tise transition, innovation and sustainability environments

Co-funded by the Erasmus+ Programme of the European Union

THE POTENTIAL OF VR TECHNOLOGY IN ENTREPRENEURIAL SOFT SKILLS EDUCATION: AN EXPLORATORY PILOT STUDY ON FUTURE STUDENT ENTREPRENEURS

Master's thesis for obtaining the academic degree

Master of Science

in the study programme Erasmus MSc. Degree in Transition, Innovation, and Sustainability Environments, TISE

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submitted by

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Krems, Austria, July 2024

STATUTORY DECLARATION

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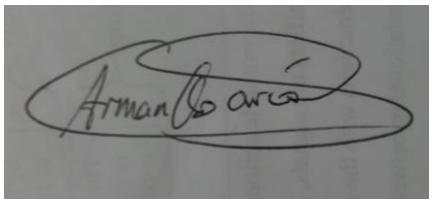

DEDICATIONS

I want to dedicate this work to my mom, who was diagnosed with non-Hodgkin's Lymphoma at the start of this journey. Completing this master's degree while carrying this personal burden has been an extremely difficult challenge for me. Thank you, Mom, for being my unwavering source of inspiration. Your strength, resilience, and the transformative impact you have had on the lives of thousands of people exemplify what it means to be a social innovator and agent of change. Your courage fueled my determination to persevere in this reality.

I also dedicate this work to all entrepreneurs, especially those from the neurodivergent community who constantly face misunderstanding, harassment, abusive treatment, and intolerance. This is for those for whom the education system, and indeed the world, still has a long way to go. Your resilient creativity is a testament to the extraordinary potential within us all, and it is my hope that this work contributes, even in a small way, to a more tolerant, inclusive, and understanding society.

ACKNOWLEDGEMENTS

I wish to express my utmost gratitude to all those who contributed to the realization of this thesis. First and foremost, I extend my heartfelt thanks to all the professors of the Erasmus MSc. Degree in Transition, Innovation, and Sustainability Environments (TISE). Your vast knowledge, experiences, and diverse perspectives shared during the courses and workshops have been invaluable to my academic journey. I am also grateful to the administrative staff of the University Nova of Lisbon (UNL), University College Dublin (UCD), Poznan University of Economics and Business (PUEB), and University for Continuing Education Krems (UWK), whose assistance with numerous critical personal matters was instrumental in my academic journey.

My sincere thanks go to the Department of Information Technology (KTI) at (PUEB). I am deeply thankful for the opportunity to conduct my research at KTI, where I received essential access to VR technology, training, and technical support throughout the development of this study. I am especially thankful to Prof. Jarogniew Rykowski for his warm reception, invaluable guidance, and crucial networking support. A special acknowledgment is due to teaching assistant Michał Śliwicki for his indispensable technical assistance, unwavering trust, and significant contributions at every phase of this project. Additionally, I extend my heartfelt gratitude to all the professors at PUEB for their support during the recruitment of student participants for this study.

I am thankful to my supervisor, Prof. Liliya Satalkina from the University of Continuing Education Krems (UWK), for her insightful guidance, patience, and dedicated time toward my thesis project. My appreciation also goes to Prof. Günther Schreder from UWK for his external guidance and valuable recommendations, and to Prof Orla Byrne from UCD, for her kind consideration in evaluating my work. I extend my sincere gratitude to all the students from PUEB, and the professors and experts from UCD, Trinity College of Dublin, NDRC, PUEB, and UWK, who kindly agreed to participate in this study. Your valuable contributions were essential, and without your participation, this pilot would not have been possible.

I want to thank some of my master's colleagues who offered a helping hand or a word of encouragement when challenges arose. Your support lightened my burdens and made this journey more bearable. Thank you for your kindness and camaraderie. Finally, I want to express my deepest sentiment of appreciation to those few people who appeared as shining stars in my path when reality was overwhelming and helped to illuminate my spirits.

ABSTRACT

This pilot study explores the potential of integrating virtual reality (VR) technology into entrepreneurship education to enhance students' entrepreneurial soft skills. Despite growing interest in VR as an educational tool, its impact on developing essential entrepreneurial competencies—such as opportunity recognition, creativity, and innovativeness—remains underexplored. This research aimed to explore VR's potential in fostering entrepreneurial soft skills (RQ1) and to assess the complexities of its implementation (RQ2). Employing a qualitative-dominant partially mixed-methods (QDPMM) exploratory design, the study involved pre- and post-training tests, surveys, focus groups, and interviews with students and other directly concerned stakeholders. Thirteen students from Poznan University of Economics and Business (Poland) took part in a 4-hour training based on a VR environment for entrepreneurial mindset development, while experts in entrepreneurial education, and VR development, joint from UCD (Ireland), Trinity College (Ireland), PUEB (Poland), and UWK (Austria). Findings suggest that VR integration might increase students' self-confidence and awareness in opportunity recognition, creativity, and innovativeness. While quantitative results lacked statistical significance due to study limitations, qualitative feedback indicated an activation of the entrepreneurial mindset and perceived skill development among students. However, challenges such as high costs, technical limitations, and the need for institutional readiness were also highlighted by consulted experts. Future research should focus on refining VR training modules, expanding sample sizes, improving data collection instruments, and exploring the interplay between training content, and delivery. These insights aim to inform the development of VR-enhanced entrepreneurship education, fostering a new generation of innovative and confident student entrepreneurs.

Keywords:

Virtual Reality, Entrepreneurship Education, Soft Skills

CONTENTS

1. INTRODUCTION

1.1 Background of the Study

Entrepreneurship is a complex, dynamic, and challenging endeavor that requires a diverse skill set for effective navigation (Gold & Rodriguez, 2018; Halabisky & LEED OECD, n.d.; NFTE, n.d.). Numerous studies from different fields recognize that entrepreneurs and entrepreneurship are important drivers of economic growth, employment, innovation, and productivity (Cooney, 2012; Li et al., 2020; Pham et al., 2023; Pita et al., 2021; Radinger-Peer et al., 2018; Valerio et al., 2014). However, starting and sustaining a business is very hard and often requires a hefty dose of optimism, multidimensional entrepreneurial skills, and a positive business environment (GEM (Global Entrepreneurship Monitor), 2023). In the long run, 90% of start-ups fail (Howarth, 2022). In the United States alone, the average failure rate during the second to fifth years after foundation can soar to a staggering 45-70%, varying significantly based on the industry. According to the latest report by the OECD, *SME and Entrepreneurship Outlook 2023*, bankruptcy rates for SMEs in approximately 40% of registered countries have increased since 2021. This recent trend is largely attributed to the economic shocks experienced by OECD countries following the pandemic outbreak (OECD, 2023). The combination of high rate of SMEs bankruptcies, lower entrepreneurial activity rates and the decline of entrepreneurship in some OECD members is concerning due to its potential negative impact on job availability, economic performance, and socio-cultural dynamics (Gudnitz Weber et al., 2021).

Given these appalling statistics, it comes as no surprise that governments, research institutions, and academia worldwide have heightened their efforts to comprehend the factors influencing entrepreneurial dynamics, and devise more impactful regulatory interventions, and strategies to cultivate entrepreneurial activity (GEM (Global Entrepreneurship Monitor), 2023; Gudnitz Weber et al., 2021). International policymakers are increasingly focusing on providing SMEs and entrepreneurs with training opportunities to enhance their capabilities, resilience, and competitiveness (OECD, 2023). Entrepreneurship is now recognized by the European Union as one of eight lifelong learning competencies, relevant to personal and collective development, employment generation, and new ventures creation (Halabisky & LEED OECD, n.d.; McCallum et al., 2018). In 2016, the European Commission unveiled the EntreComp Framework (Entrepreneurship Competence Framework), an initiative that promotes entrepreneurship education in schools, aims to "raise consensus among all stakeholders and to establish a bridge between the worlds of education and work". Entrepreneurship education is advancing globally, at university and high school level, where the number of entrepreneurship majors, specialized programs, clubs, events, competitions, and courses has grown considerably over the last decade (Gold & Rodriguez, 2018; Gudnitz Weber et al., 2021; McCallum et al., 2018).

