expectations and habits of using public transport, as well as the acceptance of electric buses as a transport option. Rezende et al. (2021), evaluates quality of transport service. In this study this criterion was operationalized through the sum of the average time per km travelled by bus and the average waiting time for public transport. The scale considered a waiting time of 50 minutes or more as maturity level 1, and 15 minutes or less as level 9, with the other values interspersed between the extremes. These values were based on Moovit Insights (2023).

Sub-criterion 4.2. Market User Aspects: According to Machado and Piccinini (2018), it is important for companies to have a long-term vision and form strategic partnerships. To evaluate Brazilian cities in this regard, it is possible to use techniques that analyze the quality of service and operational efficiency of transport companies. In this study, the scale was used to measure market users' interest in adopting electric bus technology. Maturity level 1 corresponds to cities with no interest to users, and scale 9 corresponds to cities with large interest.

Sub-criterion 4.3. Aspects of Interest: The technical and financial capacity of electric bus manufacturers is important to evaluate the development and implementation of such technology. It is essential that manufacturers invest in research and development and have a strategic vision for the future of the sector. To assess the maturity of this criterion, level 1 corresponds to manufacturers who implement incremental innovations in current models, while level 9 corresponds to manufacturers having the production of electric buses as their main production line.

Sub-criterion 5.1. Current Technologies: According to Olegário and Vaz (2019), updated technologies, largely driven by small businesses, such as lithium-ion batteries and fast chargers, are crucial for the energy efficiency of the transport system. To assess the level of technologies in cities, the Urban Systems study was used – Ranking Connected Smart Cities of 2022, which evaluates Brazilian cities in relation to technology and innovation in 15 indicators, including

the growth of technology companies, incubators, and technology parks. The scale was designed with a score of 1 corresponding to maturity level 1 of current technology, and 9 corresponding to maturity level 9 of the scale, with intermediate values between the extremes.

Sub-criterion 5.2. Emerging Technologies: Chen and Zhang (2020) highlights the importance of investing in emerging technologies, again bringing in lithium iron sulfate batteries and electric vehicle chargers (EVSE), to ensure the long-term competitiveness of the electric transport sector. Small businesses are essential in this process, as energy development agents. Similar to sub-criterion 5.1, to assess the level of emerging technologies in cities, the Urban Systems study was used – Ranking Connected Smart Cities, 2022 edition, which evaluates several Brazilian cities on 15 technology and innovation indicators. The scale was designed considering a score of 1 equivalent to maturity level 1 of emerging technologies, and 9 equivalents to level 9 of the scale, with intermediate values between the extremes.

Data Analysis

Predictive Analysis was used in this study. Statistics serves not only as a quantifying tool, but also to create models and formulas that can anticipate results. This is the central point of predictive analysis, which has as its main objective the search for a “pattern” that explains a given phenomenon and helps predict its effects. This is done, for example, by methods such as regression, in which a certain fact is conditioned to another, and this relationship may or may not be confirmed. This analysis is applied in conjunction with the AHP method, since the criteria may or may not be conditioned on each other, for example, kilometres travelled daily by bus also conditioned on the size of the population served and the geographic region of service.

Criteria for Choosing Cities

The model adopted in this study, using the AHP technique, with the assigned criteria and sub-criteria as well as the maturity scale can be applied to any Brazilian city, as long as comparison data is available, with the prerogative that it is possible to assign the appropriate scores from secondary data criteria (sub-criteria) and peer assessment (main criteria, through research or another instrument).

In this study, the cities of São Paulo (SP), Rio de Janeiro (RJ), Brasília (DF), Curitiba (PR), Campinas (SP), Salvador (BH) were selected for the final assessment. The choice of Brazilian cities as important centres of economic and demographic development, which have stood out for adopting sustainable solutions for urban mobility, such as the use of electric buses. These cities were selected based on criteria including the presence of electric buses and their inclusion on the E-bus radar monitoring website. The use of electric vehicles in the public transport fleet contributes to the reduction of air and noise pollution, in addition to providing a more comfortable journey for users. The inclusion of these cities on the E-bus radar website indicates their importance in promoting the transition to a more sustainable energy matrix and the evaluation of their performance in this area.

Results

On the 1st stage of the process, an external survey was carried out to collect primary data, which was applied to define the degree of importance between pairs of criteria and sub-criteria from the same clusters. On the survey questionnaire, questions were structured using a rating scale to compare pairs of criteria, considering the five established criteria, as shown in Figure 1. In

this case, the participant should compare pairs of related criteria, for example Regulatory Aspects vs. Technology, establish which is most important and what is the degree of importance, clicking on numbers 1 to 5, next to the most important criterion. A total of 44 interviews were carried out, 25 of which were validated and 19 discarded.

Based on the outcome of the interviews, a criteria importance degree matrix was established following the AHP analytical model, as shown in Figure 3.

	1. Usage Data	2. Capex and Opex	3. Regulatory Aspects	4. Sociocultural Aspects	5. Technology
1. Usage Data	1	1/3	1/3	1	1/3
2. Capex and Opex	3	1	1/3	1	1/3
3. Regulatory Aspects	3	3	1	3	1
4. Sociocultural Aspects	1	1	1/3	1	1
5. Technology	3	3	1	1	1

Source: The authors, from primary data collected.

Figure 3: Criteria Importance Degree Matrix

Table 3 shows the detailed results for the city of Curitiba, as it is the most advanced city in Brazil on the implementation of electric buses. In addition, Curitiba is one of the most innovative cities in Brazil, with the most efficient transportation system.

Table 3: City of Curitiba Results

CURITIBA								
Scenario 1 Low Policies			Scenario 2 Medium Policies			Scenario 3 High Policies		
Ranking	Results Scale	%	Ranking	Results Scale	%	Ranking	Results Scale	%
1º	1	26.90%	1º	5	24.38%	1º	9	21.62%
2º	6	21.32%	2º	6	21.32%	2º	6	21.32%
3º	3	10.94%	3º	1	11.15%	3º	1	11.15%
4º	2	8.67%	4º	3	10.94%	4º	3	10.94%
5º	5	8.64%	5º	2	8.67%	5º	2	8.67%
6º	4	5.88%	6º	4	5.88%	6º	5	8.64%
7º	7	5.88%	7º	7	5.88%	7º	4	5.88%
8º	8	5.88%	8º	8	5.88%	8º	7	5.88%
9º	9	5.88%	9º	9	5.88%	9º	8	5.88%

Source: The authors, from primary data collected.

Table 4 shows the consolidated results for the entire sample.

Table 4: Consolidated Results

City	Scenario 1 Low Policies		Scenario 2 Medium Policies		Scenario 3 High Policies	
	Results Scale	%	Results Scale	%	Results Scale	%
São Paulo	1	26.90%	5	37.52%	5	21.78%
Rio de Janeiro	1	26.90%	5	24.84%	9	21.62%
Brasília	1	26.90%	5	37.52%	5	21.78%
Curitiba	1	26.90%	5	24.38%	9	21.62%
Campinas	1	26.90%	5	37.52%	5	21.78%
Salvador	1	26.90%	5	39.82%	5	24.08%

Source: The authors, from primary data collected.

The results from the 6 cities in our sample show they all have the same behavior, with similar variation in the criterion related to public policies. Considering a scenario in which all cities have few and/or inefficient policies regarding urban mobility, all cities obtain the lowest level of maturity, with a percentage of 26.9% in relation to the other levels (2 to 9), in relation to the adoption of the electric bus. Even cities considered to be highly innovative in Brazil, the case of Curitiba, are not capable of obtaining the minimum degree of maturity, observing the degree of importance between pairs of criteria and sub-criteria. By changing the degree of the scale of the criteria corresponding to public policies (criterion 3 and sub-criteria), to a medium level, all cities reach, in general, this same final level of maturity (scale 5), with Curitiba and Rio de Janeiro being above 24% and the other cities above 37%.

With efficient public policies, the cities of Rio de Janeiro and Curitiba reach maximum maturity in the adoption of electric buses. Not surprisingly, Curitiba is home of multiple small business accelerators and incubators, that bring in technology development for the city's technology system, facilitating the electric bus technology adoption and the development of local public policies. The other cities come second in terms of maturity, demonstrating the influence of public policies on the adoption of electric buses. These policies also have a direct impact on other criteria, such as system users and operators and electric bus manufacturers. The increase in regulatory aspects tends to take cities to a higher level of maturity. However, isolated criteria 1, 2, 4 and 5 do not have a significant influence on the overall increase in city maturity compared to the increase in regulatory aspects.

Discussion

In this study, a model was developed to evaluate the degree of maturity of Brazilian cities in adopting electric buses for urban mobility. The AHP technique was used in conjunction with a maturity scale to analyse the established criteria. The simulation in the Super Decision software considered three scenarios related to regulatory aspects, including public policies, national and international incentives. The objective of these scenarios was to demonstrate that the existence of policies and incentives can increase the degree of maturity of cities in adopting electric buses. The study made reference to the concept of smart cities, which use information and communication technologies to improve various aspects, including transport. The electric bus is considered a fundamental part of a sustainable transport system, directly contributing to the sustainable development of smart cities. (Da Silva & Peres, 2022).

Another important point is the sustainable development goals (SDGs) of the United Nations, which bring goals related to sustainability, highlighting objectives 9.4 (modernization of infrastructure by 2030) and 12.3 (reduction of waste per capita). In this study, issues of geography and the possibility of reducing CO₂ in the atmosphere were considered using electric buses in urban mobility, which are directly aligned with the aforementioned SDGs. Furthermore, other positive results, not directly explored in this study and which are in line with the SDGs, can be cited such as: reduced noise pollution, more efficient public service, and improved public transport. The social sustainability of electric buses extends beyond these benefits to encompass broader social, economic, and community impacts. By prioritizing the well-being and needs of people, electric buses contribute to more inclusive, equitable, and resilient urban societies, fostering positive social change and enhancing the quality of life for present and future generations.

SDG 7.3 with the aim of doubling the global rate of improvement in energy efficiency by 2030 was also mentioned in the outcomes of the AHP method application. In this question, it was emphasized that the transport sector was the second largest energy consumer in the years 2018, 2019 and 2021, coming in second place in 2020, according to the 2022 energy balance, based on 2021 data (BEN, 2022). Brazil has mainly fossil fuel-powered buses, but electric buses are more efficient and sustainable. With 444 electric vehicles Brazil avoids the emission of 53 kt of CO₂. The adoption of electric buses contributes to the sustainable transition in urban mobility, meeting demands for better transport and less pollution. Technology development from small business entrepreneurial innovation is instrumental in this process. In addition, when growing the electric bus industry, small businesses are involved in the challenge of creating an ecosystem that is still in its infancy (Amir & Prabawani, 2023). Chile and Colombia have larger fleets of electric buses, investing in sustainability and complying with international agreements. The growth of this market depends on efficient public policies. Furthermore, the Transformative Innovation Policy (TIP) is advocated as a governmental approach to encourage strategic innovation and research, promoting structural change in the innovation system. The electric bus is aligned with public policies to encourage innovation and improve urban mobility.

It is notable, therefore, that electric bus technology is largely propelled by small business development and brings numerous benefits to society in terms of urban mobility, derived from the social acceptance of electric bus projects implementation. Hence, involving the community in decision-making processes, cities can address concerns, build trust, and garner support for electric bus initiatives, beyond promoting social equity through increased mobility options to underserved populations (Amir & Prabawani, 2023).

However, the implementation of electric bus technology depends on several criteria, such as the five criteria and corresponding sub-criteria considered in this study. When analyzed separately, a city can quickly assess what level it is at in adopting such technology, considering, for example, the geographic issue or population to be served. But when the question requires looking at a set of factors simultaneously, difficulties can be established in defining the level of maturity a city is at. This study considered the AHP technique to define the degree of maturity of the 6 cities analysed based on the questions considered. The model allowed not only to consider the 5 criteria and 14 sub-criteria together but also to demonstrate that the incidence of public policies and incentives accelerate and raise the level of maturity for technology adoption. Quantitative criteria were stipulated that directly influence the electric bus adoption process, separated into five distinct clusters, grouped as criteria (use and performance data, capex and opex, regulatory aspects, sociocultural aspects and technology), with their respective subcriteria.

The AHP model was developed based on primary data collection that assessed the relative importance of criteria and sub-criteria. The results indicated that regulatory issues, such as public policies and incentives, had the greatest importance, followed by the emerging and current technology cluster. Usage and performance data were of least importance. These importance scores were kept constant in all scenarios and cities, while the scores assigned to each sub-criterion could vary according to the defined scales. The model allows scale adaptations, if necessary, to include new cities, maintaining the position of the six existing cities. In all results obtained in the 6 cities, considering the initial scenario of low public policies and international incentives, a low degree of technological maturity was observed, classified as level 1. This indicates that the other sub-criteria were not sufficient to raise the level of maturity of cities. However, when scenarios 2 and 3 were simulated, the maturity level increased to levels 5 or 6, reaching 9 for Curitiba and Rio de Janeiro. This suggests that public policies, national, municipal, state, and international incentives are determining factors for the adoption of technology. The model also revealed that cities have different degrees of maturity in each subcriterion, as in the case of geography in São Paulo, which obtained a score of 7 compared to a score of 3 in Curitiba. However, when analysed together, considering all sub-criteria and criteria with the same weights, Curitiba reaches a general level of technological maturity of 9, while São Paulo reaches, at most, level 5. Finally, it is highlighted that actions Isolated measures aimed at each of the sub-criteria implemented by cities can improve the level of maturity for adopting technology, but public policies substantially accelerate results, as they interfere and assist in the other sub-criteria considered.

Conclusion

The results of this research work indicate that public policies influence the degree of technological maturity in the adoption of electric buses as a sustainable urban mobility solution in Brazilian cities, answering our research question. The use of electric buses can be an effective solution to reduce greenhouse gas emissions and improve air quality in cities, along with other benefits potentially coming from public policies, such as reduced noise pollution, more efficient public service, and improved public transport. Small businesses have a pivotal role in technology development for these ends. Furthermore, the model created to evaluate the level of technology in Brazilian cities and the results obtained validate the possibility of application in other cities and the inclusion of new parameters and analysis criteria. This is due to the fact that the model is dynamic and can be adapted to the needs and perceptions of the actors and observers involved. Other points can be considered, such as, for example, the adoption of independent scales for the sub-criteria of current and emerging technologies, as well as the application of conceptual notes for the scales aimed at public policies, the object of this study.

The social sustainability of electric buses encompasses various aspects related to their impact on communities, passengers, and urban societies. Benefits such as improved air quality, noise reduction, equitable access to transportation, community engagement and participation, and promotion of sustainable lifestyles are obtained from the adoption of electric bus technology. Beyond their environmental advantages, electric buses have broader social, economic, and communal benefits that contribute to their social sustainability. By putting people's needs and well-being first, electric buses support resilient, inclusive, and equitable metropolitan communities that improve the standard of living for both current and future populations.

This work has some limitations. Firstly, the sample is from Brazilian cities. While implicit generalization can be made through similarity, additional data is needed to validate the model in other parts of the world. Second, the model was built based on AHP, which allows quantitative

pairs through criteria of comparison. Further exploration on the subject using different models could expand the reach of this work. Third, evaluating the maturity of cities involves numerous factors, including infrastructure, regulations, public acceptance, and financial feasibility. AHP may struggle to adequately capture the interrelationships and tradeoffs among these factors, leading to oversimplification or overlooking critical considerations. Fourth, AHP provides a structured framework for decision-making but may lack the contextual understanding necessary to address the unique socio-economic, cultural, and political dynamics influencing city maturity in Brazil. This limitation could lead to generic or contextually inappropriate recommendations.

Recommendations for future research. The first recommendation is on the methodological approach. Researchers could conduct comparative studies across cities within Brazil or other countries to assess the effectiveness of AHP in different contexts. By examining variations in city characteristics, regulatory frameworks, and stakeholder dynamics, researchers can identify factors that influence the suitability and reliability of AHP for evaluating city maturity. The second recommendation is on the operational framework, where researchers could investigate emerging technologies and innovations in electric buses, battery storage, charging infrastructure, and vehicle-to-grid integration. Research efforts could focus on improving battery efficiency, reducing charging times, enhancing range capabilities, and optimizing fleet management systems to address current limitations and accelerate the transition to electric buses. Finally, conduct studies to track the progress of cities in adopting electric buses over time, by analysing trends in policy development, infrastructure investment, technological advancements, and fleet deployment, researchers can identify patterns of change and factors influencing the maturity of cities in embracing electric buses as a sustainable transportation solution.

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BEYOND PROFIT-CENTRIC MOTIVES: FACTORS THAT FACILITATE OR HINDER SUSTAINABLE ENTREPRENEURSHIP ACROSS EMERGING AND DEVELOPED MARKETS

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Abstract

Entrepreneurship plays a crucial role in a society's economic growth and employment. However, sustainable entrepreneurship goes beyond the conventional profit-centric motives, taking a holistic approach to business management. Sustainable entrepreneurship has now matured as a sub-field within the entrepreneurship domain. This study provides a comprehensive and systematic review of the entrepreneurship literature on sustainable entrepreneurship, focusing on drivers and hindrances in emerging and developed markets from an inside-out and outside-in perspective. The aim is to provide an overview of the current state of sustainable entrepreneurship by identifying context-specific drivers and hindrances, suggesting potential practical and policy implications, and proposing future research directions in this field.