Entrepreneurship education and training opportunities are pivotal in nurturing the new generation of entrepreneurs and enhancing the capabilities of established entrepreneurs to expand their businesses towards greater success (Cooney, 2012; Gold & Rodriguez, 2018; NFTE, n.d.). This is especially pertinent

for young students and graduates, as entrepreneurship education during their studies might equip them with a plethora of tools to conceive ideas, and gain knowledge, inspiration, skills, and experiences essential to promote a positive mindset and attitudes for possibly starting a new enterprise in their future (Baharuddin & Ab Rahman, 2021; Doanh, 2021; Pham et al., 2023; Wach & Głodowska, 2019). Future student entrepreneurs aged 18-35, will play a crucial role in driving economic growth and job creation, since they are natural agents of change, digitally born and raised, and with higher awareness for social and climate justice (Youth Business International, n.d.). As the next generation of entrepreneurs, they will innovate businesses, introduce new ideas, and strengthen communities and economies by creating opportunities that benefit not only themselves and their immediate circles but also society as a whole (Gudnitz Weber et al., 2021; Youth Business International, n.d.).

Amid global disruptions, tight labor markets, and pressure to adapt to the green and digital transitions, SMEs and entrepreneurs need not only to develop and strengthen their technical (hard) competencies in business development; they need more than ever the development of transversal (soft) capabilities related to the way they develop their businesses, and cope with societal transformations and rapid changes in economies (Accenture, 2017; OECD, 2023; Youth Business International & Minic, 2023). These soft capabilities and competencies includes soft skills related to behavioral aspects and entrepreneurial mindsets, such as teamwork, tolerance to uncertainty, reactiveness to novelty and emerging opportunities, strategic and critical thinking, adaptability and resilience, innovation, design, creativity and problem solving, among others (Gold & Rodriguez, 2018). Business soft skills are critical to business performance and competitiveness, crucial for future entrepreneurs success, and vital for students to ensure their academic achievement and future success in the labor market (Accenture, 2017; NFTE, n.d.; Youth Business International & Minic, 2023).

Considering that approximately 13.6% of the global youth labor force (67.6 million of young women and men) are unemployed, according to the International Labour Organization (ILO), entrepreneurship and entrepreneurial soft skills development stand out as transformative options to create work for young people and unlock income generation (Gudnitz Weber et al., 2021; Youth Business International, n.d.). The earlier they develop these skills and build the right entrepreneurial mindset, the greater the likelihood of their academic, professional, and entrepreneurial success (NFTE, n.d.; Soares et al., 2017).

Teaching entrepreneurial soft-skills is increasingly recognized as critical to strengthening human capital and making individuals more employable and competitive (Gold & Rodriguez, 2018). However, there are several difficulties that limit the effectiveness of the educational approaches and interventions seeking to enhance entrepreneurial soft skills among students. One of the first difficulties is associated to the limited guidance, understanding, and consensus of what these "soft-skills" really are (Galloway et al., 2017; Gold & Rodriguez, 2018; Youth Business International & Minic, 2023). One approximation is elaborated by the Youth Business International who defines soft skills as "set of competencies, behaviors,

attitudes, personal qualities, motives and thought processes that enable young people to perform well and achieve their goals, work well with others, and effectively navigate their environment". Examples of these soft skills are team building, risk taking, creativity, innovativeness, adaptability among many others. Soft skills are also referred to by other researchers as socio-emotional skills, transferrable skills, non-cognitive skills, mindset, personal qualities, and developmental assets, among other terms (Galloway et al., 2017; Soares et al., 2017).

Another challenge in entrepreneurship education is related to the debate weather if entrepreneurship and more specifically entrepreneurial soft skills can be actually learned or taught (NFTE, n.d.). Some researchers argue that certain aspects of entrepreneurship associated with the "science" of entrepreneurship such as business development and management skills, ie.: hard/cognitive skills, can indeed be taught and learned, while aspects associated with the "art" of entrepreneurship, e.g.: creativity, and innovativeness (soft skills), can only be learned through practical experience (The World Bank, 2013). Despite these opposing views, evidence from multiple sources support that the mindset and skills can be indeed built when entrepreneurship education and training include entrepreneurial soft skills development as part of their methodologies (Bacigalupo et al., 2020; NFTE, n.d.; OECD, 2023; The World Bank, 2013; Valerio et al., 2014) .

Other significant challenges associated with educating entrepreneurial soft skills include understanding how the transfer/development of these skills might occur and creating valid methodologies for teaching and measuring them (Galloway et al., 2017; Soares et al., 2017). According to Gold & Rodriguez (2018) teaching and accurately assessing these skills are challenging because they do not involve a straightforward transfer of knowledge. These authors state that, unlike traditional academic subjects such as math or reading, evaluating an entrepreneurial mindset requires understanding how a program has influenced a student's "patterns of thought, feelings, and behavior," rather than merely assessing facts learned in a classroom setting. Additionally, learning soft skills is a complex and multifaceted process affected by many intrinsic (e.g. age, cognitive development) and extrinsic factors (e.g. a person's social network, life experiences, education and training systems)(Soares et al., 2017). On top of that, entrepreneurial education is highly heterogeneous, with diverse goals and outcomes, and with limited research on its long-term effectiveness (Gold & Rodriguez, 2018; Soares et al., 2017).

Given the evolving complexity of teaching and measuring entrepreneurial soft skills, international frameworks and educational programs consider a multiplicity of innovative approaches, placing special focus on experiential activities. For example, the *Network for Teaching Entrepreneurship* (NFTE) from the USA, provide to students the fundamentals of business startup and entrepreneurship through classroom instruction, combined with games, short projects, and field-work with mentors and business leaders from the community to gain real-world experiences (Gold & Rodriguez, 2018). The *European Entrepreneurship Competence Framework (EntreComp)*, developed by the European Commission, provides a comprehensive intervention framework for entrepreneurship education institutions,

policymakers, researchers, educators, trainers, and social activists. This framework emphasizes the importance of experiential learning, fostering a culture of experimentation and exploration, incorporating real-world settings, and creating environments that promote novelty and high emotional engagement (Bacigalupo et al., 2020; McCallum et al., 2018). Teaching methodologies that include experiential, hands-on and close-to-real world scenarios appear to be particularly effective for developing entrepreneurial soft skills (NFTE, n.d.).

However, the rapid digitalization of human interactions and virtualization of working environments driven by disruptive technologies have accelerated the need for innovative research and teaching methods to train people faster, smarter, and cost-efficiently manner (Accenture, 2017; pwc, 2020). In the digital economy, jobs, businesses, and the way people work are being rapidly redefined. Thus, reimagining research and education methods to adapt urgently to these transformations is crucial for developing effective strategies that can meet the demands of a rapidly evolving landscape (Accenture, 2017). Digitalization is a vulnerability, within which both risks and disruptions, but also opportunities can be identified.

One disruptive invention that is gaining increasing importance and popularity in educational fields is virtual reality (VR), due to its highly immersive and interactive virtual capabilities (Xie et al., 2023). Virtual reality, one of the most promising means of human-computer interaction (HCI), involves employing head-mounted devices, controllers, or hand recognition, enabling users to engage in highly interactive experiences in computer-generated environments from a first-person perspective (Hamblin, 2005; Xie et al., 2023). In these "virtual worlds," users can experience a sense of "presence" through immersive, multi-sensory experiences, which may include visual, auditory, haptic, and tactile feedback. Virtual interfaces enable users to navigate and interact with virtual objects or characters in potentially more engaging ways than those offered by traditional desktop environments (Hamblin, 2005).

Research shows that integrating VR technologies as part of the teaching methods has significant potential to deliver innovative educational approaches, enhance students' learning experience and outcomes (Di Natale et al., 2024; Xie et al., 2023). Additionally, literature reports that VR methods might offer an advantage in knowledge acquisition supported by the highly immersive experiences that generate a feeling of "being present" (XR Global, 2019). The feeling of "being there" provides more meaningful experiences.

Multiple international corporations such as Exxon, Boeing, Walmart, and others are already successfully using VR technologies as part of their training programs (XR Global, 2019). Some of the key advantages of VR-based training reported by these organizations are that trainees are able to interact with and control the learning environment, possibility to offer field training without hazards, and allowing the user learning by doing (XR Global, 2019). Furthermore, a variety of high-risk scenarios can be simulated as part of VR training in a safe and controlled environment. Some of these scenarios are routine operations, emergency response, abnormal operations, upset scenarios, integrity critical procedures, and low

probability high consequence events. The training can then be repeated until the desired training outcome becomes “second nature”. However, it is important to note that these training programs primarily focus on industrial scenarios, aiming to develop technical or hard skills related to industrial operations.