The findings show that underrepresenting factors related to the inside-out perspective compared to the outside-in perspective in sustainable entrepreneurship emphasizes the critical role of structural and systemic aspects at the firm and national levels. This highlights the need for prioritizing initiatives by policymakers and business leaders that address institutional frameworks and regulations to foster sustainable entrepreneurship. The emphasis on firm and national factors underscores the importance of collaborative efforts for sustainable entrepreneurship success. Collaboration among diverse stakeholders, including businesses, governments, and other entities, is crucial. Strategies should encourage comprehensive, collaborative initiatives to address sustainable entrepreneurship challenges. The literature highlights the positive impact of networks on sustainable entrepreneurial activities, especially in emerging markets. However, there is a gap in research focusing on the individual inside-out perspective in these markets, suggesting a potential area for future exploration. In particular, cross-cultural studies beyond the Hofstede framework can provide insights into how values at the individual level, such as religion or professional standards, influence the adoption of sustainable entrepreneurship.

Entrepreneurs' previous knowledge and experience are crucial in identifying sustainable opportunities through entrepreneurial alertness. Human and social capital are the key drivers for sustainable entrepreneurial ventures, both domestically and internationally. However, the existing financial metric orientation poses a challenge in assessing the success of sustainable entrepreneurship. In the organizational context, management can either enable or hinder sustainability efforts. Making operations sustainable may increase complexity, necessitate new skills, and incur higher costs, which can challenge traditional financial success metrics and require changes in management education. Future research is recommended to investigate comparative studies that track the evolution of sustainable entrepreneurship, considering external factors like EU policy changes and global events such as the COVID-19 pandemic or climate change.

Keywords

Sustainable entrepreneurship, drivers and hindrances, social entrepreneurship, environmental entrepreneurship, literature review, emerging markets, develop markets.

Introduction

While entrepreneurship plays a vital role in economic growth and employment at the societal level (Siegel & Bastos Lima, 2020), sustainable entrepreneurship (SE) represents a paradigm within entrepreneurial activities that extends beyond conventional profit-centric motives, incorporating a holistic approach to business management. It refers to discovering, creating, and exploiting entrepreneurial opportunities that contribute to sustainability by generating social and environmental gains for various stakeholders (Hockerts & Wüstenhagen, 2010; Pacheco et al., 2010; Shepherd & Patzelt, 2011). While initially, the theories and normative frameworks proposed have drawn from well-established domains, such as social entrepreneurship and environmental economics, sustainable entrepreneurship appears to be gaining a level of maturity as a subfield within the entrepreneurship domain (Muñoz & Cohen, 2018). Further research is required to explore the role of entrepreneurial action as a mechanism for sustaining nature and ecosystems while generating economic and non-economic benefits for investors, entrepreneurs, and societies (Shepherd & Patzelt, 2011).

This study contains a comprehensive and systematic review of the entrepreneurship literature on SE, focusing on drivers (enablers) and hindrances (obstacles) in emerging and developed markets. With this review, we will establish a state-of-the-art overview of the various streams of literature, identify drivers and hindrances across emerging and developed economies, point towards potential practical and policy implications, and present proposals for future research in this field.

The Triple Bottom Line (3BL) approach, which refers to simultaneously achieving economic/financial, social, and ecological/environmental sustainability, is prevalent in large parts of the sustainable entrepreneurship discourse and literature (Greco & de Jong, 2017). SE operationalizes these principles, embodying a strategic approach to reconcile profitability with social sustainability and environmental stewardship (Urbaniec et al., 2022).

While social and environmental sustainability is inextricably intertwined but often at odds, forms of sustainable entrepreneurship that attempt to utilize market mechanisms to benefit social and environmental welfare can encounter considerable difficulty in simultaneously pursuing all three aspects of the triple bottom line, sometimes also referred to as the ‘3P’: Profit, people, and planet (Shepherd & Patzelt, 2011). While considerable research has been carried out at national, regional, national, and individual levels to identify the drivers and hindrances to entrepreneurship (e.g., Berman et al., 2023; Chowdhury, 2015), we expect them to differ in SE due to the differences in objectives, values, and approaches compared to traditional entrepreneurship. Sustainable entrepreneurs are more concerned with the enduring success of their ventures and their contributions to a sustainable future (Schaltegger & Wagner, 2011). At the same time, traditional entrepreneurship often focuses on short-term financial gains and immediate returns on investment, with less emphasis on long-term sustainability. Moreover, SE tends to be driven by a strong sense of purpose beyond profit, aiming to address societal and environmental challenges. While identical considerations may be present in traditional entrepreneurship, the primary focus is creating and maximizing shareholders’ financial value. Hence, stakeholder engagement may be more limited, ensuring that the needs and expectations of shareholders are satisfied. By contrast, SE actively engages with a broad range of stakeholders, including communities, employees, customers, and environmental groups, to ensure that business activities are aligned with sustainable practices and address stakeholder concerns (Muñoz & Cohen, 2018).

Through a systematic and critical literature review explicitly focusing on SE, we clarify the state-of-the-art research concerning drivers and hindrances. However, while the fundamental principles of sustainability remain applicable globally, we propose that specific challenges and opportunities differ between emerging and developed economies. Sustainable entrepreneurs must tailor their strategies to the unique characteristics of the economic context in which they operate, considering factors such as resource availability, regulatory environment, market dynamics, and consumer expectations, apart from cultural nuances that may be reflected at national and individual levels. Hence, we contextualize SE's drivers and hindrances by differentiating between emerging and developed market economy contexts.

The remainder of the paper is structured as follows: First, we comment on the development of the SE concept before describing the methodology for the systematic literature review. We then present the descriptive statistics before engaging in a content analysis of the articles encountered before discussing future research opportunities.

Sustainable entrepreneurship – a theoretical approximation

From a societal perspective, entrepreneurship drives economic growth and develops employment opportunities (Siegel & Bastos Lima, 2020). Furthermore, the scope of entrepreneurship has expanded beyond traditional economic interests to address societal and environmental challenges such as poverty, hunger, and climate change (Dean & McMullen, 2007). Therefore, SE has emerged as a solution to these challenges, and scholars have started to show interest in assessing SE's underlying enablers and hindrances.

Based on the United Nations' Sustainable Development Goals (SDGs), SE is highlighted as an important and crucial contributor to society and environment development (Khan et al., 2022). Therefore, sustainability has garnered widespread support and recognition from all stakeholders, mainly due to the growing concern over environmental challenges such as climate change, gas emissions, global warming, carbon footprint, and water and land pollution from various sources (Taibjee & Woodley, 2020). Moreover, the 12th SDG asserts that responsible consumption and production and increasing sustainability during production have become crucial objectives (Mangla et al., 2017). Subsequently, businesses are transitioning from a conventional linear consumption model to a more sustainable one in response to customer demand, societal issues, and environmental challenges (Siegel & Bastos Lima, 2020).

Moreover, in light of recent crises, such as the COVID-19 pandemic and its impact on sustainable development and economic activities, a need for innovation and entrepreneurship to address the crisis is more called out (Li-Ying & Nell, 2020). Moreover, the COVID-19 pandemic has shown the different weakening factors that impact companies, especially regarding liquidity problems and uncertainties for business continuity (Zutshi et al., 2021). This radical change in the business environment, opportunities availability, and increased uncertainty forces entrepreneurs and corporations to rethink business models and consider and enhance their sustainability capabilities to survive and thrive (Kitsios et al., 2020).

In this regard, SE has gained significant attention from managers and scholars in recent years, which may explain the myriad of definitions regarding it. For example, sustainable entrepreneurship involves the creation and development of new ventures that not only pursue economic goals but also aim to achieve social and environmental sustainability (Gupta & Matharu, 2022). In another register, SE is defined as “characterized by some fundamental aspects of entrepreneurial activities which are less oriented towards management systems or technical procedures

and focus more on the personal initiative and skills of the entrepreneurial person or team to realize largescale market success and societal change with environmental or societal innovations” (Wagner & Schaltegger, 2010, p. 434) While there is a growing body of literature on sustainable entrepreneurship, there is still a need to identify and explore the different enablers and hindrances of sustainable entrepreneurship to understand better the factors that contribute to promote or impede its success. Therefore, the primary goal of this study is to identify and examine the different factors that enable or hinder the development of SE. To do so, this study adopts a systematic literature review examining the enablers and hindrances of SE. We endeavor to map and categorize enablers and hindrances and seek to understand the mechanisms and factors that encourage SE and the various obstacles that hamper engagement in SE. This work can bridge the existing voids in academia and practice by presenting a comprehensive understanding of the motivators that lead to the emergence of entrepreneurial intentions centered around sustainability. Second, this study critically reviews the different macro and micro enablers and hindrances of the SE context specific to emerging and developed market economies.

Methodology

We use systematic literature review (SLR) as a proven method to be effective in summarising “in an explicit way what is known and not known about a specific practice-related question” (Briner et al., 2009, p. 19). Furthermore, SLR is considered to provide meticulous identification and selection of articles in a transparent and replicable process (Bafera & Kleinert, 2022; Siachou et al., 2021; Wang & Chugh, 2014). The performance of a systematic review holds great significance in fostering robust analysis and conclusions and casts light on the knowledge accumulated in a specific field (Atewologun et al., 2017; Christofi et al., 2017; Denyer & Tranfield, 2009; Tranfield et al., 2003).

By doing so, we developed our methodology following the procedures Vrontis and Christofi (2021) advocated. We adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol for article selection (Moher et al., 2009). Our protocol is based on six phases: 1) Potential search terms, 2) pilot search and databases selection, 3) search query, 4) inclusion and exclusion criteria, 5) quality assessment, and 6) analysis and synthesis (see Figure 1).

First, we initiated by exploring the literature on sustainable entrepreneurship (SE) to proceed rigorously. This stage aims to familiarise ourselves with SE’s interrelated concepts and identify the keywords and terms to consider for formulating accurate search strings (Becker & Jaakkola, 2020). Second, we selected Scopus as the central database for article selection as it is a comprehensive and exhaustive academic research database spanning numerous journals. While it should be noted that not all journals are incorporated, generally, the Scopus database encompasses the most prominent and influential journals across diverse fields (Snihur et al., 2022).

Third, we formulated our search queries based on our initial reading of SE. It is crucial to carefully develop relevant search queries to identify articles related to our topic and to determine the quality of this systematic review (Rowley & Slack, 2004; Snyder, 2019). Therefore, to minimize bias, we searched in the title, abstract, or keywords, and we restrained our search to full text, management, and business category, English written articles, and reviews published in academic peer-reviewed journals (Dada, 2018; Keupp et al., 2012) based on the following syntax: (entrepreneur* OR innovat* OR business) OR (“business model” OR “value creation” OR “circular economy” OR “business development” OR “ecosystem” OR “startup”) AND

(sustainabl* OR green OR social OR ethical OR environmental) AND (hindrance* OR barrier* OR limit* OR restrict* OR difficult* OR obstacle* OR disabler* OR driver* OR motivation* OR enabler*). This procedure resulted in 1,918 articles published by February 2023. Later, we removed duplicates (n=5), which yielded 1,913 articles. Fourth, we performed an inclusion and exclusion criteria strategy to include only the relevant articles related to hindrances and enablers of SE. Therefore, we included articles published only in the journal category of Entrepreneurship and Small Business Management of the Chartered Association of Business Schools Academic Journal Guide (CABS AJG - Chartered Association of Business Schools CABS, 2018). We limited our selection to these journals because we wanted to narrow our selection of articles to only entrepreneurship studies.

Furthermore, the ABS categorization includes journals with high impact factors and focuses on the most relevant papers with high theoretical and methodological rigor (John & Lawton, 2018; Marinković et al., 2022; Siemieniako et al., 2021). By doing the process, cut the number of articles selected to 152 articles. Fifth, we conducted a meticulous assessment process, considering only articles that assessed the hindrances and enablers of SE. During this phase, we read full texts of the 152 articles by two co-authors, who served as evaluative judges, and we organized the articles into three distinct categories: “include,” “exclude,” and “maybe.”. The judges unanimously agreed to include 37 articles, exclude 94, and assign 21 articles to the “maybe” category. To minimize any potential biases, we calculated an interjudge reliability level using the proportional reduction in loss (PRL) reliability measure, which is a “direct extension and generalization of Cronbach’s alpha to the qualitative case” (Rust & Cooil, 1994). The resulting PRL reliability measurement of .90 was above the minimum threshold of .70 required for qualitative studies (Rust & Cooil, 1994, p. 9). Subsequently, a third author screened the full text of the 15 articles in the “maybe” category and those assigned to the “disagree” category. Ultimately, we obtained a final dataset of 43 articles assessing hindrances and enablers of SE.

As a final stage in our article selection process, we examined all 43 articles, extracting pertinent information and organizing it descriptively within an Excel database (e.g., Booth et al., 2016). During this final stage, we engaged in content analysis. We coded each article based on title, year of publication, hindrances, enablers, journal, type of study, theory, theme, research methodology, key findings, and identified concepts.

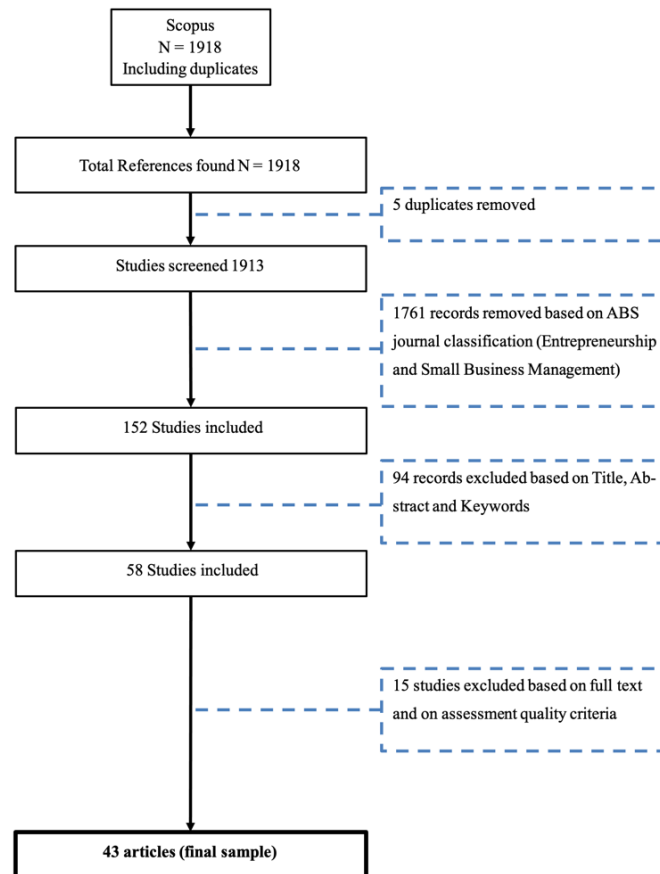
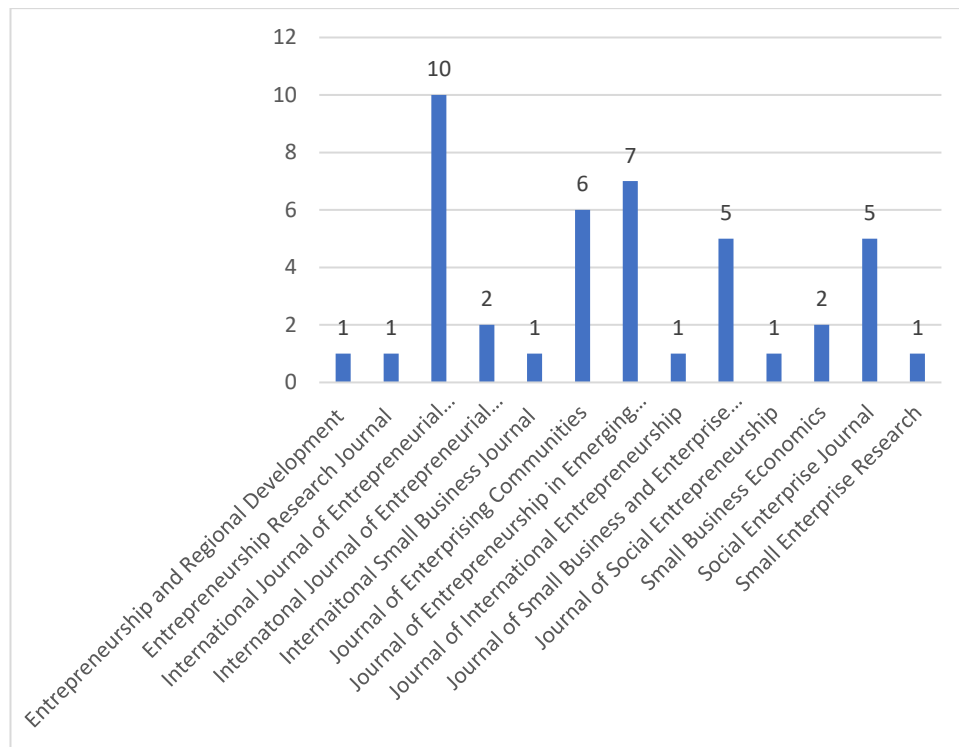


Figure 1: Reporting items for systematic reviews and meta-analysis search protocol

Analysis and Results

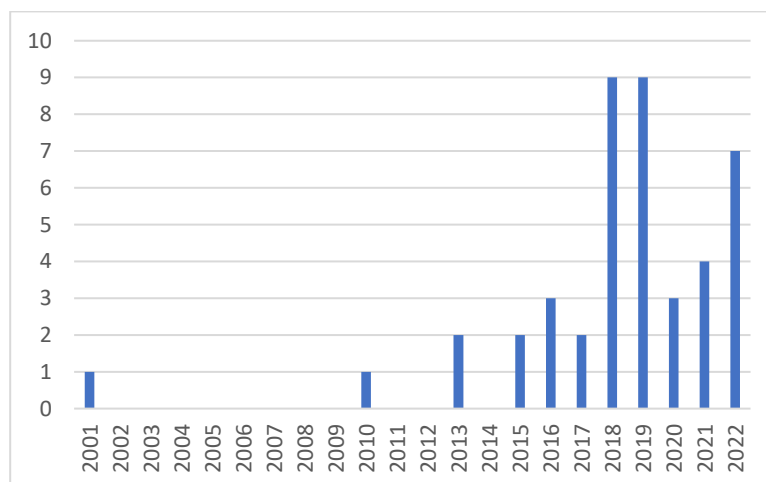
Descriptive Findings

Research about the drivers and hindrances to SE was published in 13 journals, as shown in Figure 1. Just five journals - International Journal of Entrepreneurial Behaviour and Research, Journal of Enterprising Communities, Journal of Entrepreneurship in Emerging Economies, Journal of Small Business and Enterprise Development, and Social Enterprise Journal – account for 77% of the published papers since 2001. Research on SE's drivers and hindrances took off in 2015, with a constant stream of research to be published since 2015 (Figure 1). The International Journal of Entrepreneurial Behaviour and Research published a special issue in 2018, explaining the peak in 2018 and the concentration of research in this journal. Research in this field is mainly driven by empirical studies (42 papers), indicating that extant research has the potential to provide practical insights into the actual challenges and opportunities faced by sustainable entrepreneurs. However, it suggests a lack of theoretical development essential for understanding the underlying principles and mechanisms driving or hindering SE and, in turn, potentially limiting the advancement of knowledge.