In the context of universities VR technology might have some important beneficial affordances. For example, conducting internships in institutions is essential for students to gain practical experience and ensure a comprehensive education. However, opportunities for internships and in-company experiences are usually limited leaving students with fewer chances to acquire hands-on experience, resulting in a lack of practical understanding and familiarity with processes (Xie et al., 2023). Furthermore, during involuntary disruption of academic trainings students might be unable to attend any type of practical training in university settings, like what happened during the Covid-19 pandemic. Also, geological and time restrictions might make it impossible for students to access specialized training. In these situations, incorporating VR technology in education might help mitigate the impacts of the lack of access to experiential knowledge, and insufficient practical skills, and soft skills development (Di Natale et al., 2024; Xie et al., 2023). By implementing immersive simulations, trainers can leverage the realism, high interactivity, amusement, and emotional engagement of virtual environments to develop skills among students, especially entrepreneurial soft skills.

Numerous sources highlight the "remarkable" potential of integrating VR technology into teaching methods (Di Natale et al., 2024; pwc, 2020; Xie et al., 2023; XR Global, 2019). However, they also emphasize significant challenges associated with its implementation. One major challenge is designing effective and suitable VR simulations that seamlessly integrate into traditional courses while ensuring peak performance without crashes. Navigating and interacting withing the VR simulation might be considered as complex, demanding, or even impossible for some users with special needs. For this reason, it is crucial to develop, select, and integrate VR technology that make meaningful contributions to the curriculum and meet the performance needs of both trainers and trainees, considering learning efficacy, technical assurance and ethics criteria (Di Natale et al., 2024). Additionally, the cost of developing and implementing VR technologies and methods may be prohibitive for many organizations. Institutions may face challenges in allocating resources towards implementing immersive learning technologies, especially considering budget constraints and competing educational priorities. Evaluating the cost-effectiveness and financing possibilities of VR in education is crucial to ensuring their successful implementation at the institutional level (pwc, 2020).

Finally, the adoption of VR technology in education faces several additional challenges. Technological complexities, restrictive or absent regulatory frameworks, and resistance or scepticism from stakeholders can create tensions regarding acceptance and utilization (Alkhabra et al., 2023; Di Natale et al., 2024; Gómez-Zará et al., 2023; Yang, 2023). Moreover, ethical concerns such as privacy, accessibility, digital equity, and the long-term impact of immersive technologies in educational settings must be carefully addressed to ensure their responsible use (Gómez-Zará et al., 2023). Overcoming these

obstacles is crucial for realizing the full potential of VR in education and achieving meaningful advancements in entrepreneurial education.

1.2 Problem Statement

Future student entrepreneurs often face challenges in acquiring and honing entrepreneurial soft skills due to limited access to innovative entrepreneurship training, real-life scenarios, and the limitations of traditional on-site training and trainers' skills (Mitra, 2023; Xie et al., 2023). Including VR technology with their interactive, experiential, hands-on, and deeply engaging characteristics, offer a promising avenue for enhancing the effectiveness of conventional entrepreneurial education approaches, in addressing the skills gap among future student entrepreneurs (Xie et al., 2023).

Despite the growing interest and investment in immersive technologies for educational purposes, few studies have explored the implementation of VR technologies as part of entrepreneurship education for soft skills development among students. Furthermore, there is a lack of interdisciplinary and multi-perspective research on the potential and challenges of incorporating VR technologies in entrepreneurial education. To the best of the author's knowledge, there is no existing comprehensive research or literature examining VR technology in entrepreneurship education for entrepreneurial soft skills development. This is based on a snowballing-based literature search covering 150 scientific articles and international reports in the fields of entrepreneurship education and technology education. The primary sources included Google Scholar, Nature, Science Direct, Sage Journals, and Wiley, and the key terms used during the search were "entrepreneurial education," "soft skills," and "VR". After this focalized literature review, only one study was found addressing the implementation of VR technology in education for soft skills development among students preparing for the Fintech industry, from a quantitative perspective.

Xie et al., (2023) conducted a study titled "Integrating Immersive Experience into Hybrid Education: A Case Study in Fintech Experimental Education" to assess the effectiveness of combining traditional on-site education with VR-based education. Their research involved a comparative user experiment with 60 students from Guangdong University of Finance, revealing that hybrid education positively influences critical thinking, communication, and teamwork skills at the individual level. Although their findings provide valuable insights into soft skills development through VR education methods, they may not be directly extrapolated to the entrepreneurship context.

Furthermore, Xie et al.'s (2023) study analyses the impact of the course from a quantitative research design level, leaving unexplored the perspectives of students, teachers, and other institutional stakeholders regarding the VR experience. Additionally, their research did not include qualitative data analysis, missing an exploration of participants' personal perceptions, insights from other experts in the field, and potential challenges and barriers from an institutional perspective.

It is evident that significant research gaps still need to be addressed to analyse the potential of VR technology as part of entrepreneurial education for soft skills development to support future student

entrepreneurs. For this reason, and due to the complexity of the topic, an explorative qualitative dominant mixed-method pilot study was proposed and conducted as part of this M.Sc. degree research to explore this specific area of research, gain a preliminary understanding of the complexities involved, propose and test procedures and protocols, elaborate hypotheses related to this research topic, and identify potential challenges and opportunities to inform future research.

1.3 Research Questions and Specific Objectives of the Exploratory Pilot Study

To help filling these gaps and contribute to expand the knowledge of the field, this explorative pilot study revolves around the following research questions:

- **RQ1**: What is the potential of VR in entrepreneurship education for soft skills development among future student entrepreneurs?
- **RQ2**: What are the complexities related to the implementation of VR in entrepreneurship education for soft skills development among future student entrepreneurs?

The specific objectives of the explorative pilot study and related questions include:

1. **Exploring the potential impact from a quantitative and qualitative perspective of VR in Entrepreneurship education for soft-skills development (RQ1):**
   - What trends might be observed when implementing VR as part of an entrepreneurship training for soft skills development among students?
   - What key insights might provide students from their experiences with VR in entrepreneurship education pointing to soft-skills development?
   - What key features of VR technology are highlighted by directly concerned stakeholders, that might be relevant for entrepreneurial soft skills development?
2. **Gauge the challenges of implementation in university settings (RQ2):**
   - What is the role of the universities in the implementation of VR for entrepreneurship education?
   - What are the advantages, disadvantages and challenges, from the perspective of participants in the study, to be considered in the deployment, and usage of VR as part of entrepreneurship education for soft skills development in university settings?
   - What are the expectations, and needs of students, trainers, and VR for education developers in relation to the implementation of VR technologies in the context of entrepreneurship soft skills education?
   - What are the preconditions or prerequisites that need to be considered to deploy VR as part of entrepreneurship education?
3. **Contribute for future research of entrepreneurship soft skills development in virtual environments (RQ1 & RQ2):**
   - Which hypothesis might be elaborated for future research, about the potential impact of VR in entrepreneurship education to foster soft skills among students?

- What learnings might provide the explorative pilot study to inform future research about entrepreneurial soft-skills development in VR environments?

1.4 Purpose and Motivations of the Exploratory Pilot Study

Purpose of the Pilot Study:

The purpose of this pilot study is to provide an explorative yet multi-perspective analysis of the potential of implementing VR as part of entrepreneurship education for soft skills development among future student entrepreneurs. By examining preliminary quantitative trends, perspectives of directly involved stakeholders, and gauging the complexities of implementing these innovative methods, this study aims to generate initial knowledge that might serve for future pilot designs and research, and thus helping support ethical, safe, and efficient transformation of traditional educational approaches to satisfy the dynamic demands of entrepreneurial training in the digital age.

Motivations behind the Pilot Study:

The motivations behind this explorative pilot study are multifaceted:

1. Addressing Entrepreneurial Skills Gaps among Students. Traditional educational methods often fall short in equipping students with essential entrepreneurial soft skills, such as opportunity recognition, creativity, and innovativeness. These skills are critical to ensure their academic, professional, and possibly their entrepreneurial success. Unemployment among students and start-ups long term failure is highly prevalent. VR technologies, with their highly immersive, interactive, engaging, and experiential learning environments, can significantly increase student motivation, mental, emotional engagement, and participation, which offer a promising alternative to enhance soft skills more effectively. However, research and implementation of VR tech in this field are scarce or inexistent. This explorative pilot study seeks to support educators and researchers to create more captivating and impactful learning experiences that might help students develop more effectively their entrepreneurial soft skills, and ultimately their competitiveness and resilience.

2. Overcoming Practical Limitations of Entrepreneurial Education. Many students face barriers to gaining practical experience through traditional internships and real-life scenarios. The lack of opportunities, the impossibility of on-site education due to global disruptions such as pandemics, war, or geographical constraints, and the pressing need for more impactful entrepreneurial education push universities to urgently innovate and adapt. VR simulations might replicate these experiences in a controlled, accessible, and safe environment, offering students valuable hands-on learning opportunities. This exploratory pilot study aims to contribute to the development of more impactful and innovative entrepreneurial education methods in universities.

3. Contributing to Research and Innovation in Entrepreneurial Education. There is still a pressing need for research on entrepreneurial soft-skills development, training, and measurement methods. The existing literature in this field is fragmented and insufficient. Additionally, there is a notable lack of

comprehensive research on the implementation and effectiveness of VR-based education methods in entrepreneurship. This pilot study aims to generate valuable knowledge to explore the potential and challenges of implementing VR in entrepreneurship education for soft-skills development, thereby contributing to the broader field of entrepreneurial educational innovation.

4. Informing Policy, Research and Practice. The findings of this study might provide first insights for policymakers, researchers, educators, and institutions. By understanding the potential benefits and complexities of implementing VR technologies as part of entrepreneurship education, stakeholders can make informed decisions about integrating these methods into their curricula and strategies.

In summary, this pilot study is motivated by the need to explore and validate innovative educational approaches that can better prepare future entrepreneurs with the soft skills necessary for success in a rapidly changing world. By conducting a thorough analysis, this study aims to contribute to the advancement of entrepreneurial education and the effective utilization of VR technology in this field.

1.5 Relevance of the Pilot Study

Why Entrepreneurship Soft Skills for students?

The subject matter addressed in this master thesis holds significant relevance both scientifically and practically. Entrepreneurship is a vital driver of economic growth, innovation, and employment, making it essential to equip aspiring entrepreneurs with the necessary skills and tools for success. The high failure rates among startups, coupled with prevalently high unemployment rates, underscore the need for innovative approaches to entrepreneurial education. Soft skills are often neglected or given minor attention in educational programs, not only due to a lack of strategic focus but also because of the challenges in developing valid training and assessment methodologies targeting these skills. This study proposes new ways of researching and training entrepreneurial soft skills, providing new avenues for gaining scientific knowledge, offering the development of more effective and innovative methodologies, and ultimately contributing to the improvement of the competitiveness and resilience of future entrepreneurs.

Why VR technology as part of Entrepreneurship Education for students?

By investigating the potential of VR technology in entrepreneurship education, this study aims to provide first insights into its effectiveness, potential, and practical implementation challenges. It uniquely explores the intersection between VR technology, entrepreneurship education, and soft-skills development among students. While traditional on-site learning methods have been extensively utilized, immersive learning offers a promising avenue for bridging the skills gap in a more engaging, interactive, and experiential manner. The findings of this study may open new perspectives on the role of immersive technologies in addressing the skills gap among future entrepreneurs and exploring innovative educational approaches. Additionally, this pilot provides first insights for policymakers, researchers, educators, trainers, and institutions seeking to enhance the efficacy of entrepreneurship education and improve

educational outcomes. Importantly, it offers crucial information that may support universities in their research programs aiming to adapt their educational offerings to the rapidly changing learning styles of students born and raised in a highly digitalized world.

Why a Qualitative dominant mix-method Pilot Study?

This master's research proposes a qualitative dominant mix-method pilot study to explore the potential of immersive learning for enhancing soft skills among future student entrepreneurs. It serves to generate first knowledge that might be used in future research to address the lack of multi-perspective studies on immersive learning tailored for entrepreneurial skills development in academia. This study employs a methodological approach that combines an initial quantitative exploration with an enhanced qualitative analysis, to uncover insights from multiple perspectives.

The qualitative dominant mix-methods approach provides in-depth perspectives from students, professors, technical experts, and trainers, enriching the understanding of implementation challenges, potential, and attitudes toward immersive learning for soft skills enhancement in academia. By conducting an exploratory pilot study, this research takes a significant first step, laying the groundwork for more extensive future research and the implementation of innovative entrepreneurial educational programs. Further investigations could delve into specific aspects such as resource allocation, adoption challenges, ethical considerations, and comparisons between traditional and immersive learning methods in different educational contexts.

1.6 Limitations

Assumptions

1. Entrepreneurial Soft Skills Can Be Trained and Measured: There's evidence that entrepreneurial soft skills (or aspects of them) such as opportunity recognition, innovativeness, and creativity can be trained and measured. Literature indicates that behaviors, attitudes, and patterns of thought associated with these mindsets can be activated and fostered through highly engaging, experiential, and interactive learning experiences. Additionally, innovative assessments have proven effective in measuring the impact of these training methods. This assumption supports the interest in evaluating VR approaches in the specific context under study.

2. Researcher Bias is Negligeable: The researcher's opinions and perceptions are assumed to have no significant effect on the study results. This is due to strict data collection protocols and the use of training content based on reputable sources in entrepreneurial education. Any potential for bias is further mitigated through triangulation of data from multiple sources and integration of perspectives of multiple stakeholders.

3. Participant Responses are Authentic and Valid: It is assumed that the responses provided by participants in surveys, focus groups, tests, and interviews accurately reflect their true knowledge, skills, attitudes, feelings, and perceptions. This assumption is supported using multiple data collection methods,

enabling triangulation of results, combined with direct observation of participant behaviors during the controlled portions of the research.

Limitations

1. Short Training Duration: The VR training session was limited to approximately 4 hours. Consequently, any quantitative results related to its effects should be treated as exploratory, aimed at identifying trends and informing the qualitative analysis.

2. Lack of Control Over Testing Environment: The survey, pre-training test, and post-training test were not administered under the direct supervision of the researcher. This was further mitigated with the qualitative information collected from participants during the focus group. However, more controlled data instruments must be implemented in future research to further investigate and validate the hypothesis proposed as part of this research.

3. Resource Constraints: The study was conducted within a short timeframe and with limited resources and support. These constraints hindered the full potential impact of the study but do not invalidate the value of its contributions, results, and conclusions.

4. Content Quality: The VR training content was prepared by the researcher using reputable sources and recognized training materials. However, the study's results are dependent on the effectiveness of this content (and the sources) in addressing entrepreneurial skills education and training.

5. **Small Sample Size:** Only 13 students from the Poznan University of Economics and Business from Poland, participated in the VR training, and only 6 experts from 4 international universities were interviewed. This small sample size limits the generalizability of the study's conclusions and the robustness of the analysis.

6. Generalizability to Other Educational Contexts: The findings from this study are based on a specific educational context (Poznan University of Economics and Business in Poland) and may not be generalizable to other institutions or cultural contexts.

7. Long-term Impact: The study does not assess the long-term impact of VR-based entrepreneurial training on participants' soft skills. The effects measured are immediate and do not account for how skills and perceptions might develop or fade over time.

8. Participant Selection Bias: The study participants have a pre-existing interest in entrepreneurship and VR, which could've influenced their engagement and outcomes, leading to selection bias. Discussions with participants during the focus group about what they did not like of the experience helped mitigate this limitation. Additionally, students with no experience with VR, or entrepreneurship were included to further mitigate this limitation.

9. VR Content Specificity: Any effect of the VR training on participants perceptions was influenced by the specificity and relevance of the VR content designed and delivered. Other contents with less alignment with the intended learning outcomes might have less impact.

10. Trainer Dependency: Any effect of the VR-based entrepreneurial training applied as part of this study was dependent on the trainer's ability to deliver the content and VR experience in a meaningful, engaging, and impactful manner.

Delimitations

1. Scope of Soft Skills: This study treats "soft skills" as a broad category that includes mindsets, non-cognitive skills, behaviors, and attitudes. For the purposes of this study, no distinction is made between these constructs, and they are used interchangeably as part of the same "set" of skills.

2. Focus on Soft Skills: The study exclusively focuses on soft skills. It does not cover technical or hard skills such as marketing, financial analysis, or other business development-related skills.

3. Role of Quantitative Data: The quantitative data collected and analyzed in this study provided valuable initial trends and aided in hypothesis development. This initial knowledge together with the qualitative analysis results served to provide key guidelines for future pilot development and research on the topic under study.

4. Age, Interests, and Educational Level: The study focuses on students of a particular age group and educational level (university students), with interest in entrepreneurship, or VR methods for education purposes, excluding other potential participants such as high school students or adult learners.

5. Specific VR Technology: The study utilizes a specific type of VR hardware and software. Results may vary with different VR platforms, which could affect the generalizability of the findings.

6. Focus on Initial Implementation: The study focuses on the initial implementation and immediate outcomes of VR-based training. It does not consider iterative improvements or the evolution of the training program over multiple iterations.

7. Controlled Environment for VR Sessions: The VR training sessions were conducted in a controlled environment. The effectiveness and feasibility of implementing such VR-based training in less controlled or more varied environments are not addressed.

8. Software and Hardware: This study did not focus on the development of any software or hardware related to VR technology. Instead, the research centered on evaluating the effectiveness of existing VR-based education methods for developing entrepreneurial soft skills among students.