Source: own compilation.

Figure 2: Distribution of articles by journal title



Source: own compilation.

Figure 3: Distribution of research by year of publication

Content Analysis and Findings

While coding the extant literature, it became clear that the drivers and hindrances fall into two main categories. The first category includes an individual inside-out perspective, focusing on the single entrepreneur and the personal factors that may promote or limit sustainable entrepreneurial activities. The starting point is the entrepreneur, and the literature investigates the individual factors that may impact their propensity to engage in sustainable entrepreneurship. The other main category has a contextual outside-in perspective. This category focuses on the

various contextual surrounding factors – thus starting ‘outside’ the entrepreneur – that may have an advancing or limiting impact on sustainable entrepreneurial activities.

We divided the literature into studies investigating what could be classified as developed and emerging economies. This type of division is somewhat simplified and generalizing, as each country or region is unique and could be treated separately. However, in this study, we will use the classification, as it allows us to compare, contrast, and highlight critical differences in drivers and hindrances that affect different types of economies differently.

During the coding process, several sub-categories of drivers and hindrances for each main category (individual inside-out and contextual outside-in perspective) became apparent. The sub-categorization was not predetermined beforehand but unfolded and became apparent throughout the coding process. We reviewed the material several times in the abductive coding and content analysis process. The material was coded, analysed, and synthesized. Then, we revisited the theory, which led to coding changes. Then, we re-coded, analysed, and synthesized once more. The individual/inside-out drivers and hindrances include four sub-categories, including cognitive and self-confidence, behavioural factors, emotions/values, and intentions. The contextual outside-in drivers and hindrances include the seven sub-categories: family/network, firm/organization, institutions/markets, education/Universities, government/policy, national/cultural, and technology.

Table 1 provides an overview of the various categories of drivers and hindrances in the literature distinguishing between emerging and developed market economies. For readability, the table only includes keywords for each driver and hindrance.

Table 1: Drivers for and hindrances to sustainable entrepreneurship

	Developed economies		Emerging economies	
	Drivers	Hindrances	Drivers	Hindrances
Individual-level inside-out perspective				
Cognitive/ and self- confidence	Identification of sustainable opportunities Entrepreneurs' prior knowledge Human capital Social capital Prior international experience Entrepreneurial alertness Ability to set aside time for planning Not compromise future prospects by focusing purely on immediate needs, Holistic decision making Focus on significant sust.de-mands Entrepreneurial alertness	Lack of Information Learning/challenges	Self-efficacy Perceived feasibility Perceived desirability	Lack of Information Learning/challenges Challenges related to formal qualifications Refugees face extra layers of difficulties Arrangement scripts: increase in venture-specific skills.
Behav- ioural	Liability of poorness as a motivator Motivated to persevere	Working with various stakeholders Lack of ability to work with various Institutional stakeholders	Influence institutional change by working with multiple stakeholders, Applying entrepreneurial bri-colage	

			Leadership factors: Trusting, innovative team orientation; Leadership factors: A strong and shared vision Willingness scripts	
Emotional / values	Entrepreneurial spirit & enthusiasm Personality characteristics: A personal interest in doing good, Making a positive social contribution Empathy and moral judgment Entrepreneurial self-efficacy Appreciation of the environment Being more environmentally aware Seeing the impact of climate change first-hand Non-financial incentives drive inner values Altruism as a way of thinking Appreciation of nonmonetary compensation Social entrepreneurial self-efficacy Green values Passion Being their own boss Seeing a gap in the market, develop gains for themselves, develop gains for others	For immigrant entrepreneurs: language barriers, lack of experience, host culture, financial constraints A need for security is a hindrance to SE; Attitudinal barriers; Negative perception of sustainability; Risk aversion	Self-transcendent values Sustainability orientation Entrepreneurial passion Entrepreneurial bricolage Persistence Self-enhancement Personal entrepreneurial spirit Personal autonomy and confidence	Attitudinal barriers: positive perception of sustainability, risk aversion
Intentions	Perception/belief of the individual Motivational factors Entrepreneurial intentions Perceived entrepreneurial desirability Attitude toward sustainability Perceived behavioural control It's the right thing to do Export intentions Intentions to create both financial and non-financial profits The social missions Personal views/beliefs Perceived meaningfulness	A negative relation between sustainable orientation and entrepreneurial action Entrepreneurship and sustainability are not linked The cause of environmental problems Female-led social 'lifestyle' enterprises Social vision and prosocial intentions Social mission is both driver and barrier	Social, institutional variables Subjective norms Social networking Sustainability oriented values Personal motivations A wish to break barriers A positive attitude Entrepreneurial motivation drives entrepreneurial intentions Entrepreneurial self-efficacy Avoid unemployment & discrimination Survive without the aid of NGOs Get around the local policies and the unfavourable economic conditions Not wanting to be a burden to society Intention to create a venture	
Aggregate outside-in perspective				
Family/network	Belonging to local social networks		Family exposure Prior entrepreneurship experience	

	Giving back to the local community Sharing business success Generate goodwill for their firms Local social networks as a driver of local social value creation Virtual community participation Social and cultural capital Human and social capital Networks and networking		Social network thanks to the diaspora Social networking with people with similar interests can provide resources	
Firm/organizational	Taking advantage of external market opportunities Cost reductions/ financial benefit Personal commitment, Responsibility to the community Marketing benefits Compliance with regulations, Meeting people's expectations. Simple activities, saving energy Activities that are not (too) costly Recycling and waste minimization Good business ethics as good business financially	Management unwillingness Complexity in business operations Stakeholder engagement & integration Information System Susceptibility to errors High operating cost Lack of necessary talent Lack of Human Resource Training Costs, Time, Lack of resources, Knowledge deficit Cost implications Lack of awareness and regulation Make a constant effort The need to make money/profit. Money will always overtake social motivations. Short-term considerations in terms of needed profit	Taking advantage of external market opportunities for social innovation	Management unwillingness Complexity in business operations Stakeholder engagement and integration Information System Susceptibility to errors High operating cost Resource-constrained environments Inability to incorporate sustainable practices Lack of education Limited environmental awareness Weaker inter-firm knowledge Exchange collaborations Illegitimate practices of competitors force firms to do the same
Institutional and markets	Market size, i.e., large market sizes (abroad), are enablers. Opportunity recognition: seeing opportunities. Environmental Management Systems (ISO 14.001)	Financial, structural, and operational barriers Liability of poorness and poverty Inadequate resources, insufficient capabilities, limits on access to a given opportunity Diminished self-perceptions Experienced scarcity Competitors are lowering the quality	Social norms Foreign funding helps local firms' CSOs Institutional infrastructure Coercive, normative, and mimetic isomorphic pressures Intermediary organizations Impact investment Financial capital Human capital Social capital Political instability in the home country Pull and push factors for SE	Financial, structural, and operational barriers Lack of formal qualifications Refugees face extra difficulties in mobilizing resources Social capital compensated for lack of formal qualification Linking social capital Lack of legitimacy Institutional dysfunctions Institutional barriers within the ecosystem Monopolization of knowledge networks Distance between social and political priorities Mainstream financial institutions

Education/ Universi- ties	Entrepreneurship education Perceived meaningfulness: prosocially motivated individuals Appreciation of nonmonetary compensation Social entrepreneurial self-efficacy Education and entrepreneurial experience Formal & informal ties, network Universities and research centers	Entrepreneurship education The existing frameworks do not take the entrepreneurship process into account	Education for sustainable entrepreneurship Support from financial bodies and universities Education and learning drive entrepreneurship	Traditional teaching about SE does not drive SE Learning should be action-based, flexible, and relevant in terms of context and social aspects Lack of education
Govern- ment/ pol- icy	Government regulation and policy impact entrepreneurial activities Information from governmental and non-governmental institutions		Government legislations	Ethnic and administrative barriers Unstable political situation Mutual historical tensions and lower trust
National/ Cultural	Local market opportunities and the specific ethnic resources available	Unanticipated external change Exogenous market shocks	Welfare states Market forces & the social economy itself Environmental regulations and international buyers	Unanticipated external changes Exogenous market shocks
Technol- ogy	ICT Internet of things Smart Products Feedback-rich systems Traceability Social media Virtualization Product Service systems Circular Product Design Circular Business model Big Data and Data Analytics Serviced business models Industry 4.0 Digital Printing Additive manufacturing, Smart Manufacturing	Integration of digital technologies Lack of interface design Difficulties in upgrading technology Outdated automated synergy models	ICT Internet of things Smart Products Feedback-rich systems Traceability Social media Virtualization Product Service systems Circular Product Design Circular Business model Big Data and Data Analytics Serviced business models Industry 4.0 Digital Printing Additive manufacturing, Smart Manufacturing	Integration of digital technologies Lack of interface design Difficulties in upgrading technology Outdated automated synergy models

Individual level inside-out factors: Enablers

Much of the literature and studies deal with the individual entrepreneur and their motivations, drivers, and obstacles for engaging in sustainable entrepreneurship.

Entrepreneurs' prior knowledge and experience are essential in identifying sustainable opportunities (Hanohov & Baldacchino, 2018; Del Vecchio, Secundo, Mele & Passiante, 2021). The ability to exercise entrepreneurial alertness (Kirzner, 1999) refers to the cognitions and behaviors that enable individuals to recognize more promising opportunities, including those perceived as sustainable. Entrepreneurial alertness includes the ability and willingness to develop behavioral patterns (e.g., asking questions, following the news, and searching for information) and cognitive abilities (e.g., connecting the dots, seeing environmental trends, and identifying patterns) (Gaglio & Katz, 2001).

Appropriate (high) human and social capital among entrepreneurs are drivers both domestically and in the internationalization process of sustainable entrepreneurial ventures (Luseno & Kolade, 2022). Human capital refers to both general knowledge, skills, and competencies (education, general business knowledge) as well as domain-specific knowledge (prior entrepreneurial experience, knowledge in the specific sector/industry, and knowledge about sustainability), and literature shows that high(er) human capital drives the ability to pursue sustainable entrepreneurial ventures (Bhatt & Ahmad, 2017; Samaratunge et al., 2015).

Social capital refers to the potential entrepreneur's background and networks (Honing & Davidsson, 2003). Belonging to local social networks is a driver for social and environmental entrepreneurship. Belonging to a local network is a catalyst because entrepreneurs may want to sponsor or 'give back' to the local community and thus 'share' their business success. This may be done from an altruistic/idealistic stance, but it may also be seen as a way to generate goodwill for their firms (De Beer, 2018).

Personal values play a significant and vital part. Studies show a personal interest in doing good, i.e., making a positive social contribution, empathy, and moral judgment. Inner values and non-financial incentives may drive entrepreneurs. So does an altruistic way of thinking. Individuals with strong prosocial motivation may feel compensated by enhancing societal value in addressing social problems, although the work is not necessarily monetarily rewarded. These individuals may envision other possible satisfaction from their prosocial behaviour (Grant & Berry, 2011), such as seeing those deprived of essential resources successfully overcome hardships due to their social enterprises' products and services.

The concept of social entrepreneurial self-efficacy drives social innovation and entrepreneurship. Prosocially motivated individuals may be genuinely concerned about the needs of others (Meglino & Korsgaard, 2004). They will consequently seek and process information based on multiple perspectives (De Dreu et al., 2000) to understand what people need and determine how to reconcile all those interests. Thus, combining a (high) level of entrepreneurial self-efficacy and a prosocial and pro-environmental mindset is an essential individual enabler of sustainable entrepreneurship.

Altruism, inner values, and a sustainable mindset do not exclude a parallel motivation and desire to develop gains for themselves. Even though sustainable entrepreneurs may not want to exploit a gap in the market that they do not perceive as sustainable, they still want to be profitable and make a living (Kirkwood & Walton, 2010). Wanting to be self-employed and achieving personal monetary gains is essential in most sustainable entrepreneurial ventures (Hanohov & Baldacchino, 2018; Kirkwood & Walton, 2010), in parallel with the desire to make a positive difference.

The literature on SE relies heavily on the Theory of Planned Behaviour. There is strong evidence that personal attitudes, subjective norms, and perceived behavioural control drive sustainable entrepreneurial intentions, which drive sustainable entrepreneurial behaviour (Ajzen, 1991).

In sum, the studies show that sustainable entrepreneurs are motivated by mainly six factors: 1.) green and social values 2.) the desire to be profitable and earn a living; 3.) a sustainable passion and intention; 4.) having a high perceived behavioural control and high entrepreneurial self-efficacy 5.) being their own boss, and 6.) seeing a sustainable gap in the market.

Individual level factors: Enablers in developed vs. emerging economies

These factors are applicable in both developed and emerging economies. However, some additional factors are specific to emerging market economies.

Emerging economies tend to be characterized by (more) severe resource constraints. These constraints are both financial on an individual micro-level and a country-wide macro-level, and there are also constraints regarding the availability of skilled labour and advanced educational levels. Respective research underlines the drivers in emerging market economies to overcome these resource constraints. Applying entrepreneurial bricolage, which means using the means at hand, making do, and creating something out of nothing (Baker & Nelson, 2005), is a way of overcoming resource constraints. It implies making workable, functional solutions, which may not be perfect but are made by combining the resources at hand to the new problems and opportunities in new and innovative ways (Baker & Nelson, 2005; Desa & Basu, 2013; Murnieks et al., 2020).

More recent studies on SE in developing economies investigate entrepreneurial passion, spirit, and persistence and find that the passion and individual will to overcome obstacles are essential drivers in markets characterized by resource constraints and (lack of) institutional support (Alexandre et al., 2019; Ciambotti et al., 2022; Thorgren & Omoredede, 2018).

Individual level inside-out factors: Hindrances

In terms of hindrances, the more recent literature pinpoints the lack of information and learning about sustainability (Antikainen et al., 2018; Cantú et al., 2021; de Sousa Jabbour et al., 2018; Khan et al., 2022; Pham et al., 2019). Another hindrance to engaging in SE is the perception that entrepreneurship and sustainability are not linked; entrepreneurship might even be seen as the cause of environmental problems instead of a potential solution (St-Jean & Labelle, 2018).

Individual level factors: Hindrances in developed vs. emerging economies

Comparing developed and emerging market economies, extant studies in emerging markets have primarily identified factors related to cognitive and self-confidence and emotions/values. There is a lack of formal qualifications that can be recognized by stakeholders (Khan et al., 2022; Wahga et al., 2019) and arrangement scripts (Abdelnaeim & El-Bassiouny, 2021). In both contexts, sustainable entrepreneurs unfamiliar with the national context, either for being refugee or immigrant entrepreneurs, face additional barriers in the form of language challenges, unfamiliarity with context, etc. (Chen et al., 2019).

Contextual outside-in factors: Enabling factors

The second main category in the literature deals with the contextual outside-in factors, which are more numerous than the inside-out, individual-level factors.

At an organizational/firm level, the enablers of sustainable entrepreneurship are often simple activities that are not (too) costly, such as recycling, waste minimization, and saving energy when running the business (Shahedul Quader Kamal & Hassan, 2016). Communication of the firms' potential sustainable product or production elements in marketing is also seen as a sustainable activity. However, there is a related debate (outside the scope of this study) about communication and potential 'green-washing.'

Drivers of environmental improvements of firms can include cost reductions/financial benefit, personal commitment, responsibility to the community/social good, and marketing benefits when showing high business ethics and thus meeting people's expectations (Cassells & Lewis, 2019; Martin, McNeill & Warren-Smith, 2013).

Technological development plays a vital role in finding (more) sustainable solutions to the various customer demands and the grand challenges that society is facing. Information Communication Technology may speed up process development time and speed up time-to-market for sustainable solutions, and it may reduce the need for business travel, including flight trips (Antikainen et al., 2018; Bressanelli et al., 2018a; Cantú et al., 2021; Salmenperä et al., 2021).

In addition, new technologies may advance circular product design and circular business models with lesser resource consumption and more efficient recycling systems (Alcayaga et al., 2019; Bocken et al., 2016; Khan et al. 2022).

As described in the above section on individual drivers, being an active member of social and local networks can enable social and environmental entrepreneurship. Networks can also be seen as a contextual outside-in enabler. Local social networks may act as a catalyst and factor for entrepreneurs to do good in the local environment. Thus, networks may act as a driver of local social value creation.

Perhaps not surprisingly, the legislation and regulations act as an organisational-level enabler. Firms strive to comply with regulations; thus, tighter environmental and social regulations will drive firms to higher social and environmental compliance (Martin et al., 2013). Another fundamental enabler is the fact that there are significant and seemingly increasing market opportunities for (more) sustainable ventures (Dowin et al., 2019; Zolfaghari Manesh & Rialp-Criado, 2019).

Furthermore, universities and educational institutions play an essential role as an enabler of sustainable entrepreneurship. Entrepreneurship education (competencies in sustainability education) arises as a valuable perspective for creating innovative competencies and mindsets for enhancing sustainable entrepreneurship. It promotes experiential learning processes able to integrate knowledge from the domain of business management and technology management into the area of social and environmental sustainability (Abdelnaeim & El-Bassiouny, 2021; Del Vecchio et al., 2021).

As sustainability, in general, becomes more apparent and widespread in society, both on an individual and societal level – among firms, consumers, media, intuitions, and policymakers, the institutional pressures will function as enablers of sustainability and sustainable entrepreneurship. This will take place on a regulatory level (legislations and laws), a normative level (social/public opinions and social legitimacy), as well as on a cognitive level (a desire to comply). Coercive, normative, and mimetic isomorphic pressures are interrelated, supportive, and catalytic on each other simultaneously – and most likely increasingly – they will drive sustainable entrepreneurial activity in SMEs (Bozic, 2020, DiMaggio & Powell, 1983).

Contextual outside-in factors: Enablers in emerging and developed economies

The above enabling contextual outside-in factors apply to developed and emerging markets. However, as with the individual factors, some additional factors are specific to the emerging markets.

(More) severe resource constraints characterize emerging market economies. These constraints are both financial on an individual micro-level and a country-wide macro-level, and there are also constraints regarding the availability of skilled labour and advanced educational levels. A way to overcome resource constraints is through the use of networks. This is also relevant in developed economies. However, in emerging economies, the (lack of) institutional structure and support activities make using personal and local networks even more important.

Social networking is an essential enabler in emerging markets because it connects people with similar interests, and it can provide resources that otherwise would not be available.

The government legislation, infrastructure, and institutional support system in developing markets may not be as advanced as in developed economies. Developing countries seem to depend more on foreign funding that provides aid and support for local projects and entrepreneurs. Foreign donor organizations are essential to enhancing sustainable activities in many developing countries.

Contextual outside-in factors: Hindrances

At the firm/organizational level, management plays a crucial role both as a potential enabler and a hindrance if management is unwilling to change into a more sustainable direction (Khan et al., 2022).

If firms need to change their operations and enhance their social and environmental-friendly activities, including more sustainable sourcing, production, and products, then it may add more complexity to the business (Cantú et al., 2021; Gupta et al., 2019; Moreno et al., 2019; Pieroni et al., 2019), at least in a transition period. This may lead to higher operating costs (Kerin & Pham, 2019), and a more comprehensive and broader stakeholder engagement and integration may be necessary (Cantú et al., 2021; Gupta et al., 2019; Jabbour et al., 2019; Pham et al., 2019). These changes require extensive skills and competencies and may necessitate human resource training (Cantú et al., 2021; de Sousa Jabbour et al., 2018). It may – at least in the short run – mean lower financial performance, and firms may see this as a severe obstacle to moving in a more sustainable direction.

In short, the top four barriers hindering firms from making environmental improvements are costs, time, lack of resources, and knowledge deficit (encompassing ‘lack of information,’ ‘lack of expertise,’ and ‘lack of training/support’).

The issue of technology is prevalent in much extant research. Technology plays an essential part in sustainability and the green transition of firms and industries, and according to the literature, entrepreneurs experience a lack of appropriate interface design, they experience difficulties in upgrading technology, and outdated automated synergy models (Kristoffersen et al., 2020), and lack of integration of digital technologies (Antikainen et al., 2018; Cezarino et al., 2019; Kirchherr et al., 2017; Pham et al., 2019). These issues are perceived as obstacles to exploiting new sustainable potential opportunities.

The hindrances at the network are the same – but opposite – as with drivers of sustainable entrepreneurship. I.e., not being an active member of social and local networks can hinder social and environmental entrepreneurship. Local social networks may act as a catalyst and factor for entrepreneurs to do good in the local environment. Thus, the lack of appropriate networks acts as a hindrance to local social value creation.

In addition to the above-identified firm-level barriers, several potential institutional and market-level hindrances to sustainable entrepreneurial activities are identified in extant studies.

At an overall institutional level, entrepreneurial success is, roughly speaking, still solely measured financially. Applied success criteria are profitability, measured only through financial benefits and financial profitability (Alcayaga et al., 2019; Antikainen et al., 2018; Bressanelli et al., 2018b; Cantú et al., 2021), creating a tendency that environmental and social concerns are considered in a second step. Early on, this was a fundamental barrier to enhancing true/strong, sustainable development and sustainable entrepreneurship (Solow, 1993).

There are structural barriers in the market in the form of missing exchange of information and unclear responsibility distribution related to a new and more holistic way of viewing business and success criteria (Antikainen et al., 2018). Inadequate infrastructure may limit access to potential sustainable opportunities. Assessment of sustainable entrepreneurial activities should not be limited to the activities that take place in the venture. The assessment of sustainable activities should be seen throughout the whole supply chain (Antikainen et al., 2018; Bressanelli et al., 2018b; Kerin & Pham, 2019). An insufficient ability and access to assess and measure the social and environmental impact through the whole value chain may hinder firms and entrepreneurs from completing scope one, two, and three emission calculations and optimization activities (<https://ghgprotocol.org/>).

Entrepreneurship education, enhancing competencies in sustainability education, may be seen as an enabler of sustainable entrepreneurship. However, the current frameworks are not always as efficient and effective as they should be. Foucrier and Wiek (2019, p. 2) see most initiatives as: “somewhat disconnected from the reality of entrepreneurship and lacking bridges across the different disciplines related to entrepreneurship.” The lack is that the existing frameworks do not consider the entrepreneurship process (from initial discovery through planning, startup, and build-out to consolidation and harvesting) with the different competencies required according to the process (Foucrier & Wiek, 2019). Thus, universities may have the best intentions, but the efforts may not have the desired impact on a general level.

Contextual outside-in factors: Hindrances in developed vs emerging markets

The above contextual outside-in hindrances are applicable in both developed and emerging markets. However, as with the individual factors, some additional factors are specific to the emerging markets. (more) severe resource constraints characterize emerging market economies. These constraints are both financial on an individual micro-level and a country-wide macro-level, and there are also constraints regarding the availability of skilled labour and advanced educational levels. The resource-constrained environments strongly affect entrepreneurial ventures, which often engage with entrepreneurial bricolage to compensate for the lack of financial, human, and social resources (Busch & Barkema, 2021; Di Domenico et al., 2010).

There may be a general lack of experience and, thus, an inability to incorporate sustainable practices in businesses. This is due to a lack of education, limited environmental awareness, and weaker inter-firm knowledge exchange collaborations. Furthermore, illegitimate (and

cheaper) practices of competitors in developing countries force firms to do the same (Wahga et al., 2018) and prevent them from acting more sustainably.

Structural and operational barriers may be more severe in developing countries (Antikainen et al., 2018), and it may be even more challenging to integrate the whole supply chain into sustainability activities (Antikainen et al., 2018; Bressanelli et al., 2018b; Kerin & Pham, 2019). Additional challenges may be related to formal qualifications relevant to new and more sustainably oriented ventures. Extra difficulties may be mobilizing already limited resources for entrepreneurial activities in severe resource-constraint environments.

In some developing countries, there is a general lack of legitimacy (Suchman, 1995) for social innovators within systems unfavourable to social innovation. Dominant stakeholders can use institutional mechanisms to limit the social action of others to prevent systemic change from occurring (Weber, 1978). A somewhat non-transparent political and institutional system can constrain social and environmental innovators through institutional power and dysfunctions inherent in the system (Popov et al., 2016). Institutional barriers within the ecosystem can exist both by deliberate design and because of inefficiencies (Maher & Hazenberg, 2021). Furthermore, mainstream financial institutions tend to marginalize social entrepreneurs and beneficiaries of social innovations (Bhatt & Ahmad, 2017; Moore et al., 2012a; Moore et al., 2012b). In other words, the system and institutional factors are rigid and may, directly and indirectly, resist change and sustainable progress, even though these changes may benefit society.

At a macro level, unstable political situations, mutual historical tensions, and lower trust between actors in developing economies may create barriers to public–non-public collaboration, innovation, and networking (Bozic, 2020) and thus function as a *de facto* barrier to sustainable entrepreneurship. Also, unanticipated negative external change (exogenous market shocks) hinders social innovation (Dowin Kennedy & Haigh, 2019). This may hit harder on developing economies, as they may be less financially resilient.

Discussion and Conclusion

Based on the extant entrepreneurship literature analysis on SE, the findings indicate that the enablers and hindrances to SE fall into two main categories, each coded and synthesized into several sub-categories. We described and discussed how these factors impact potential sustainable entrepreneurial activities in an enabling or limiting way. The factors were compared and contrasted between developed or emerging market economies to identify context-specific conditions for SE.

First, it appears that factors related to the inside-out perspective are seemingly less numerous compared to those associated with the outside-in perspective of SE. Hence, a preponderance of factors at the firm and national levels suggests that the structural and systematic aspects of SE are considered critical by researchers. Organizations and national contexts play pivotal roles in shaping the landscape for SE. Hence, policymakers and business leaders may need to prioritize initiatives that address institutional frameworks, regulations, and incentives at the organizational, regional, and national levels to foster SE (Chaudhary et al., 2023). Moreover, with a greater emphasis on factors related to firms and the national context, the implication is that collaborative and collective efforts are crucial. SE may thrive when synergy exists among multiple actors, including businesses, governments, and other stakeholders. Strategies and interventions should encourage collaborative initiatives that involve businesses, governmental bodies, non-governmental organizations, and communities to address sustainable entrepreneurship

challenges holistically (DiVito & Ingen-Housz, 2021). Indeed, extant studies underlined that networks and collaboration throughout the entire entrepreneurial ecosystem are contextual factors that positively affect the level of sustainable entrepreneurial activities. Belonging to local social networks is a driver for social and environmental entrepreneurship. The network enables knowledge sharing and resource gathering, and belonging to a local network may act as a catalyst because it may increase the intentions to pursue monetary outcomes and social and environmental gains.

The findings of the literature review of studies in the entrepreneurship literature also show that the inside-out perspective at the individual level is much less adopted in respective research on drivers and hindrances in emerging markets, particularly concerning intentions and behavioral factors to SE's hindrances. Hence, these might be areas for fruitful future research to understand whether these factors impact SE similarly or differently in emerging markets compared to developed market economies. While researchers have identified numerous factors from an outside-in perspective as hindrances and drivers to SE, it is essential not to neglect the role of individuals. The literature review findings show – perhaps not surprisingly – that entrepreneurs' prior knowledge and experience in business and entrepreneurship play an essential role in being entrepreneurially alert and identifying new sustainable opportunities. Human and social capital among present and potential entrepreneurs are drivers both domestically and in the internationalization process of sustainable entrepreneurial ventures. Human capital refers to general knowledge, skills, and competencies (education, general business knowledge) and domain-specific knowledge (prior entrepreneurial experience, knowledge in the specific sector/industry, and knowledge about sustainability). The literature shows that high(er) human and social capital drives the ability to pursue sustainable entrepreneurial ventures. This means that the level of general entrepreneurial activity in a country or region such as the EU plays an essential underlying pre-requisite for enabling and enhancing SE.

Also, at a firm/organizational level, management plays a crucial role both as a potential enabler and a hindrance, depending on the intention and attitudes. Changing the operations with more focus on social and environmental concerns throughout the whole value chain may add more complexity to the business, it may require new and more advanced skills and competencies, and it may add more costs, resulting in lower financial performance than similar less sustainable ventures – at least in the short turn. Entrepreneurial success is, roughly speaking, still solely measured in financial terms. The success criteria are profitability and financial sustainability. This is a fundamental barrier to enhancing true/strong, sustainable development and sustainable entrepreneurship. Also, capacity educational and capacity-building initiatives in management education may be needed, especially regarding awareness, skills, and attitudes toward SE. Ex-tant findings on hindrances to SE should be taken into account. I.e., not all entrepreneurial programs have the desired effect. Entrepreneurship programs may be too instrumental and not focused on behavioural skills and the entrepreneurial process and practice, strengthening the need to engage in an inside-out perspective in SE research in emerging markets.

Finally, our analysis of the extant entrepreneurship literature on the drivers and hindrances for SE indicates that potential obstacles and drivers can be found at multiple levels and are inter-linked. While considerable similarities in drivers and hindrances for SE exist for sustainable entrepreneurs in emerging and developed market economies, specific differences were identified at the individual, firm, and national levels. Hence, empirical research should engage in comparative studies and track the evolution of SE over time. At firm and national levels, exploring how external factors such as policy changes within the European Union affect sustainable entrepreneurs in European developed and emerging market economies. Also, how global

events, such as the recent COVID-19 pandemic or the impact of climate change, influence the drivers and hindrances of SE. From an inside-out perspective, cross-cultural studies would be valuable to understand how cultural factors influence adopting sustainable entrepreneurship practices. In particular, studies that go beyond the Hofstede national culture conceptualization and try to conceptualize other essential values at the individual level, such as religion, professional standards, or personal life experiences, would be particularly valuable (Gümüşay, 2015; Zhang-Zhang, 2023). Also, given the considerable similarities in factors related to drivers and hindrances across emerging and developed market economies, relating, for instance, to technology or education/Universities, inviting policymakers to identify local “best practices” that can be spread to encourage SE and assessed over time for more evidence-based policymaking.

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DIGITAL TRANSFORMATION AND INNOVATION IN TEACHING AND LEARNING IN ENTREPRENEURSHIP EDUCATION IN HIGHER EDUCATION INSTITUTIONS

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Abstract

This study provides state-of-the-art and future perspectives on digital transformation and innovation in teaching and learning in entrepreneurship education in higher education institutions. It conceptualizes a hybrid teaching framework for digital transformation and innovation in entrepreneurship education including integrating AI solutions, MOOCs, online learning platforms, serious games, virtual simulation games, and social media into teaching and learning in entrepreneurship education besides integrating digital technology and pedagogy into teaching and learning to innovate teaching and learning in entrepreneurship education in higher education institutions. Digital transformation and innovation aim to enhance the effectiveness and quality of inclusive and equitable entrepreneurship education for continuous quality improvement and sustainable development.

Keywords

Digital transformation, innovation, teaching and learning, entrepreneurship education.

Introduction

Entrepreneurship education is “the process of providing individuals with the ability to recognize commercial opportunities and the insight, self-esteem, knowledge, and skills to react to them” (Jones & English, 2004, p. 416), which involves entrepreneurial learning, experiential learning, problem-based learning, active learning, and many other perspectives. Digital transformation and innovation reshape traditional teaching and learning models of entrepreneurship education through blended/online learning, smart learning, social learning, mobile learning, virtual collaborative learning, virtual simulation game learning, and other forms of learning through virtual learning spaces (e.g., social media sites, online learning platforms, virtual incubators, virtual learning communities, or virtual collaboration spaces). Virtual learning spaces have become digital knowledge-sharing and knowledge-exchange spaces to share, disseminate, produce, or co-create knowledge more easily than physical spaces to overcome the constraints of physical spaces. Teaching and learning in a virtual setting provides learners virtual learning experience as a digital twin of entrepreneurship education in a physical learning space or new innovative learning experiences that cannot be achieved through face-to-face teaching and learning.