1.7 Structure of the paper

The structure of this study is organized as follows. The Introduction provides the background, problem statement, research questions, objectives, purpose, and motivation, as well as the significance and relevance of the study. Key terms, and empirical evidence from literature were included as needed in different parts of the content of this work to limit its extension. The Methods sections details the research methodology, including research approach, pilot study design, participant recruitment, data collection methods, analysis techniques, and ethical and safety considerations. It also discusses limitations and measures to ensure reliability and validity. The Results section presents the quantitative and qualitative insights gained from students before and after the VR training, and valuable information

collected from entrepreneurship educators, and business and XR technology development experts. The Integrated Discussion of Results elaborates on potential answers to the research questions and guidelines for future research, and present contrast with findings from literature. Finally, the Conclusions summarize the key findings, discuss their potential implications, highlight the study's contributions to knowledge, and offer recommendations for future research.

2. METHODS

This section outlines the methodology employed to investigate the potential of VR technology in entrepreneurship education to develop soft skills among future student entrepreneurs. The research aims to answer key questions regarding the potential impact and implementation challenges of these technologies as part of innovative entrepreneurship education programs:

- **RQ1**: What is the potential of VR in entrepreneurship education for soft skills development among future student entrepreneurs?
- **RQ2**: What are the complexities related to the implementation of VR in entrepreneurship education for soft skills development among future student entrepreneurs?

The section begins with a general explanation of the qualitative-dominant research approach with elements of mixed-method, continuing with a more detailed explanation of the exploratory pilot study design. It then details the recruitment of participants, data collection instruments, the VR training, and the ethical and safety considerations. Following this, the section describes the data analysis techniques used to interpret both quantitative and qualitative data. Finally, it addresses the measures taken to ensure reliability, validity, and the mitigation of bias, providing a comprehensive framework for understanding the study's findings.

2.1 Research Approach

For this study, a qualitative-dominant research approach with elements of mixed-methods was deemed the most suitable methodology to offer a more comprehensive understanding and effectively address the research questions (De Lisle, 2011). Usually, mixed-methods research involves integrating elements of both qualitative and quantitative approaches, including collecting, analyzing, and combining both types of data within a single study or a series of studies, for the broad purposes of breadth and depth of understanding and corroboration (Clough & Nutbrown, 2008; Creswell & Plano Clark, 2011; De Lisle, 2011). A qualitative dominant (also called qual-dom, qualitative driven, or led) mixed-method can be defined as a special type of mixed research that relies on a qualitative approach in the research process, while concurrently recognizing the benefits of adding supportive quantitative data and approaches in the research project (De Lisle, 2011).

The present study's research approach was designed as a qualitative-dominant partially mixed-method approach (from now on QDPMM approach) following a partial integration of quantitative analysis and insights with qualitative research approach in multiple stages of the study, giving dominant role to the qualitative approach. One example of integration is the definition of research question 1 (RQ1: What is the *potential* of VR in entrepreneurship education for soft skills development among future student entrepreneurs?) in which the answer is approximated by combining quantitative data (trends, numerical insights) and qualitative data (perspectives, feelings). In turn, the answer to research question 2 (RQ2: What are the complexities related to the implementation of VR in entrepreneurship

education for soft skills development among future student entrepreneurs?) is purely qualitative. Also, the design of the methodology considered the parallel collection and analysis of quantitative data to enrich and concurrently support the overarching qualitative analysis. Furthermore, data collected was dominantly qualitative but quantitative data was still significant, and the data analysis process considered both qualitative and qualitative approaches (thematic analysis and McNemar test / paired sample t-test analysis). Finally, the open and exploratory nature of the qualitative approach drove the overall analysis of the study integrating the complementary quantitative insights gained, to efficiently address the complexities of the topic under study (Hendren et al., 2023).

When necessary, the data were integrated using two primary approaches (see Figure 1) (Clough & Nutbrown, 2008):

- **Connection/Triangulation:** Utilizing quantitative findings (trends and numerical insights) to complement and expand upon qualitative insights.
- **Merging:** Combining quantitative insights with qualitative results to achieve a more comprehensive understanding of the problem and generate holistic answers to the research questions.

No embedding of the data was conducted. The research approach was designed so that the quantitative analysis supported the qualitative analysis, rather than the qualitative analysis depending on or being built from the quantitative analysis (or vice versa).

Implementing a QDPMM approach allowed the researcher to leverage the strengths of both data types, enabling a more holistic exploration led by the qualitative approach of the impact, challenges, and potentialities of implementing VR technologies as part of entrepreneurial education for soft skills development among students. Some of the strengths of this QDPMM approach included a better understanding of the problem's context, insights into participants' perspectives, and mitigation of biases through data triangulation (Hendren et al., 2023). Additionally, the partial integration of quantitative analysis allowed the researcher to approximate to a complex question that cannot be answered by a qualitative approach alone (*What is the potential…?*), as mixed-methods research encourages collaboration and the integration of different perspectives, paradigms, and “worldviews”. While partial or full mixed-methods research offers increased flexibility to answer the study's questions more comprehensively, it also results in a more complex research process, demanding more time and resources for data collection, analysis, and presentation (Clough & Nutbrown, 2008; Creswell & Plano Clark, 2011).

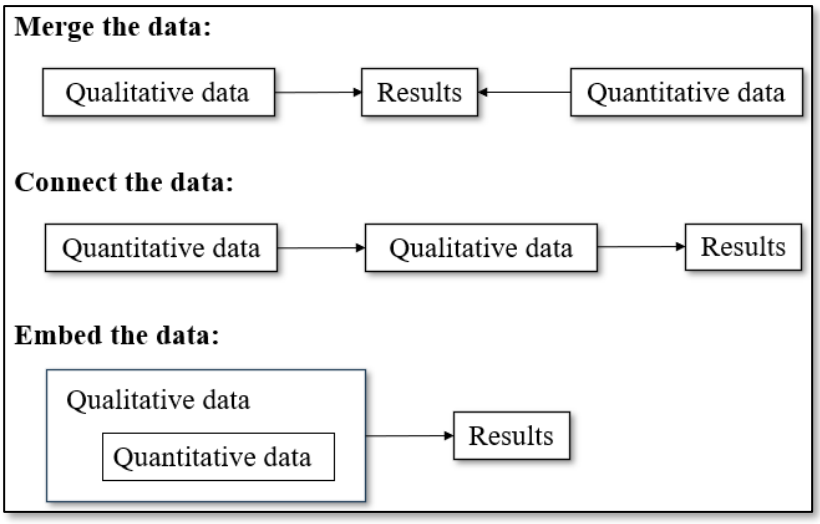

Figure 1. Three Ways of Mixing Quantitative and Qualitative Data (Adapted from (Clough & Nutbrown, 2008)

It is crucial to highlight that, at the time of this research, no other studies were found having implemented a fully or partially mixed-methods approach to explore the potential of VR technologies as part of education methods for entrepreneurial soft-skills development. Only qualitative or quantitative studies alone covering specific elements related to this research were identified. This presented an opportunity to explore the potentialities and difficulties of implementing this type of research approach in the specific context of our study, and to contribute to future pilot studies and research development.

Four studies from the literature review were found to be relevant and supportive in building the foundations of the QDPMM approach proposed in this study. Xie et al. (2023) effectively implemented a quantitative approach in their study "Integrating Immersive Experience into Hybrid Education: A Case Study in Fintech Experimental Education". They evaluated the effectiveness of hybrid education through a comparative user experiment involving 60 students from Guangdong University of Finance. Using median data, average data, and the entropy weight method, they uncovered that hybrid education positively impacts soft-skills development. Like Xie et al. (2023), pwc, (2020) and XR Global (2019) implemented comparative quantitative analysis to assess the impact of VR-based training on users' skills development. On the other hand, Di Natale et al. (2024) conducted a qualitative study titled "Learning in the Metaverse: Are University Students Willing to Learn in Immersive Virtual Reality?" In this study, they surveyed 329 undergraduate students from different universities in Italy to research students' attitudes toward immersive virtual reality (IVR) in education. Their study revealed that the strongest predictors of students' intention to use IVR in education were performance expectancy, effort expectancy, social influence, and facilitating conditions.

In the next section, the study's research design is detailed, offering a more comprehensive insight into the conceptualization and development of the research process. This includes how qualitative and quantitative data were collected and analyzed to address the research questions and sub-

questions. This detailed explanation will illustrate the overall approach taken to ensure the validity and reliability of the findings, highlighting the integration of both data types to provide a nuanced understanding of the potential of VR technology in entrepreneurship education for developing entrepreneurial soft skills.