Digital transformation brings transformative changes in educational models and technological-pedagogical innovation to entrepreneurship education, which stimulates the fast growth of blended/online learning to overcome the constraints of face-to-face courses in physical spaces. Technology-enhanced entrepreneurship courses change the pedagogical and didactic design supported by digital teaching and learning management systems, digital learning tools, and digital instructional resources. Entrepreneurship education requires entrepreneurship learning and entrepreneurship outcomes to meet the social and economic needs of all the stakeholders besides “the relevance, self-consistency, usefulness, effectiveness, and efficiency of entrepreneurship courses and programs” (Fayolle, 2013, p. 700). Inclusive and equitable entrepreneurship education must meet the diversified needs of heterogeneous learners such as the growing number of digital learners and students with financial constraints or special needs.

Literature Review

Entrepreneurship education “needs robust theoretical and conceptual foundations drawing from the fields of entrepreneurship and education to support entrepreneurship programs and courses; and reflects upon practices and take a more critical stance, breaking away from the far too common ‘taken for granted’ position” (Fayolle, 2013, p. 693). “Entrepreneurship education research could help understand the concepts supporting entrepreneurial learning and the development of entrepreneurial competencies, and how to incorporate effectuation and bricolage and related entrepreneurial behaviours at the content level” (Fayolle, 2013, p. 693; Fisher, 2012). Entrepreneurship education is relevant across various educational contexts, including formal, non-formal, and informal settings. However, “no research examines how to mix professional (practice-oriented) and theoretical knowledge with the other components of the didactical setting” (Fayolle, 2013, p. 696). However, there is a lack of literature addressing ongoing digital transformation and innovation in entrepreneurship education in higher education institutions.

Entrepreneurial learning involves a blend of traditional education, experiential learning, and real-world applications, focusing on hands-on experience, networking, mentorship, and continuous adaptation to changing market dynamics, which has become “an important research area at the interface of entrepreneurship and organizational learning (Wang & Chugh, 2014, p. 42). “Theoretical perspectives, types of learning, and methods and the unit of analysis, the diversity, individuality, and inconsistency of entrepreneurial learning research reflect researchers’ different ontological and epistemological positions” (Wang & Chugh, 2014, p. 33). Entrepreneurial learning employs different methods to study different entrepreneurial contexts and is socially constructed through conversations in different micro-learning contexts” (Schou et al., 2022, p. 2087). “The three pairs of learning styles (individual and collective learning, exploratory and exploitative learning, and intuitive and sensing learning) advance entrepreneurial learning research in response to the need for integrating individual opportunity-seeking behaviour with organizational advantage-seeking behaviour, the need for developing skills and resources required for opportunity exploration and exploitation, and the need for understanding how entrepreneurial opportunities come about” (Wang & Chugh, 2014, p. 42). “Entrepreneurial learning in five forms of learning conversations is situated in four different learning contexts from a classroom with a student-teacher dynamic, a collaborative space where entrepreneurs collect ideas and develop new skills and knowledge, a club context in which they challenge each other, and a care context in which they can bring their fears and uncertainties” (Schou et al., 2022, p. 2088).

Experiential learning as an approach in entrepreneurial education positively influences entrepreneurial intention, the development of entrepreneurial skills and competencies (Motta & Galina, 2023), student engagement, student learning outcomes, and career readiness (Aithal & Mishra, 2024, p. 146). Experiential learning in an online setting can be implemented by “hosting pitch competitions online; facilitating group work in a virtual setting; creating engagement and networking opportunities with the local business community when teaching entrepreneurship online; and using digital technologies for business model and business plan development” (Vecchiarini et al., 2024). Experiential learning theory defines learning as “the process whereby knowledge is created through the transformation of experience” (Kolb, 1984, p. 41) and comprises “a process of knowledge construction in which the student experiences, reflects, thinks, and acts” (Kolb, 2014). Entrepreneurial learning needs to consider the influence of technological advancements and the integration with emerging learning models (Aithal & Mishra, 2024, p. 146). Digital transformation expands Kolb’s experiential learning cycle (experience,

reflective observation, abstract conceptualization, and active experimentation) (Kolb, 1984) to virtual experiential learning in virtual or hybrid learning spaces. However, there is a research gap between experiential learning and entrepreneurial learning in an online or hybrid setting.

Literature has drawn attention to entrepreneurial learning, experiential learning, and game-based learning in entrepreneurship education but they are seldom discussed in online or hybrid teaching and learning environments. Teaching and learning in entrepreneurship education involves active learning, experiential learning, problem-based learning, and many other perspectives. However, there is a gap in theories and practice on integrating digital pedagogy, digital didactic, and ICTs into teaching aims, subjects, methods, and curriculum design of technology-enhanced hybrid teaching and learning in entrepreneurship education in alignment with digital transformation and innovation in teaching and learning in hybrid-flexible learning spaces. To bridge this research gap, this study conceptualizes a theoretical framework to address integrating AI, MOOCs, online learning platforms, social media, serious games, and virtual simulation games in entrepreneurship education in higher education institutions in alignment with entrepreneurial learning and experiential learning in a hybrid setting, namely, digital and physical spaces. Thus, this study expands the discourses beyond integrating digital technology and pedagogy into teaching and learning to digital transformation in entrepreneurship education in higher education institutions for innovation, continuous quality improvement, and sustainable development in higher education institutions.

Theoretical and Conceptual Framework

This study conceptualizes a hybrid teaching model based on the generic teaching model in entrepreneurship education (Fayolle, 2013; Fayolle & Gailly, 2008) to combine objectives, contents, and teaching methods to address the needs and the specificities of each particular audience (Fayolle, 2013), which is based on Kolb's experiential learning cycle (experience, reflective observation, abstract conceptualization, and active experimentation) (Kolb, 1984) in a hybrid setting, the experimental teaching-learning space model (PSMT) (Wang & Jin, 2023), the technology, pedagogy, content, and space (TPeCS) knowledge framework (Kali et al., 2019), the technological pedagogical content knowledge (TPACK) framework (Archambault & Barnett, 2010) and the pedagogy-space-technology (PST) framework (Radcliffe, 2009).

“The experimental teaching-learning space model (PSMT) combined with the experimental teaching-learning space construction, a theoretical model framework of three layers (the element layer, the functional module layer, and the implementation layer) and four elements (experimental pedagogy, experimental space, management and service mode and technical support) of experimental teaching-learning space (PSMT) based on the PST model” (Wang & Jin, 2023, p. 88). The TPACK emphasizes the integration of technology, pedagogy, and content knowledge to enhance teaching and learning with effective technology-enhanced learning experiences (Archambault & Barnett, 2010). The Pedagogy-Space-Technology (PST) Framework for guiding the design of learning spaces considers three factors (pedagogy, space, and technology) in informing the conceptual design and post-occupancy evaluation of individual learning spaces or whole campus networks (Radcliffe, 2009, p. 11). Technology is embedded with the pedagogy and content (Mishra & Kohler, 2006, p. 1026) to adapt to physical or digital spaces.

This study addresses the objectives of entrepreneurship education in the process of digital transformation by integrating AI, MOOCs, online learning platforms, serious games, virtual simulation games, and social media in entrepreneurship education in higher education institutions, which is embedded with the teaching and learning context, content, a hybrid-flexible smart

learning environment, and technology-enhanced data-driven learning outcomes assessment for inclusive and equitable entrepreneurship education.

Digital transformation affects how entrepreneurship education is designed, delivered, monitored, and assessed. Figure 1 shows changes in Faylle and Gailly's (2008) generic teaching model with the concept of audiences, objectives, contents, methods, and evaluation at the ontological and educational levels (Faylle & Gailly, 2008). The five dimensions at the educational level include "What - content and theories; Why - the objectives and goals of entrepreneurship education; For whom - audiences and target groups; for which results – evaluation and assessment: How- methods and pedagogies" (Faylle & Gailly, 2008). Digital transformation offers hybrid entrepreneurial learning supported by hybrid teaching methods and data-driven learning outcome assessment powered by digital technologies such as big data and AI to learners in digital or hybrid learning. This study conceptualizes a hybrid teaching and learning model in entrepreneurship education.

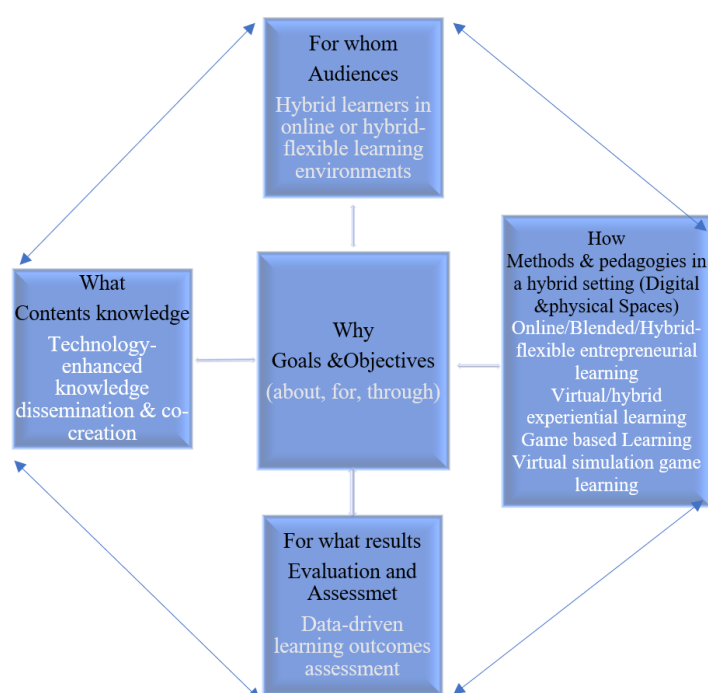


Figure 1: A hybrid teaching model in hybrid learning environments adapted from Faylle and Gailly's (2008) generic teaching model.

The objectives of entrepreneurship education are multifaceted to empower individuals with the knowledge, skills, and mindset to succeed as entrepreneurs in the digital age; to enhance the quality of entrepreneurship education; and to advance the effectiveness and efficiency of entrepreneurship education. Three objectives of entrepreneurship education focus on "education 'about' entrepreneurship to increase awareness about entrepreneurship, 'for' entrepreneurship to enhance students' intentions to be entrepreneurs, and 'through' entrepreneurship to develop entrepreneurial competencies in new venture creation" (Scott et al., 1998). The main effectiveness of entrepreneurship education involves entrepreneurship pedagogy and its effectiveness for sociality and the economy (Fayolle, 2008). New perspectives can advance the field such as "in, after, under, over, besides, during, and meanwhile", or "what, when, where, and how" to expand the narrow perspectives on learning focusing on "about, for, and through" (Ramsgaard, 2018, p. 3).

Digital transformation in entrepreneurship education aims to enhance the quality and effectiveness of teaching and learning of inclusive and equitable entrepreneurship education for sustainable development with the support of digital platforms, resources, and methods to empower students with the knowledge, skills, and resources needed to succeed in a technology-driven and rapidly evolving business landscape in the digital age. This study addresses the following objectives in entrepreneurship education in an online or hybrid learning setting driven by digital transformation and digital innovation:

- Promoting accessibility, affordability, scalability, and flexibility for inclusive and equitable entrepreneurship education. Digital transformation enables hybrid-flexible and cost-efficient learning models to provide personalized self-paced learning and hybrid-flexible learning pathways that accommodate diverse learning styles, preferences, and schedules, which allow learners to tailor their educational experiences to their needs to make entrepreneurship education accessible to a broader audience to learn everywhere at any time regardless of geographical location or socioeconomic background through online platforms and digital instructional resources.

- Enhancing student engagement, student learning experiences, and learning outcomes by integrating digital technologies, interactive digital tools, gamification, simulations, and multimedia content to allow educators to create more engaging and interactive student learning experiences. Online learning platforms, virtual simulations, and multimedia facilitate virtual networking and collaborations among students, educators, industry experts, and mentors through online communities, forums, and networking events, fostering valuable connections and opportunities for cooperation in the hybrid or digital learning spaces.

- Embracing technology-enhanced teaching and learning and data-driven teaching and learning management, virtual classrooms, and online/blended/hybrid courses. Digital transformation allows educators to collect and analyse data on student performance, engagement, and learning outcomes to adapt teaching methods and teaching content to improve student learning outcomes and academic progression.

- Fostering a culture of innovation to advocate innovation and experimentation by integrating emerging digital technologies (e.g., AI, big data, XR, AR, VR, MR, IoT, and blockchain) into entrepreneurship curriculum development, teaching and learning, and assessment to cultivate an innovative mindset and encourage students to explore entrepreneurial opportunities; and applying digital tools to simulate real-world scenarios to engage students to think like entrepreneurs and enable virtual exchange, self-paced learning, experimentation, testing business ideas, and exploring new business models and market trends.

- Developing students' entrepreneurial skills and cultivating an entrepreneurial mindset characterized by creativity, resilience, adaptability, problem-solving, and risk-taking to prepare students for their future work with practical skills and real-world experience through hands-on projects, internships, and experiential learning opportunities facilitated by digital platforms and technology-enabled hybrid-flexible learning environments.

- Connecting with industry and Startups to bridge the gap between academia and industry, preparing students for entrepreneurial ventures. Entrepreneurship education should prepare graduates for the job market with relevant digital competencies to support students to engage in real-world projects, internships, and networking opportunities; and facilitate collaboration between higher education institutions, startups, and established companies.

Digital Transformation and Innovation in Teaching and Learning in Entrepreneurship Education

Integrating Digital Technology and Pedagogy into Teaching and Learning

Digital transformation of higher education teaching and learning involves integrating digital technologies into curriculum development and delivery to transform entrepreneurship programs in instructional resources, environment, platforms, and the instruction management system for information collection, analysis, implementation monitoring, feedback, and adjustment. The hybrid learning spaces create hybrid-flexible learning with time flexibility, resource sharing, and the diversity of educational supply with high levels of multi-channel interaction through virtual classroom systems in a hybrid-flexible learning environment. Digital transformation and innovation must fully integrate digital technologies, pedagogies, infrastructures, digital instructional resources, and learning management systems and innovate teaching and learning in hybrid-flexible learning environments.

Digital technological and pedagogical integration into teaching and learning in entrepreneurship education provides students with academic and digital competencies to meet the growing demands of heterogeneous learners and the needs for massively scalable and computerized personalized self-paced learning, which restructures the way of teaching and learning through hybrid-flexible technology-enhanced courses in a hybrid-flexible environment. Integrating digital technologies and pedagogy into teaching and learning engages students in a virtual or hybrid learning process and fosters technology-enhanced online/blended learning courses in a hybrid-flexible learning environment to innovate teaching and learning for continuous quality improvement and sustainable development. A HyFlex (hybrid-flexible) or hybrid model of entrepreneurship education with innovative hybrid-flexible course delivery in hybrid-flexible learning environments require a complete pedagogical shift and innovation in the course design, teaching process, pedagogy, and course management to meet the needs and expectations of digital learners. An efficient mechanism of integrating digital technology applications in teaching and learning will leverage digital technologies' positive transformative potential and power for cost-effectiveness and the benefit of transforming teaching and learning in entrepreneurship education. It is critical to move beyond the superficial dichotomy of digital natives (digital residents or the net generation) and digital immigrants to understand digital learners in the digital age and adapt to different cultural and institutional contexts (Bullen & Morgan, 2011, p. 63). Digital transformation and innovation of teaching and learning is a dynamic and complex process involving fundamental technical, pedagogical, didactic, and content changes in the process of teaching and learning, which needs to consider teachers, students, the contents of courses, and digital technological and pedagogical integration as important factors to support teachers to produce technology-enhanced courses in hybrid learning spaces.

Integrating AI into Teaching and Learning

Technology advancement promotes ICT applications, especially AI-powered chatbots (e.g., ChatGPT), big data, automation, data analytics, natural language processing, and algorithms of machine learning to enhance the quality of entrepreneurship education. Entrepreneurship education continues to change and develop under the enabling force of AI to evolve and adapt to new technological standards. Educators can leverage AI-powered chatbots to design new courses, develop teaching materials, grade assignments, answer students' questions, conduct research, or other applications while students can use AI-powered chatbots to receive feedback on assignments, create project outlines, prepare for exams, and gather information more quickly

(Cribben & Zeinali, 2023; Vecchiarini, & Somià, 2023, p. 2). “AI has the potential to accelerate the process of achieving global education goals through reducing barriers to access learning, automating management processes, and optimizing methods to improve learning outcomes” (UNESCO, 2019). “AI uses and combines machine learning (the usage of computer systems to perform specific tasks efficiently without relying on clearly programmed instructions), smart machines (devices embedded with machine networking and/or cognitive computing technologies to make decisions without human contribution), and other data analysis techniques (e.g., big data analysis) to achieve AI capabilities to justify the situation deductively and inductively; to communicate in different languages; and to analyse and solve complex problems” (Lesinskis et al., 2023, p. 5). The development of generative AI offers transformative potential and opportunities for technological and pedagogical innovation (Bell & Bell, 2023, p. 231).