2.2 Research Design

The present research is an explorative pilot study inspired by the approaches proposed by pwc (2020); Xie et al. (2023); XR Global (2019), NFTE (What We Do - NFTE, 2023), and Di Natale et al., (2024). From these studies, the pilot design was inspired by the approaches implemented by pwc (2020), and XR Global (2019), while data collections instruments and entrepreneurial training gained inspiration from the NFTE framework, Xie et al. (2023), and Di Natale et al. (2024).

This study was designed as a QDPMM exploratory pilot, which served to explore from a quantitative-enhanced qualitative perspective the potential of implementing VR technologies as part of entrepreneurship education for soft-skills development among students. There is often no consensus in literature when defining exploratory or pilot studies, and no uniform formal methodological guideline is provide in relation to what constitute a pilot study (Lancaster et al., 2002; Lowe, 2019). Terms like pilot, trial, and feasibility studies are sometimes used interchangeably, whereas others differentiate them based on specific design features or objectives (Hallingberg et al., 2018; Lancaster et al., 2002).

One definition of a pilot project or study is a "*small-scale, experimental, exploratory, preliminary, trial, or test investigation designed to assess the feasibility of methods and procedures for larger-scale implementation"* (Thabane et al., 2023; van Teijlingen & Hundley, 2001). Numerous pilot studies have been conducted in both quantitative and qualitative studies, especially in the health and pharmaceutical fields in the context of randomized control trials (RCT)(Lowe, 2019; van Teijlingen & Hundley, 2001). Most of them are frequently designed to assess costs, risks, validity of methods, to provide evidence of their potential, evaluate effectiveness or efficacy of interventions, increase experience of implementation, and identify optimal parameters of application; all of these as a preparation for a larger study. A common approach when implementing this type of pilot studies is to conduct first explorative interviews/focus groups followed by a definition phase of quantitative analysis (van Teijlingen & Hundley, 2001).

For this research, the pilot study was designed and conceptualized as a small-scale, experimental, and exploratory trial. The primary objective was to explore, learn and generate evidence about the potential and challenges of integrating VR technology into entrepreneurial education for soft-skills development among students. The research approach of this study was executed as part of the QDPMM exploratory pilot in the following manner (interplay of the data is shown on figure x in the next section). The quantitative analysis aimed to identify trends and develop hypotheses, rather than to prove the statistical significance of observed effects or validate the instruments used. The enhanced qualitative analysis played a crucial role in generating a rich understanding, capturing perspectives from

multiple stakeholders directly involved in the issue, and providing insights into the topic under discussion. Consequently, the QDPMM exploratory pilot study was designed to approximate the “assessment" and "feasibility" of implementing VR technology by exploring trends and integrating the perspectives of the study participants.

To ensure validity of the explorative pilot study results, the VR environments (Jelgersma, 2016) and entrepreneurial education methods employed in this study were publicly available or free instruments already validated by recognized institutions or by evidence from scientific literature and used solely for research purposes (EBR, 2019; Ideanote, n.d.; Stephenson, n.d.; *What We Do - NFTE*, 2023). Data collection instruments were crafted based on materials from literature review (Gold & Rodriguez, 2018; Youth Business International & Minic, 2023) or other publicly available validated sources (*What We Do - NFTE*, 2023). In this regard, this exploratory pilot study also had as a secondary objective to generate knowledge and practical insights to inform the future development and testing of specific methods and methodologies involving VR technologies for entrepreneurial soft-skills development. The exploratory nature of the research design facilitated the maximal acquisition of knowledge and made possible the execution of the proposed pilot study under the specific limitations and conditions of this project.

2.3 QDPMM Exploratory Pilot Study Conceptualization

In this section, the conceptualization of the QDPMM exploratory pilot study is described. First, the two phases of the study are briefly presented to provide a general overview of the pilot. Following this, a detailed description of the population and sample, activities, platforms, methods, data collection instruments, analysis techniques, and other aspects of the pilot design are provided.

The QDPMM exploratory pilot was conceptualized to involve two phases: (1) A Comparative Quantitative Analysis, and (2) A Focused Multi-Stakeholder Qualitative Analysis. These two phases are depicted in the figure x, and described as follows:

2.3.1 Phase 1 : Explorative Comparative Quantitative Analysis

In this phase, an explorative comparative quantitative analysis was conducted to explore changes in students' perceptions, knowledge, and awareness following a 4-hour VR-based training session. The training focused on delivering knowledge and expose students to educative dynamics in VR environments related to entrepreneurial soft skills development, such as opportunity recognition, creativity, and innovativeness. During the session, a trainer (the author of this research) provided theoretical knowledge and guided students through highly interactive and immersive activities in simulated business environments using VR headsets (details of the VR training can be found in appendixes D.3 and D.4). A pre-training test was administered to establish a baseline of students’ knowledge and perceptions of their attitudes towards these three soft skills, as well as to introduce students to the training content. After the training, a post-training test was conducted to explore the effects of the VR-based training on students' knowledge and perceptions of their attitudes with respect

to these soft skills. A McNemar test and a paired t-test analysis was conducted to elaborate hypothesis based on the trends and findings observed.

2.3.2 Phase 2: Focused Multi-stakeholder Qualitative Analysis

In this phase, a focused group of stakeholders was consulted. These stakeholders included individuals directly concerned about or affected by the potential implementation of VR technologies in entrepreneurial education, such as students, university professors, entrepreneurship and business education experts, VR technology specialists, and entrepreneurial accelerator leaders. The students who participated in this phase were the same ones who took part in the VR training in Phase 1. They completed first a survey to provide insights into their expectations, needs, and other relevant information regarding VR technology implementation, and entrepreneurship skills development. Additionally, these students participated in a VR-based focus group (hosted immediately after participating in the VR training), which allowed for the collection of detailed information about their perspectives, feelings, and perceptions regarding both the VR training they experienced and the use of VR technology.

The remaining stakeholders participated in individual semi-structured interviews designed to gather their perspectives on the implementation of VR technology in entrepreneurial education for soft skills development within university settings. The knowledge obtained from the surveys, focus groups, and interviews was analyzed through a thematic analysis. The results of Phase 2 were then expanded and integrated with the findings of Phase 1. This combination provided holistic insights into the challenges and potentialities of implementing VR-based entrepreneurship education in an academic setting.

The two-phases process of the exploratory pilot study, including all the activities, data collection, and analysis is summarized in Figure 2.

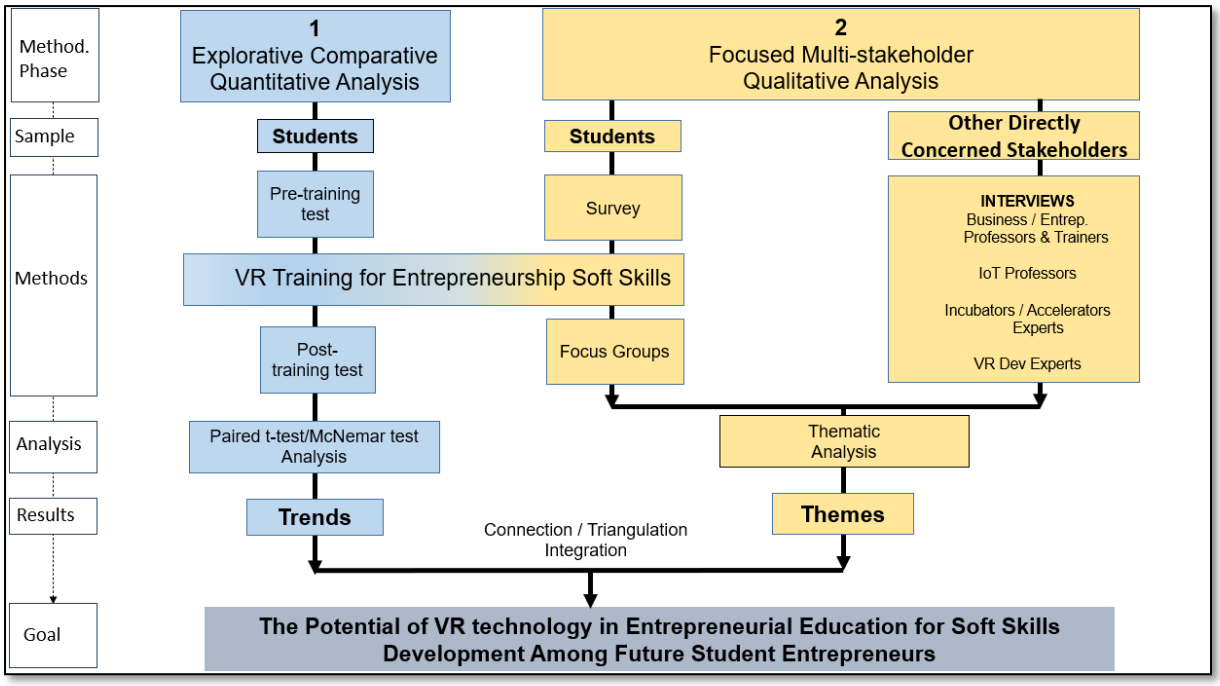

Figure 2. Conceptualization of the QDPMM Exploratory Pilot Study

2.4 Study Area and Participants Recruitment

2.4.1 Study Area

The pilot was carried out in Poland, at the Poznan University of Economics and Business (PUEB), located in Poznan. The research took place within the Department of Information Technology (KTI) at PUEB, which provided access to advanced VR technology, well-equipped laboratory rooms, and technical support from experts in VR technology development and implementation.