Educators can integrate AI, big data analytics, and machine learning algorithms into teaching and learning to improve teaching effectiveness in entrepreneurship education (Chen, 2024, p. 14). (Ala et al., 2022). “AI can improve entrepreneurial attitude in business simulation games in various ways such as simulating competitors, providing targeted feedback for failures, and improving game experience” (Sepasgozar, 2020, p. 1). AI can enhance teaching and learning experiences, entrepreneurial analytics assessment accuracy, and pedagogical designs; identify entrepreneurial opportunities; and analyse entrepreneurial projects with low costs and high effectiveness (Chen, 2024, p. 14). AI-driven entrepreneurial tools can be used in the following areas: AI in business intelligence with applications of machine learning algorithms and data analytics techniques to automate data processing and to interpret complex data for data-driven decision-making can teach students how to use AI-powered analytics tools for market research, customer segmentation, and trend analysis; AI automated marketing can transform marketing process, optimize marketing activities and advertisement targeting, personalize content, and enhance customer engagement; and predictive modelling combines AI and historical data to make accurate predictions for businesses to predict demand, optimize pricing, and manage inventory. Intelligent chatbots and virtual assistants can interpret, understand, and produce human language based on user requests (Caldarini et al., 2022). Meanwhile, AI needs to combine with specific entrepreneurial learning content and procedures. “AI in entrepreneurship education requires more sophisticated pedagogical designs on diagnosis, prediction, intervention, prevention, and recommendation aligned with specific entrepreneurial learning content and procedures” (Chen, 2024, p. 14). “Generative AI, machine learning, and big data can perform a variety of natural language processing tasks” (Winkler et al., 2023, p. 581). AI improves learning outcomes and essential entrepreneurial skills such as critical thinking, self-reflection, and knowledge application among students; increases the efficiency of the educational process; supports a student-centred approach (Winkler et al., 2023, p. 584). The computational capabilities and knowledge resourcefulness of AI applications have significant implications for entrepreneurial learning with the high level of uncertainty and complexity despite accountability, bias, diversity and inclusion, privacy, reliability, and security of generative AI (Winkler et al., 2023, p. 584). Another concern is AI plagiarism, AI dependency as passive learners, and AI threat to academic integrity (Vecchiarini, & Somià, 2023, p. 2).

Integrating MOOCs and Online Learning Platforms into Teaching and Learning

MOOCs provide free or affordable access to high-quality educational content and an inclusive and accessible way to learn, leveraging digital platforms, fostering student engagement, and offering a powerful online resource for learning across various content areas in entrepreneurship education (Thanachawengsakul, 2020; Vorbach et al., 2019; Welsh & Dragusin, 2013). MOOCs bring flexibility, affordability, interactivity, global research, and cost-effectiveness to

entrepreneurship education. MOOCs widen access to more learners and provide learners with self-paced learning. MOOCs facilitate interaction with instructors, peers, and experts so that learners can acquire practical skills relevant to entrepreneurship. MOOC platforms (e.g., Coursera, EdX, and Udemy) have the largest online entrepreneurship courses (Chen et al., 2021, p. 216). Online learning platforms including MOOC platforms have facilitated global access and openness for inclusive and equitable entrepreneurship education.

Integrating Serious Games and Virtual Simulation Games into Teaching and Learning

Interactive games with different scenarios especially during online teaching could enhance the learning effectiveness of entrepreneurship education (Takemoto & Oe, 2021, p. 28). Serious games as tools are designed to educate or train through entertainment, providing environments that facilitate deeper learning (Martins et al., 2023). Serious games are digital simulations designed for educational purposes to eliminate the fear of failure and enable students to learn by doing. Interactive gameplay keeps students motivated and immersed in the learning process. In entrepreneurship courses, students play serious games (e.g., SimVenture) to experiment with concepts in a virtual environment and simulate real-world entrepreneurial challenges without the associated risks. Virtual serious games combine the principles of serious games with VR/AR in immersive environments to enhance the learning experience by allowing users to interact with digital content in a more engaging and realistic way. Serious games often incorporate virtual simulation elements. Serious games and virtual simulation games offer dynamic ways to teach entrepreneurship that combine entertainment, learning, and practical applications. Game-based learning in entrepreneurship education such as experiential learning with serious games is well-known but virtual simulation game learning in a digital setting still needs more attention. Real-life business scenario simulations can support learners to acquire entrepreneurial skills and competencies while avoiding real-life risks and damages and reducing cost and uncertainty. Educators can use serious games, mobile business simulation games (Chen et al, 2023), and virtual simulations to create a holistic learning experience.

Virtual simulation games create immersive environments where players interact with digital elements. For example, business simulations simulate business scenarios, allowing students to run virtual companies, make financial decisions, and compete in markets. Startup Simulators focus specifically on startup creation, product development, and scaling. Virtual simulation games have emerged as an effective teaching method for entrepreneurship education, which can be integrated as a key part of online learning into entrepreneurship courses or as digital learning resources. Virtual simulation game learning in entrepreneurship aims to engage students in online learning to improve their learning experience within the virtual environment including virtual teamwork experience and self-efficacy, which will affect students' entrepreneurial skill development. Virtual simulation games can generate improved immersive and interactive experiences in students' entrepreneurial learning by using extended reality (XR) technologies including virtual reality (VR), augmented reality (AR), mixed reality (MR), and virtual interactive environments to deliver engaging, simulated, and real-world learning experiences. Virtual simulation game learning in entrepreneurship education provides an innovative way to foster students' engagement and entrepreneurial skill development, which has significant implications for teachers to select and/or develop virtual simulation games to enhance students' engagement and learning outcomes. The integration of virtual simulation games in the hybrid and online model of entrepreneurship education in higher education institutions and their impacts on student learning outcomes. Virtual simulation games as an effective teaching method for online entrepreneurship education directly or indirectly affect the development of entrepreneurial skills through students' learning engagement to improve students' participation,

learning outcomes teamwork experience, and general self-efficacy (Yang et al., 2022, p. 1). Simulative business games make this process attractive, e.g., gamers attend entrepreneurship activities from Second Life and use virtual money in virtual life (Chen et al., 2021, p. 219). The e-learning model using virtual simulation games is designed to build a virtual learning space to foster learner's entrepreneurial mindset through virtual experiential learning. The technological and pedagogical design of virtual simulation games and their integration of hybrid and online entrepreneurship education has significant implications for promoting digital innovation of entrepreneurship education by using virtual simulation games to enhance student learning outcomes and entrepreneurial competencies as well as the effectiveness and the quality of entrepreneurship education in higher education institutions. Meanwhile, the over-focus on virtual simulation game learning in entrepreneurship education also raises concerns about digital well-being and digital inclusion.

Integrating Social Media in Teaching and Learning

Social media platforms provide a space for self-presentation and self-disclosure, influenced by factors such as social presence and media richness (Kaplan & Haenlein, 2010). Social Media platforms can facilitate cooperation among participants in entrepreneurship education and discuss entrepreneurial concepts. Entrepreneurs increasingly use social media for entrepreneurial activities, thus they can also use social media platforms to learn about doing business. The adoption of social media into informal or formal learning (Dabbagh & Kitsantas, 2012) increases student engagement (Blaschke, 2014) and satisfaction (Barczyk & Duncan, 2012). Entrepreneurship education aims to build a social network and human relations (Man et al., 2002; Mitchelmore & Rowley, 2013) and entrepreneurship learners communicate with each other on social media (e.g., Facebook, Twitter and WhatsApp) and show their life (e.g., Snap Chat, YouTube and Instagram) and work experiences (e.g., LinkedIn, Facebook and Research Gate) in social media platforms and applications. Social media expand face-to-face communication in classrooms to hybrid communication via digital communication channels and social learning spaces for students, teachers, and staff to engage in virtual communication, virtual networking, and virtual exchange in virtual communities. Social networking sites as digital communication and social learning spaces allow students to take up the ownership of learning through learning communities, student blogs, wiki projects, virtual social networking, online presentations, sharing information, posting questions, discussions, or a virtual world like the second life.

“The three levels of the pedagogical framework of social media use and the three phases of Zimmerman's model are interrelated in a self-oriented system of reflective feedback to support and promote self-regulated learning in the creation of personalized learning environments” (Dabbagh & Kitsantas, 2012, p. 6). At the personal information management level, students use social media such as blogs and wikis to create a personal learning environment to engage in self-regulated learning processes of Zimmerman's forethought phase such as goal setting and planning to create a personal or private learning space by self-generating content and managing this content for personal productivity or organizational e-learning tasks such as creating online bookmarks, media resources, and personal journals and calendars (Kitsantas & Dabbagh, 2010); At the social interaction and collaboration level, students use social media to engage in basic sharing and collaborative activities, to foster informal learning communities surrounding the course topics, extending the PLE from a personal learning space to a social learning space; At the information aggregation and management level, students use social media to synthesize and aggregate information to reflect on their overall learning experience in a personalized learning environment aligns with the final phase of Zimmerman's model, self-reflection (Dabbagh & Kitsantas, 2012, p. 6). These social media activities engage students in the self-regulation

process of self-evaluation and allow students to take greater control of their learning environments for personalized learning goals (Dabbagh & Kitsantas, 2012, p. 6).

Discussion

Digital transformation and innovation of teaching and learning in entrepreneurship education involve academic program approaches, curriculum development and delivery, teachers' professional competencies, learners and their learning, and teaching quality assurance systems that interact with each other and are subject to pedagogic and technological impacts. Educators play an important role in integrating digital technology and pedagogy into teaching and learning because they must adapt continuously to meet the changing needs of students and their relevance to the real world of work. Enhancing teachers' and students' digital skills and competencies will positively affect the outcomes of technology-enhanced teaching and learning. Digital transformation in entrepreneurship education requires teachers' professional competencies in integrating digital technologies and pedagogy into teaching to manage technological and pedagogical change in teaching and learning to meet the needs of digital learners. Educators may have positive or negative impacts on students' learning outcomes. Teachers change their functions from knowledge dissemination to organization and facilitation of learning while students organize and manage to learn themselves. Digital transformation and innovation in higher education require "teachers' professional competencies in awareness, literacy, capacity, and research of integrating digital technologies into teaching (digital awareness transformation from awareness to digital intelligence; digital literacy transformation from using tools to becoming role models of digital teaching; digital capacity transformation from integrating technology to teaching innovation; digital research transformation from standardized models to leading innovation)" (ICHEI, 2022, pp. 39–40). Teachers need professional digital competencies to cope with challenges in technology-enhanced teaching and adopt a sociocultural, anthropological, communicational, and pedagogical approach from learners' perspective (Gallardo-Echenique et al., 2015).

Digital transformation, smart education, and the fast growth of blended/online learning stimulate the innovation of teaching and learning, curriculum, and assessment in entrepreneurship education. Digital transformation and innovation in entrepreneurship education also raise concerns about digital well-being, study-life balance, digital equity, digital inclusion, and digital responsibility to uphold social responsibility and social accountability for the digital public good, social inclusion, social transformation, diversity, and social justice. It raises issues such as the selectivity and exclusivity of ICT applications, digital inequality, digital exclusion, digital control, digital discrimination, the ownership of digital data, digital security, digital ethics, data privacy, data protection, digital dependence, and digital surveillance regarding the potential risks of digital technologies to facilitate extensive surveillance through the collection and processing of data from teaching and learning activities.

Implications

Digital transformation of entrepreneurship education is a dynamic and complex process involving digital innovation in many aspects more than integrating digital technology and pedagogy into teaching and learning. Digital transformation and innovation in entrepreneurship education in higher education institutions have impactful changes on educational standards, quality enhancement, and hybrid self-paced learning. Digital transformation and innovation have powerful impacts on teaching and learning, governance, research, and educational assessment in higher education institutions, which accelerate the innovation process in entrepreneurship

education and widen students' access to courses and programs across borders via virtual mobility and virtual internationalization. Entrepreneurship education should embrace digital transformation and innovation strategically. Entrepreneurship education can be effectively delivered through online and blended formats. Digital transformation of entrepreneurship education needs best practices and practical advice on teaching approaches, modules, methods, and tools to manage digital transformation; strengthen the role of teachers and students as change agents; and engage all actors in innovation and quality enhancement to uphold social, economic, and environmental responsibilities.

Cultivating digital skills and competencies of teachers and students will affect the outcomes of technology-enhanced teaching and learning in entrepreneurship education. Digital transformation in entrepreneurship education requires teachers' professional competencies in integrating digital technologies into teaching within the Technological Pedagogical Content Knowledge (TPACK) framework (Archambault & Barnett, 2010) to enhance teachers' digital competencies to manage technological and pedagogical change in teaching and learning in entrepreneurship education. Teachers need to develop professional digital competencies in technology-enhanced teaching with a technological and pedagogical approach from digital learners' perspective.

It is critical to uptake best practices to integrate ICT applications in teaching and learning with concrete action plans and effective strategies for sustainable management of digital transformation and innovation in entrepreneurship education; integrate digital transformation and evolutionary learning mechanisms for hybrid-flexible personalized self-paced learning experiences to ensure the quality of hybrid education delivery of entrepreneurship education to innovate entrepreneurship education; and embrace digital transformation to adapt to changing trends (e.g., globalization, digital economy, digitization, and social media).

This study conceptualizes a theoretical framework for digital transformation and innovation in entrepreneurship education by integrating AI solutions, MOOCs, online learning platforms, serious games, virtual simulation games, and social media into teaching and learning in entrepreneurship education teaching and learning. Digital transformation in entrepreneurship education has deep impacts on innovating online or hybrid teaching and learning for hybrid-flexible learning experiences, widening access to global educational resources and networks, fostering innovation through ICTs and digital teaching and learning platforms, and enhancing the quality of entrepreneurship education. It has significant implications for the sustainable development of effective entrepreneurship education through digital transformation and innovation, which provides best practices to follow and lessons learned for future teaching and learning in entrepreneurship education in higher education institutions. Digital transformation and innovation move beyond digital technological and pedagogical integration into teaching and learning in entrepreneurship education in higher education institutions.

This study expands the discourses on digital technological and pedagogical integration into teaching and learning in entrepreneurship education in higher education institutions to innovating teaching and learning through digital transformation in alignment with the Principles for Responsible Management Education (PRME), OECD Platform for the Entrepreneurship Education Collaboration and Engagement (EECOLE) to support higher education institutions as Champions of Sustainable Development Goals (SDGs), UNESCO's Research Report on Digital Transformation of Higher Education Teaching and Learning, the Report on the Digital Development of Global Higher Education, and the SDGs (e.g., SDG4 education for sustainable development to ensure inclusive and equitable quality education) in higher education

institutions in the 2030 Agenda for Sustainable Development and the Education 2030 Framework for Action. It has significant implications for the sustainable development of entrepreneurship education through the digital transformation of teaching and learning, providing best practices to follow and lessons learned for future teaching and learning in entrepreneurship education in higher education institutions.

This study discusses key issues on digital transformation and innovation in teaching and learning in entrepreneurship education to enhance the quality and effectiveness of entrepreneurship education in higher education institutions for sustainable development, contributing to the scholarly discussion on digital transformation and innovation in entrepreneurship education. Digital transformation and innovation in entrepreneurship education bring more than pedagogical and technological changes in teaching and learning, which might serve as a reference to rethink teaching and learning in entrepreneurship education in higher education institutions.

Limitation

Digital transformation and innovation in entrepreneurship education involve many aspects beyond digital technological-pedagogical integration into teaching and learning in entrepreneurship education. This study has limitations on the scope of the study because it only focuses on teaching and learning in entrepreneurship education in higher education institutions. Thus it cannot cover all aspects such as the applications of XR (including AR, VR, and MR), big data, e-testing, e-assessment, learning analytics, social media, and other digital technology applications in entrepreneurship education in higher education institutions and how they reshape curriculums, teaching, learning and assessment including their impacts on entrepreneurship education. Future studies may draw attention to “peopleware”, digital well-being, digital equity, digital inclusion, and digital responsibility to uphold social responsibility and social accountability for the digital public good and social justice besides ICT (including software and hardware/digital infrastructures) applications and integration to innovate entrepreneurship education.

Conclusion

Digital transformation enables digital innovation of teaching and learning in entrepreneurship education with new digital services and digital management systems to enhance the quality of teaching and learning in entrepreneurship education for sustainable development. The integration of ICTs into education processes is not merely about applying digital technologies and tools but about transforming and innovating teaching and learning by integrating AI, MOOCs, virtual simulation game learning, social media, and others. The integration of digital technologies and pedagogy in the teaching and learning process modifies the teaching and learning management system, communication models, and teaching activities in hybrid teaching and learning in entrepreneurship education to engage students in a virtual or hybrid learning process in online/blended learning courses in a hybrid-flexible learning environment. Digital transformation of teaching and learning is a dynamic and complex process involving fundamental technical, pedagogical, didactic, and content changes in teaching and learning, which needs to consider teachers, students, course contents, and digital technological and pedagogical integration as important factors to enhance the quality of entrepreneurship education. It is vital not only to integrate pedagogies and technologies into teaching and learning in entrepreneurship education but also to form a broader concept for transformation and innovation to modify the existing systems/processes, communication modes/channels, and academic and administrative activities in entrepreneurship education.