Established in 1926, the Poznan University of Economics and Business (PUEB) is one of Poland's oldest and most esteemed economic universities. Renowned for its leadership in economic research, PUEB serves as a major hub for applied research, expert evaluation, analysis, and consultancy. Traditionally focused on educating professionals in economics, the university has evolved into a research-oriented institution, comprising five faculties that specialize in economics, management, international trade, and information and communication technology (ICT). Among the 11 universities of economics in Poland, PUEB ranks third, underscoring its prominence and excellence in the field (Halabisky & LEED OECD, n.d.).

As of 2011, PUEB had approximately 11.100 students, with 8.250 enrolled in full-time courses. The university offers an elective course on entrepreneurship, taken by about 25% of its students, though it does not have mandatory entrepreneurship courses. Two of PUEB's faculties—Management, and International Business and Economics—offer entrepreneurship education at higher levels (Halabisky & LEED OECD, n.d.). The lack of focus and sufficient initiatives on entrepreneurial development for its student population, underscores the value of considering innovative entrepreneurship education and

research, making PUEB an ideal setting for exploring the potential of VR technologies in entrepreneurial education for soft skills development among future student entrepreneurs.

The Department of Information Technology (KTI) at PUEB focuses on research areas relevant to cutting-edge business technologies. Its primary research directions include virtual and augmented reality, the Internet of Things (IoT) and its applications, cybersecurity and privacy, e-business, and e-administration. The department is involved in teaching activities across three faculties and participates in inter-university courses like Industry 4.0 and Internet of Things Applications. The goal of KTI's scientific projects is to develop new electronic business technologies, while its industrial projects aim to implement these technologies to enhance business processes (*Department of Information Technology | Poznań University of Economics*, n.d.).

Conducting the research at PUEB, particularly within the KTI department, was strategically advantageous for several reasons. The access to advanced VR technology and expertise in VR implementation created an ideal environment for exploring the potential of VR technology as part of entrepreneurship education among students. The university's strong emphasis in research and prestigious standing in business and economic studies provided access to the targeted population for the investigation. Additionally, the KTI department's focus on innovative business technologies aligned perfectly with the study's objectives to examine the impact of VR on entrepreneurial soft skills development. This setting offered access to cutting-edge resources, knowledgeable professionals, access to the target population, and the necessary support to make possible the study's execution.

2.4.2 Population

The study design focused on stakeholders directly concerned with the implementation of VR technology in university-based entrepreneurial education.

Students: The primary group of stakeholders involved students who had an interest in entrepreneurship or entrepreneurial skills development. Targeted students were those enrolled in various programs offered at the Poznan University of Economics and Business (PUEB) exhibiting interests in entrepreneurship education, business skills development, or with entrepreneurial pursuits. For practical reasons and to ensure access to training facilities and VR technology, the study targeted initially students from PUEB, and other institutions located in Poznan, Poland.

Professors, Trainers, and Experts: Other directly concerned stakeholders included professors, trainers, and experts with interests or expertise in entrepreneurship, entrepreneurship education, VR technology, or technology in education. The inclusion of these stakeholders was essential to gain comprehensive insights into the feasibility and effectiveness of VR-based entrepreneurial education from multiple perspectives.

While students were selected from PUEB due to logistical considerations, the rest of the stakeholders (experts and professors) participated in online interviews. This approach allowed the researcher to reach experts beyond local boundaries and include participants from prestigious European

universities and institutions related to entrepreneurial education and VR technology development for education. In this regard, the experts who participated in the pilot study came from a range of internationally recognized institutions, including Poznan University of Economics and Business (PUEB) in Poland, University College Dublin (UCD) in Ireland, University for Continuing Education Krems (UWK) in Austria, and the Trinity College Dublin (TC) in Ireland. All these universities are known for their leading positions in entrepreneurial networks, top-tier business schools, and innovative education programs. By including stakeholders from these institutions, the study ensured a diverse and knowledgeable participant pool, which contributed to the depth and validity of the research findings.

2.4.3 Sample and Recruitment Strategy

The sample size for this pilot study was determined based on several key factors: the exploratory nature of the research, practical constraints, and the emphasis on obtaining rich, detailed insights. Due to limited time and resources, it was essential to focus on a manageable number of participants who could provide in-depth, meaningful data.

Students: Thirteen students from PUEB, aged between 18 and 24, with an interest in entrepreneurship education and development, participated in the pilot study. The recruitment process followed a purposive snowball sampling strategy (Clough & Nutbrown, 2008), aiming to attract participants with relevant interests. The recruitment strategy was comprehensive, centered on the promotion of a free VR-based training focused on developing entrepreneurial soft skills among students. This training was advertised as a public event on Eventbrite and formally communicated through PUEB's official Facebook page, as well as other student and entrepreneurial communities on Facebook. Additionally, a recruitment email was circulated among PUEB's professors, who helped disseminate the information within their student communities (please see Appendix B). Early enrollees were also encouraged to spread the word among their peers.

Communication with potential participants was clear and detailed, outlining the training's goals, agenda, content, benefits, and planned activities. Students who enrolled were required to fill out a survey and complete a pre-training test before participating in the VR training. After the VR training, they participated in a post-training focus group and completed a post-training test. To enhance engagement and maximize the benefits of the training, students were offered a certificate, access to pictures of the activities in the virtual environments, and post-training support.

Professors, Trainers, and Experts. The recruitment process for educators and experts also followed a purposive snowball sampling strategy, targeting individuals with specialized expertise in entrepreneurship education, research, training, VR technology development, educational technology, and university entrepreneurial ecosystem development. Six participants were directly contacted and invited through the professional networks of professors from four abovementioned universities.

A formal invitation email was sent to these experts prior to the interviews, detailing the pilot's objectives, research questions, key concepts, activities, methodology, and research design. Additionally, pictures and videos from the VR-based training conducted with PUEB students were shared with the experts to help them familiarize themselves with the first phase activities and contextualize the research.

Given the pilot study's aim to explore the potential and challenges of implementing VR technology in entrepreneurial education, this sample size (6 experts and 13 students) was deemed appropriate. Moreover, the richness of qualitative data typically compensates for smaller sample sizes, as it allows for a deeper understanding of participants' perspectives and experiences (Clough & Nutbrown, 2008; Lancaster et al., 2002; Thabane et al., 2023), (see also in the section 1.6 where the limitations of the study are described).

2.5 Data Collection Methods

2.5.1 Phase 1: Explorative Comparative Quantitative Analysis

In the first phase, a comparative quantitative analysis was implemented. A pre-training and post-training test were administered via Google Forms, with data securely stored and password-protected (please see Appendix C).

The test consisted of ten questions: four 5-point Likert scale questions and six multiple-choice questions with only one correct answer. The Likert scale questions focused on assessing changes in participants' perceptions of their confidence in recognizing and implementing entrepreneurial opportunities, their creativity and innovation skills, and their familiarity with entrepreneurial methodologies and action steps. The multiple-choice questions were designed to evaluate changes in knowledge regarding creativity and innovation, awareness about sources of entrepreneurial ideas, and design thinking for entrepreneurial action. Additionally, three of these questions employed a scenario analysis approach to gauge participants' entrepreneurial thinking towards recognizing innovative ideas.

The test was designed to take approximately 15 minutes to be completed and was distributed to students via email before and after the VR-based training. The development of the test and training content took inspiration from the internationally recognized and publicly available NFTE Entrepreneurial Mindset Model, which has been extensively validated (Gold & Rodriguez, 2018; *The Entrepreneurial Mindset - NFTE*, 2023). This ensured the implementation of a test and training developed under highest possible level of validity. Furthermore, it’s important to note that implementing this test during the pilot served as an internal pilot opportunity to evaluate the feasibility of using such instruments to measure entrepreneurial soft skills, such as opportunity recognition, creativity, and innovativeness, within the context of VR technology in entrepreneurial education.