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THE ROLE OF SOCIAL CAPITAL AMONG CHEMISTRY STUDENTS FROM TWO COUNTRIES: GERMANY AND POLAND

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Abstract

It is expected that chempreneurs will revolutionise the chemical industry, tackling current challenges such as sustainability. Chemistry students are 54% less likely to start a business than the average student in Germany. The investigation of the influencing factors shows a significant effect for Polish and German students in the subjective norm and for students with founders in their circle of acquaintances, in the following referred to as social capital. We therefore want to use the survey data set to better understand the differences between students with social capital and those without. We therefore compare chemistry students, with and without founders in their immediate circle, of all year groups in Germany with samples of Polish chemistry students to understand motivation, obstacles and intentions and to understand possible differences between students with founders in their circle.

By including samples of students with significant differences in culture, economics and educational background, we developed and tested hypotheses about the influence of these factors on the intentions, perceptions, motivations and barriers of four groups. A random sample of chemistry students was included for both Germany and Poland. We distinguished between intrinsic and extrinsic factors. We found a number of significant differences between the four groups. We discuss the results and suggest new approaches for the education of chemistry students and for future research approaches.

Keywords

Chempreneurs, entrepreneurs, subjective norm, chemistry, education.

Introduction

The chemical industry is one of the most important economic sectors within the EU countries (Alatraste-Contreras, 2015). At the same time, chemistry is included in almost every value chain and thus represents an opportunity for entrepreneurship and innovation (Abigail et al., 2022). The need for innovation is evident with regard to the challenges of a new basis for the products of the chemical industry without petrochemicals (Confalone, 2014). Innovations can take the form of new processes, products and procedures. The technology transfer for an innovation can take place, for example, through patents, spin-offs from universities or the founding of a company (Wolf et al., 2021). Entrepreneurship can thus be a means of promoting innovation and competitiveness in the chemical industry (Walther et al., 2023). Within the academic career literature, it is assumed that career intentions can be influenced both positively and negatively by contextual variables (Mueller & Schnurbus, 2023). Subjective norms are a particularly critical contextual variable, which is triggered by social pressure from the person's environment, such as relatives, friends, role models, neighbours, colleagues, peers or classmates (Majeed & Ghumman, 2021). Research shows that people tend to adopt behaviour that is consistent with the perception of subjective norms (Zhang et al., 2022). This effect can also be seen in chemistry students in Germany and Poland, which leads to an investigation of the differences between the student groups with social capital and an assumed more positive attitude and those without such

contacts. Characterised by the value of the support of a person's environment in their venture, similar to social capital as a micro-level network (Winter, 2023).

Literature Review

The foundations of research with the subjective norm go back to the fundamentals of the theory of planned behaviour. The subjective norm is defined as the existence of social pressure perceived by the individual to implement a desired behaviour (Ajzen, 1991). The research model for this study is based on the theory of planned behaviour (TPB) (according to Ajzen, 1991). According to the TBP, human behaviour is determined by three factors and their beliefs. The basic model comprises the attitude, the subjective norm and the perceived behaviour of the mediator control. In their corresponding aggregates and behavioural beliefs, a positive or negative attitude towards the behaviour. The effects of the attitude towards a behaviour and the subjective norm on the intention are moderated by the perception of behavioural control. In general, the more favourable the attitude and subjective norm and the greater the perceived control, the stronger the person's control should be over their intention to perform the behaviour in question (Ajzen, 2006). The basic model is modelled depending on the question and application, which means that different "relevant behaviours", i.e. target variables or questions, can be investigated, such as entrepreneurial behaviour (Boissin et al., 2009).

In this study, the TPB model was supplemented by the variables start-up knowledge, perceived educational support, perceived support from university/research institution and perceived career opportunities (Cook et al., 2000; Roy et al., 2017; Zapkau et al., 2015). This can also provide fundamental insights into the training of prospective chemists in Germany and Poland (Walther et al., 2024). The applied research model based on the TPB has already been expanded to include findings on significant influencing factors on chemistry students for Germany and Poland (Walther et al., 2024; Walther et al., 2024). The green arrows therefore indicate factors that have a significant influence in both countries, and the light green arrow indicates a significant influence in Germany.

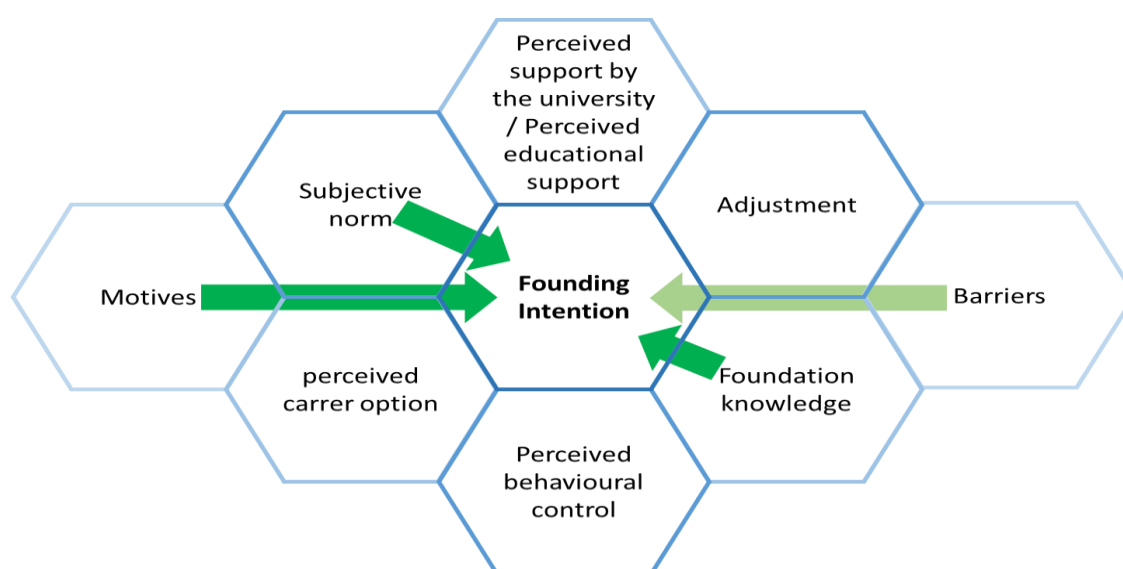


Figure 1: adapted research model according to the Theory of Planned Behaviour

There is a growing body of research on the subjective norm and career intentions (Aga & Singh, 2022). It is assumed that the subjective norm influences career intentions via the social context anchored in the individual (Moriano et al., 2012). Research shows both positive (Abigail et al.,

2022; Aga & Singh, 2022) and negative correlations (Evers & Sieverding, 2015; Hauss et al., 2015). The mode of action and direction of the subjective norm can vary depending on the question and research. The research question varies between, for example, entrepreneurial (Abigail et al., 2022) or academic career intentions (Hauss et al., 2015).

A longitudinal study with postdocs from German universities revealed a positive influence of the subjective norm on an academic career (Evers & Sieverding, 2015). In this study, some of the data was only collected 1.5 years after graduation. This makes it difficult to argue the results. The authors emphasised the importance of the timing of the survey for future research. For example, research with Algerian students shows a significant influence of the subjective norm on entrepreneurial intention, the study of which was conducted with 248 students (Bouarar et al., 2022). A trans-national study with students from different disciplines from Argentina, Chile, Panama and Spain found a significant influence of subjective norm for Panama and Spain, but not for Argentina or the majority of STEM students from Chile (Ward et al., 2019). A study of 498 chemistry students in Germany found a significant positive influence of the subjective norm on the start-up behaviour of chemistry students (Walther, et al., 2024). The evaluation of Polish chemistry students from the identical survey also came to this conclusion (Walther et al., 2024). The subjective norm from the TPB focuses on the individual perception of social expectations and the resulting influences on behaviour. A link to an individual's social environment is the concept of social capital, which considers the breadth and depth of a person's social networks and emphasises their value in creating access to new opportunities. Characteristics such as resilience and adaptability can be seen as a result of possessing different forms of capital. These types of capital include a strong sense of personal identity, supportive social networks, good self-management skills and enriching life experiences (Estêvão et al., 2017; Wang et al., 2022). In Winter's (2023) concept, two models are combined, resulting in four types of social capital: social, human, cultural and personal capital (Brown et al., 2020; Lehmann, 2019). These types of capital are defined as follows:

- Social capital: The breadth and depth of a person's social network and its value in providing a sense of belonging. Can open up access to new opportunities.
- Human capital: the breadth and depth of skills and knowledge an individual can accumulate over a lifetime and be of value to others in specific contexts.
- Cultural capital: the breadth and depth of an individual's awareness and contextualised behaviour, based on previous experience, and the value to the individual in facilitating inclusion in and credibility with particular social groups.
- Personal capital: the range and coherence of contextual identities, values and personal narratives that an individual has been able to develop and articulate, enabling them to identify with different social groups and maintain a sense of purpose.

This paper is primarily concerned with social capital. This can be divided into performative and transformative social capital, which I differentiate in Eben. Performative social capital refers to strongly "binding" networks at the micro level, while transformative social capital refers to the macro level of diverse "bridging" networks (Winter, 2023). In order to gain a deeper understanding, we made the evaluation of the survey dependent on whether or not the students identified founders in their social environment. The levels described are additionally divided into formal to informal, which are used in entrepreneurship research (Randerson et al., 2020; Scott, 2010) see Table 1.

Table 1. Entrepreneurship and institutions: levels and constitutive elements

		Formal		Informal
	Level	Regulative	Normative	Cognitive-cultural
Macro	Transnational	UN, NATO; EU, Regional Trade Agreements	MNCs professional organisations, implicit codes of conduct of certain professions	“Global” culture: push towards sustainability, circular economy
	National	Law and other codified or non-codified mandatory rules (e.g. precedent or jurisprudence)	Axiom associated with identifying as a member of the concerned nation	National culture (Hofstede, 1980)
Meso	Sub-national (regional, field, community, religion)	Laws (or rules of equivalent force) company statutes, articles of association	Community identity, precepts of religions, industry codes of conduct	Culture each of these levels
Micro	Inter-personal, family	Family constitution, family law, family contract	Professional identity, birth, position among siblings, gender identity	Family culture

The applied forms of business with the associated barriers and motives within this entrepreneurial activity can be explained on the basis of levels (micro-macro) or formal to informal by, for example, prevailing national laws and regulations or differences within cultures (Randerson, et al., 2020). Social capital is also referred to in research as social embeddedness and was first used by the economic sociologist Polanyi (1944) to show that economic activities are embedded in social relationships (Polanyi, 1944). In addition to rational and structural embeddedness, later developments of this model also deal with four types of embeddedness: cognitive, cultural, structural and political (Granovetter, 1985; Zukin & DiMaggio, 1990). Through further adaptation, the model is no longer only used for research on international immigration and entrepreneurship, but also for entrepreneurship of women and migrants in urban and rural areas to discuss the impact of local socio-cultural economic and institutional environments on entrepreneurship (Kloosterman et al., 1999; Langevang et al., 2015). Social embeddedness can provide the opportunity for a deeper understanding of social relationships and network structures on people's economic activities and a key role in individual entrepreneurial decisions (Land & Fink, 2018). Relationships can help broker resources such as employees, venture capital and production licences for the business environment, provide entrepreneurial support for start-ups, identify new consumers for products, help exploit economic resources or evaluate potential markets (Jack & Anderson, 2002; Kalantaridis, 2010; Ndofor & Priem, 2011).

To understand how individual entrepreneurial activities may be dependent on social embeddedness or social capital. It is important to find out whether the presence of founders in the

social environment of students influences entrepreneurial behaviour or entrepreneurial inclination. The derived hypotheses can be found in Table 2.

Table 2. Hypothesis

Number	Hypothesis
1	Students with social capital are more likely to start a business than students without.
2	Students with social capital rate the social pressure lower than students without.
3	Students with social capital rate motives higher than students without.
4	Students with social capital rate barriers lower than students without.

Methodology

This study is part of a comparative study of German and Polish chemistry students that examines innovation-oriented technology transfer from the students' perspective. Due to time and cost constraints, a longitudinal design was chosen for our study. The chosen method was a survey with one measurement point (August 2022 – January 2023) to collect prospective and current data using an online questionnaire. Additional questions were added to the questionnaire used in this article. The questionnaire was translated into English, French, Spanish and Polish by specialised staff and then checked for loss of meaning. The target group for the survey was students from the departments of chemistry as well as related fields (biochemistry, analytics, industrial chemistry, process engineering, industrial biology and food chemistry).

The questionnaire used in this study is composed of questions from different studies. The questions are divided into demographic factors, the probability of founding or career intentions and the assumed influencing factors from the TBP with supplemented questions. The questions were asked in the fixed order of demographic questions, external influencing factors, start-up probability and personal influencing factors. After the demographic questions on gender, migration, nationality and age, participants were excluded due to their student status in order to obtain the desired data. Subsequently, study-relevant characteristics such as place of study, field of study, intended degree, total duration of study, type of employment or the presence of founders in the environment were recorded and questions were asked to determine the latent constructs. For this, questions from different studies were used, which were adapted to a 6-point Likert scale to force selection. Absolute ignorance (1) to comprehensive knowledge (5) for questions on basic knowledge, or I don't know (0), don't agree at all (1) to completely agree (5) for the others. The probability of founding a company was asked through two different types of questions, on the one hand the probability of founding a company after graduation from very unlikely (1) to very likely (6). An overview with the question categories used, the number of questions, the presence of the answer option "I don't know" as well as the question source can be found in Table 3.

Table 3. Overview of applied study questions with sources, number and additions

question categories	number of questions	Answer option “I don’t know”	Question source	Addition of own questions
Foundation knowledge	3	no	(Cook, Heath, & Thompson, 2000)	no
Perceived educational support (PES) & Perceived Support of the university (PSU)	10	yes	(Roy, Akhtar, & Das, 2017)	yes
subjective norm (SN)	2	no	(Saeed, Yousafzai, Yani-De-Soriano, & Muffatto, 2015)	no
Founding intention	2	no	(Saeed, Yousafzai, Yani-De-Soriano, & Muffatto, 2015)	no
Perceived Career options (WCO)	6	yes	(Cook, Heath, & Thompson, 2000)	no
Perceived Behavioural control (PBC)	9	yes	(Zapkau, Schwens, Steinmetz, & Kabst, 2015)	no
Self-assessment for the foundation (SF)	3	yes	(Krueger, Reilly, & Carsrud, 2000)	no
Motives for Starting a Business	17	yes	(Pruett, Shinnar, Toney, Llopis, & Fox, 2009), (Solesvik, 2013)	yes
Barriers to Starting a Business	19	yes	(Pruett, Shinnar, Toney, Llopis, & Fox, 2009), (Solesvik, 2013)	yes

Participants

A total of 4,367 people and 120 professors or student representatives were contacted. In February 2023, we received completed questionnaires from 1,287 participants, a response rate of 29.4 %, which is acceptable compared to other studies [58]. Before conducting our statistical analyses, we excluded 320 participants due to incomplete data. We also excluded participants who reported that they were not currently a student ($n = 135$), or belonged to another field (such as teaching or electrical engineering), or were studying in another country ($n = 21$). The final sample thus consisted of 811 students, 498 from Germany and 313 from Poland. The students were asked “Do you have founders in your circle of acquaintances?” in order to be able to separate them according to the presence of social capital. The average time spent in the questionnaire was 9.25 minutes. A summary of the distribution of study participants can be found in Table 4.

Table 4. Summary of the study participants

Factor	Germany		Poland	
	yes	no	yes	no
social capital				
Age [years]	23.5	23.0	22.0	21.5
Men	51.0 %	45.9 %	28.1 %	28.2 %
Women	47.1 %	53.1 %	70.9 %	68.4 %
Migration background	26.0 %	21.4 %	19.9 %	21.4 %
Foreign citizenship	17.2 %	14.3 %	2.6 %	6.0 %
Public university	78.4 %	80.6 %		
Bachelor's programme	46.1 %	57.1 %	73.0 %	69.2 %
Master's programme	28.4 %	23.1 %	18.9 %	23.1 %
No income	29.9 %	41.5 %	56.1 %	65.8 %
Full-time employment	7.8 %	6.1	6.1 %	4.3 %
Founder among their acquaintances	41.0 %	59.0 %	62.6 %	37.4 %

Statistical analysis

The statistical analysis was carried out with IBM SPSS Statistics version 28.0.1. Within the demographic questions, the students were asked whether they had "a founder within their circle of acquaintances". According to this factor, we divide the answers of the hours into those with founders in their circle of acquaintances and those without for the respective country. Before ANOVA, the data were tested for normal distribution using Shapiro-Wilk tests. Since the data were not normally distributed, the Kruskal-Wallis-Test was used for independent samples, which is a non-parametric alternative to ANOVA. Kruskal-Wallis-Test compares the ranks of the data. The result of an ANOVA analysis is the standardised z-value, which indicates how many standard deviations the test statistic deviates from the expected value, and the significance level (p-value) determined by the distribution function of the test. The significance level was defined as 5 %. The calculation of the probability of founding a company is based on the percentage of participants who selected founding a company as a career option. The general presentation of the results is in the form of a graph and shows the areas with significant differences. The mean values from one category are given and the significance refers to at least one question from this category. The significant results are presented as a table showing the factor, country, number of "I don't know" statements, proportion of "I don't know" statements, sample size (n), mean, median, z-value (z) and p-value (p). A complete list with all questions is included in the study by (Walther et al., 2024; Walther et al., 2023).

Results

The overview with the averaged values of all factor groups and the comparison groups used (students with founders in their circle of acquaintances and without for Germany and Poland) can be found in with information on their respective significance.

Total Overview- Comparison of the factorgroups analysed

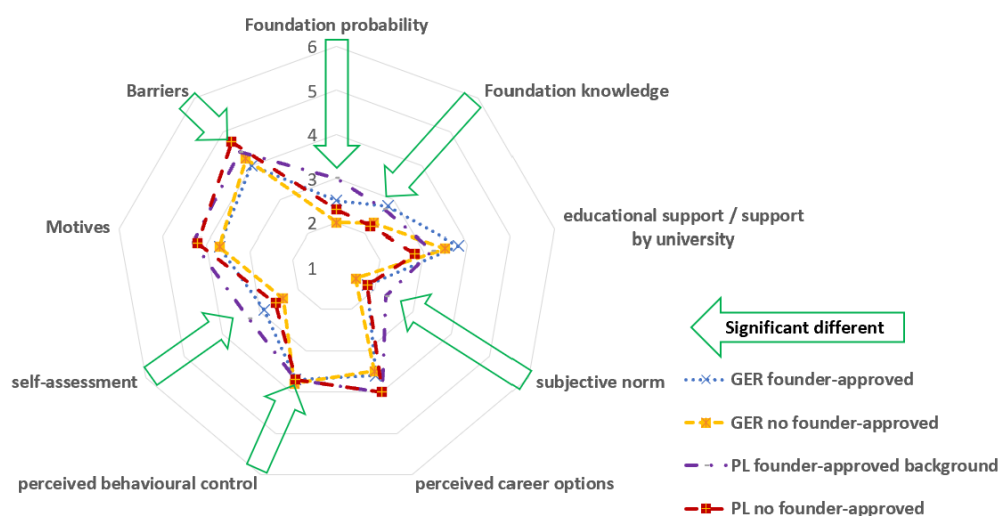


Figure 2: Overview of statistically significant differences in the ANOVA analyses

As can be clearly seen in Figure 2, there are differences in all factor groups except for "educational support / support by university", "perceived career options" and "motives". For the methodology used and the analysis, however, only differences within a country are of interest and are labelled as significant. For example, although there are differences in the factor groups educational support / support by university, perceived career options and motives, these can be attributed to cultural differences between the countries. For a closer look at these differences, we recommend a detailed analysis of the cultural differences (Walther et al., 2023).

Entrepreneurial intentions

The analysis of the ANOVA comparisons for the Entrepreneurial Intentions can be found in Table 5.

Table 5. Results ANOVA comparison on the entrepreneurial intentions

Question / Factors	Country	Social capital	n	mean	median	GER				PL	
						Yes		No		Yes	
						z	p	z	p	z	p
Entrepreneurial intentions	GER	Yes	204	2.5	2						
		No	294	2.0	2	3.636	0.002				
	PL	Yes	196	3.0	3	-3.586	0.002	-7.482	<0.001		
		No	117	2.3	2	0.717	1.000	-2.270	0.139	3.782	0.001

Table 5 shows clear differences between the compared groups. In addition, cultural differences become clear through the comparison of German and Polish chemistry students with social capital. Here, the German students show an average assessment of 2.5 and the Polish students an average of 3.0 for the willingness to start a business. At the same time, the direct comparison of the groups within a country shows the respective significant difference with the higher ratings for the students with social capital. This leads directly to the conclusion that social capital has an influence on the willingness of chemistry students to start a business. This correlation has already been postulated for Germany with a significant effect of students with social capital

and a 47 % higher willingness to start a business (Walther, et al., 2024). However, no significant influence of social capital could previously be postulated for chemistry students in Poland (Walther, et al., 2024). This leads directly to the conclusion that social capital has an influence on the willingness of chemistry students to start a business. This correlation has already been postulated for Germany with a significant effect of students with social capital and a 47 % higher willingness to start a business. However, no significant influence of social capital could previously be postulated for chemistry students in Poland.

Foundation knowledge

The following Table 6 contains the ANOVA comparison with the answers of students from Germany and Poland with and without social capital to the questions from the area of start-up knowledge.

Table 6. Results ANOVA comparison on the factors of foundations knowledge

Question / Factors	Country	Social capital	n	mean	Median	GER				PL	
						Yes		No		Yes	
						z	p	z	p	z	p
To what extent do you know about the tasks involved in setting up a business?	GER	Yes	204	2.6	2						
		No	294	2.1	2	4.419	<0.001				
	PL	Yes	196	2.8	3	-1.710	0.523	-6.222	<0.001		
		No	117	2.0	2	3.999	<0.001	0.559	1.000	5.433	<0.001
To what extent can you distinguish between a "good" and a "bad" start-up idea?	GER	Yes	204	3.1	3						
		No	294	2.7	3	3.063	0.013				
	PL	Yes	196	2.8	3	2.005	0.269	-0.851	1.000		
		No	117	2.5	2	4.035	<0.001	1.728	0.504	2.288	0.133

Question / Factors	Country	Social capital	n	mean	Median	GER				PL	
						Yes		No		Yes	
						z	p	z	p	z	p
Do you know of any funding organisations that can help you with your start-up?	GER	Yes	204	2.7	2						
		No	294	2.0	2	5.304	<0.001				
	PL	Yes	196	2.5	2	1.206	1.000	-3.933	0.001		
		No	117	2.1	2	3.566	0.002	-0.638	1.000	2.507	0.073

As Table 6 shows, significant differences can only be identified for Polish students with or without social capital in the question "To what extent do you know about the tasks involved in setting up a business?". For the German students with and without social capital, however, significant differences could be identified for all questions in this category "To what extent do you know about the tasks involved in setting up a business?", "To what extent can you distinguish between a "good" and a "bad" start-up idea?", "Do you know of any funding organisations that can help you with your start-up?". The questions were rated higher by students with social capital, regardless of the country considered. From this it can be concluded that students are more likely to be informed about start-ups due to the possibility of barrier-free communication. The social capital at this point thus indicates a transfer of knowledge by the founders, which at the same time increases the start-up knowledge of chemistry students in both countries. At this point, we can therefore speak of human capital acquired from the contacts (Winter, 2023).

Perceived educational support (PES) / Perceived Support of the university (PSU)

As Table 6 shows, there are no significant differences for the groups with social capital in Germany or Poland.

Subjective norm (SN)

Table 7 contains the assessments of the chemistry students from GER and PL for the subjective norm in the respective gender comparison.

Table 7. Results ANOVA comparison on the factors of subjective norm

Question / Factors	Country	Social capital	n	mean	median	GER				PL	
						Yes		No		Yes	
						z	p	z	p	z	p
People I care about expect me to start a business after I graduate.	GER	Yes	204	1.5	1						
		No	294	1.3	1	1.722	0.511				
	PL	Yes	196	2.1	1	-5.636	<0.001	-.7814	<0.001		
		No	117	1.7	1	-.1706	0.528	-.3245	0.007	3.132	0.010
People who are important to me think that I should start a business after I graduate.	GER	Yes	204	2.1	2						
		No	294	1.6	1	3.547	0.002				
	PL	Yes	196	2.4	2	-1.425	0.925	-5.051	<0.001		
		No	117	1.8	1	1.745	0.486	-1.106	1.000	2.952	0.019

As Table 7 shows, students in both countries have significant differences in their assessment of "People who are important to me think that I should start a business after I graduate." The students with social capital rated the question higher in each case. The Polish students with social capital also rated the question "People I care about expect me to start a business after I graduate." significantly higher. This suggests a direct influence from social capital.

Perceived Career options (WCO)

As Table 7 shows, there are no significant differences for the groups with social capital in Germany or Poland. It can therefore be assumed that the direct contact of founders has no significant influence on the perceived career options.

Perceived Behavioural control (PBC)

Table 8 contains the results from the survey for the factors from the area of perceived behavioural control.

Table 8. Results ANOVA comparison on the factors of perceived behavioural control

Question / Factors	Country	Social capital	„I don't know“ n	„I don't know“ %	n	mean	median	GER				PL	
								Yes		No		Yes	
								z	p	z	p	z	p
I think it would be fun for me to have responsibility over other people.	GER	Yes	3	1.5	201	4.6	5						
		No	2	0.7	292	4.4	5	1.754	0.477				
	PL	Yes	6	3.1	190	3.8	4	5.188	<0.001	3.874	0.003		
		No	4	3.4	113	3.0	3	8.629	<0.001	7.668	<0.001	4.140	<0.001

The Perceived Behavioural control factor group shows a significant difference among Polish students in response to the question "I think it would be fun for me to have responsibility over other people". This was rated higher by students with founders in their circle of acquaintances ($m = 3.8$) than by those without ($m = 3.0$). This factor indicates a low fear of accepting liability.

Self-assessment for the foundation (SF)

The results for the factors from the area of self-assessment for the foundation can be found in Table 9.

Table 9. Results ANOVA comparison on the factors of self-assessment for the foundations

Question / Factors	Country	Social capital	„I don't know“ n	„I don't know“ %	n	mean	median	GER				PL	
								Yes		No		Yes	
								z	p	z	p	z	p
Starting a business after my studies is for me, possible.	GER	Yes	29	14.2	175	3.7	4						
		No	45	15.3	249	3.2	3	3.558	0.002				
	PL	Yes	17	8.7	179	4.2	4	-2.482	0.078	-6.273	<0.001		
		No	17	14.5	100	3.3	3	2.012	0.265	-0.833	1.000	4.134	<0.001
It would be easy for me to develop a business idea.	GER	Yes	14	6.9	190	2.8	3						
		No	30	10.2	264	2.5	2	2.524	0.070				
	PL	Yes	13	6.6	183	3.3	3	-3.056	0.013	-5.786	<0.001		
		No	12	10.3	105	2.7	3	0.538	1.000	-1.514	0.781	3.120	0.011
I know all about the practical details required to start a business.	GER	Yes	8	3.9	196	2.1	2						
		No	10	3.4	284	1.6	1	4.919	<0.001				
	PL	Yes	8	4.1	188	2.3	2	-0.929	1.000	-5.867	<0.001		
		No	6	5.1	111	1.7	1	-3.116	0.011	-0.774	1.000	3.884	0.001

As shown in Table 9, the German students show the following results for the factors "Starting a business after my studies is for me, possible." and "I know all about the practical details required to start a business." show significant differences. The Polish students also show significant differences in the factor "It would be easy for me to develop a business idea." show significant differences. The students with social capital showed higher ratings for all questions. This indicates an influence of the subjective norm on the students' self-confidence. It can therefore be concluded that the possibility of low-threshold communication with founders has a positive influence on the willingness of chemistry students in Germany and Poland to start a business. This also indirectly confirms the influence of social capital.

Motives for Starting a Business

As Table 9 shows, there are no significant differences for the groups with social capital in Germany or Poland. Contrary to other studies, no influence on possible motives and benefits of social capital such as entrepreneurial support, the provision of resources or the identification of potential markets can be recognised (Jack & Anderson, 2002; Kalantaridis, 2010; Ndofor & Priem, 2011).

Barriers to Starting a Business

Table 10 contains the results for the ratings of male and female the chemistry students from GER and PL for the factors from the area of barriers to starting a business.

Table 10. Results ANOVA comparison on the factors of barriers to starting a business

Question / Factors	Country	Social capital	„I don't know“ n	„I don't know“ %	n	mean	median	GER				PL	
								Yes		No		Yes	
								z	p	z	p	z	p
...a lack of ideas about which company to found.	GER	Yes	16	7.8	188	4.3	5						
		No	32	10.9	262	4.4	5	-1.005	1.000				
	PL	Yes	8	4.1	188	4.2	4	-0.029	1.000	0.974	1.000		
		No	12	10.3	105	4.7	5	-3.171	0.009	-2.512	0.072	-3.146	0.010
...a lack of experience in management.	GER	Yes	10	4.9	194	4.1	4						
		No	23	7.8	271	4.6	5	-3.788	0.001				
	PL	Yes	7	3.6	189	4.0	4	-0.129	1.000	3.620	0.002		
		No	10	8.5	107	5.0	5	-.5425	<0.001	-2.601	0.056	-5.290	<0.001
...a lack of guidance.	GER	Yes	26	12.7	178	3.8	4						
		No	44	15.0	250	4.1	4	-2.056	0.238				
	PL	Yes	9	4.6	187	4.1	4	-2.390	0.101	-0.502	1.000		
		No	15	12.8	102	4.9	5	-5.703	<0.001	-4.311	<0.001	-3.721	0.001
...a lack of support in setting up a business.	GER	Yes	32	15.7	172	3.8	4						
		No	56	19.0	238	4.2	4	-2.698	0.042				
	PL	Yes	10	5.1	186	4.3	5	-3.406	0.004	-0.922	1.000		
		No	12	10.3	105	4.5	5	-3.806	0.001	-1.719	0.514	-0.910	1.000

Table 10 shows significant differences for the German chemistry students with and without founders in their circle of acquaintances when asked about "...a lack of support in setting up a business.". While for the Polish students the questions "...a lack of ideas about which company to found.", "...a lack of experience in management." And "...a lack of guidance." show significant differences. The barriers are rated higher by students without social capital. This suggests that the founders have a direct influence on breaking down barriers. In contrast to the motives, the barriers show a direct influence of social capital. The variables that indicate advantages through social capital, such as entrepreneurial support and the provision of resources, are significantly lower. These significant differences show an effect primarily in Poland, which suggests cultural differences (Walther et al., 2023). Our study thus confirms previous analyses of social embeddedness (Jack & Anderson, 2002; Kalantaridis, 2010; Ndofo & Priem, 2011).

Discussion

The estimates for the developed hypotheses from Table 2 are in Table 11.

Table 11. Answer hypothesis

Number	Hypothesis	answer
1	Students with social capital are more likely to start a business than students without.	accepted
2	Students with social capital rate the social pressure lower than students without.	rejected
3	Students with social capital rate motives higher than students without.	rejected
4	Students with social capital rate barriers lower than students without.	accepted

As the results in Table 7 and the categorisation of the hypotheses show, students with social capital are significantly more likely to start a business. This indicates that low-threshold communication with founders in the social environment is a way to motivate students to start a business. This represents an opportunity to adapt entrepreneurship education by establishing low-threshold communication through an experienced founder. The possibility of adapting teaching in the context of chemistry education has already been successfully tested in other countries (Abigail et al., 2022) and could serve as a basis here. The assessments by students with social capital show higher ratings for the variables in the area of start-up knowledge. This can also be attributed to the low-threshold communication without or with few barriers with founders, as a result of which the students rate their knowledge higher. As the survey and the variables are self-assessment questions, it should be noted that this does not necessarily mean that they have a higher level of knowledge. Nevertheless, this starting point can be used to break down potential barriers such as "insufficient start-up knowledge". The subjective norm shows higher assessments of students with social capital for the perceived pressure of a start-up. This is due to potential backgrounds such as founders or businesses within the family. For example, the pressure to continue the family tradition can be perceived. These variables can be used to ensure that the inclusion of experienced founders in entrepreneurship education means that students are more likely to build up experience and spend more time working on / discussing the topics in their social environment. As a result, students may be more likely to be motivated by their social environment to found a company after spending a lot of time on these topics. The Polish chemistry students with social capital rated the variable "I think it would be fun for me to have responsibility over other people" significantly higher than their Polish colleagues, while their German colleagues showed no differences. This variable in the area of Perceived Behavioural control may indicate a higher sense of duty among Polish chemistry students with social capital through, for example, family businesses and a type of cultural role model. In contrast, the insignificant difference in Germany rather points to lower motives in this area. As this is not a representative study, these effects should be specifically analysed in further studies with more participants.

The motives show no significant effects for social capital in the analysis and survey carried out. Hypothesis 3 from Table 2 is therefore rejected. This means that the effects described by Kalantaridis (2010), Ndofor and Priem (2011), and Jack and Anderson (2002) cannot be verified here, as the students with social capital did not give any significantly higher ratings. However, since the Polish chemistry students with social capital gave significantly lower ratings for barrier variables such as "...a lack of ideas about which company to found.", "...a lack of experience in management." And "...a lack of guidance." Hypothesis 4 could be confirmed and it can be concluded that existing founders may provide support. This starting point also represents a possible approach for further research and entrepreneurship teaching. These approaches can be further developed and analysed. Especially the support of potential founders and the removal of possible barriers can help to expand this career path.

The results presented from the study only provide an initial overview of chemistry students in Germany and Poland and their willingness to set up their own company. However, as this is not a representative study but a random sample, it is only possible to recognise trends and define possible fields of action. We therefore recommend conducting a representative study, possibly covering several countries, for future research. For further research, we recommend carrying out entrepreneurship education among chemistry students using the findings already gained from the study. The experienced role models can be used and built upon, and women in particular can be further motivated to start a business (Walther et al., 2024). In general, however, it

is advisable to investigate the effects further and to make possible adjustments to the lessons after the implementation of a phase. The implementation in phases such as in a Plan-Do-Check-Act cycle (PDCA cycle), as is common in quality management, would be helpful here in order to incorporate the circumstances and changed starting situations of the respective students into the programme to ensure optimal utilisation of potential and competencies.

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