2.5.2 Phase 2: Focused Multi-stakeholder Qualitative Analysis

In the second phase, several qualitative methods were employed to gather insights from a diverse group of stakeholders (please refer to Appendix C).

Survey. A survey was conducted via Google Forms, with data securely stored and password protected. The survey aimed to collect crucial information from participating students, including demographics, motivations, familiarity with entrepreneurship and XR technologies, expectations, entrepreneurial intentions, and prior entrepreneurial initiatives. It consisted of twelve questions: eight open-ended to allow for detailed responses, and four a mix of 5-point Likert scale and multiple-choice questions for more precise information.

VR-based Focus Groups. A series of VR-based focus groups were conducted at the Department of Information Technology (KTI) from May 20, 2024, to May 24, 2024. Students participated in one of four focus groups held in a virtual business office environment used during the VR training. Each focus group included three to four participants due to VR headset availability and followed a strict protocol to ensure consistency. The VR setting was chosen to enhance participants' immersion, promoting engagement and more accurate, significant contributions regarding their experiences, feelings, and perceptions of the VR training and technology. Each focus group session lasted approximately 45 minutes, was conducted immediately after the VR training, and included seven open-ended questions about the training experience and the potential for VR technology in entrepreneurial education (complete focus groups' protocol is provided in appendix C.3). All responses were audio-recorded and securely stored for analysis, with supplementary pictures and video extracts from the focus groups aiding future analysis.

Interviews. Online interviews with professors and experts in entrepreneurship education, business development, and technology development were conducted from May 27, 2024, to June 7, 2024. Each interview lasted about an hour and explored participants' backgrounds, experiences in entrepreneurship education and VR technology, and perspectives on implementing VR in university settings for entrepreneurial soft skills development among students. Eleven open-ended questions guided the discussions, with participants receiving detailed information about the research objectives, methodology, and VR training context beforehand (complete interviews' protocol is provided in appendix C.4). Anonymized audio-visual materials from the VR training with students were shared and discussed during the interviews to enhance clarity and context. Interviews were conducted via Zoom, recorded, transcribed using the Fireflies AI bot, and securely stored for analysis.

The combination of surveys, focus groups, and interviews helped to gather comprehensive qualitative insights from multiple stakeholders directly concerned with the issue discussed in this pilot. This provided a holistic understanding of the challenges and potentialities of implementing VR technology as part of entrepreneurship education in academic settings. Table 1 summarizes the data collection instruments used in the study, showing how each instrument contributed to answering each research question.

Table 1. Data Collection Instruments and Research Questions

Phase & Analysis	Instrument	Sample	Data Type	Expected Information	Research Question
Explorative Quantitative Analysis (Paired t-test / McNemar test)	Pre-Training Test	Students (13)	Quantitative	Level of confidence, familiarity with entrepreneurial skills	RQ1
	Post-Training Test	Students (13)	Quantitative	Changes in confidence, familiarity with entrepreneurial skills	RQ1
Focused Multi-stakeholder Qualitative Analysis (Thematic Analysis)	Survey	Students (13)	Qualitative	Expectations, needs, entrepreneurial intentions	RQ2
	Focus Group	Students (13)	Qualitative	Feelings, perceptions, experiences with VR training	RQ1 & RQ2
	Interviews	Professors and Experts (6)	Qualitative	Perceptions and perspectives on VR in education	RQ1 & RQ2

Explanatory Note:

-Pre and Post Training tests: helped explore the impact of VR training on students' knowledge and attitudes (RQ1).
-Survey: helped in understanding the initial conditions and motivations of the participants, which is essential for assessing the feasibility and relevance of VR technology in entrepreneurial education (RQ2).
-Focus Group: This data provided rich insights into the user experience of VR-based entrepreneurial education, exploring both the potential impact and challenges (RQ1 & RQ2).
-Interviews: Insights from experts helped identify advantages, challenges, and recommendations for future implementation (RQ1 & RQ2).

2.6 Analysis Methods

2.6.1 Phase 1: McNemar test and Paired t-test Analysis

An exploratory quantitative analysis was conducted using McNemar test and paired t-test. The paired t-test is a statistical method that was used to compare the means of the pre-training and post-training test answers to the Likert-scale questions, and thus identify trends and potential differences (Kim, 2015). The McNemar test is a statistical test that was used to test changes between the pre-training and post-training test answers to the multiple-option questions (Pembury Smith & Ruxton, 2020). Although both tests are typically employed to determine statistically significant differences between groups, in this study, the paired t-test and the McNemar test were used to explore trends and formulate hypotheses based on the "potential for statistical significance" hinted by the initial results generated by this pilot, and that can be more rigorously analyzed in future research. Both the paired t-test and the McNemar test are particularly suitable for this study as they are designed to analyze differences between two measurements/changes in answers taken from the same participants before and after an intervention (Kim, 2015; Pembury Smith & Ruxton, 2020).

The results from the paired t-test and the McNemar test were used to explore whether implementing VR might have a potential for significant effects on students' entrepreneurial soft skills and knowledge. While not intended to provide definitive proof of significance, these findings are helpful to justify further, more robust studies that could more accurately assess these potential effects of including VR in enhancing entrepreneurial competencies among students. This exploratory analysis directly addresses RQ1 by providing preliminary evidence that might justify in-detail research on the efficacy of VR in entrepreneurial education. Combined with the results obtained from the thematic analysis of the experiences and feelings reported by students, the goal was to provide comprehensive recommendations for larger studies in the future.

2.6.2 Phase 2: Thematic Analysis

Thematic analysis was employed to analyze qualitative data obtained from surveys, focus groups, and interviews. The analysis followed Braun and Clark's (2021) six-step thematic guide (Maguire & Delahunt, 2017), which involves familiarizing with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Thematic analysis is suitable for identifying, analyzing, and reporting patterns (themes) within qualitative data. It is flexible and can be adapted to fit the needs of complex, multi-method qualitative research. This method is effective for capturing the richness of participants' experiences, perceptions, and insights.

2.7 VR Training Design

A VR-based entrepreneurship training focused on soft skills development was designed selecting and implementing VR technologies with the assistance of experts from the Department of Information Technology (KTI) at Poznań University of Economics (PUEB), Poland. The VR platform, instrumentation, and program of the training used is explained as follows (please find in appendix D supporting content about this section).

2.7.1 VR Platforms and VR Instrumentation

MeetinVR. MeetinVR is a cutting-edge virtual reality (VR) platform tailored for hosting diverse virtual collaborative activities such as meetings, workshops, and training sessions within immersive virtual environments (Jelgersma, 2016). In these simulated environments, users can navigate through virtual spaces using compatible VR headsets like Oculus Pro and Meta Quest series. Equipped with a range of interactive tools, students explored highly immersive, dynamic, lifelike experiences that bridge geographical gaps and enhance engagement. The virtual environments available in MeetinVR allowed the trainer and students to engage in highly interactive activities, using advance collaboration tools including exportable whiteboards, multimedia screen-sharing, VR tablets, pens for 3D sketching, sticky notes manipulation, and much more. The platform was selected to conduct the pilot for its customized VR rooms that replicate real-world settings, photorealistic graphics and intuitive controls

via a tablet-based interface, which made the training more engaging and impactful for students. All of this enriched the learning experience and made it possible to gather valuable insights into the efficacy of VR technology for entrepreneurial education.

Two virtual rooms were selected and utilized during the research project:

- Conference/Workshop Hall: This virtual space can accommodate up to 32 participants and is equipped with a VR screen for media casting, six breakout areas with individual tables, and separate whiteboards for collaborative tasks such as workshops, design sprints, and brainstorming sessions. The hall's versatile layout supported the VR training by providing a virtual space to conduct entrepreneurial seminars, creative planning, idea pitching, and storyboarding activities, fostering interactive teamwork and idea generation among students.

-Focus Group Room: Designed to replicate a business setting, this room features a six-seat round table arranged for intimate group discussions and focused work. The trainer utilized tablet controls to manage media files and engage in detailed discussions with the participants, making it ideal for conducting VR-based focus groups with students. The room's immersive environment enhanced communication and collaboration, providing a conducive space for in-depth exploration of topics related to entrepreneurship education and soft skills development.

In the VR environment of *MeetinVR*, users were represented through lifelike avatars. Each avatar mimicked facial expressions, bone structure, hair color, and other distinctive features of human beings, enhancing the sense of personal presence in the virtual space. Additionally, these avatars allowed participants to visually identify with each other within the virtual environment, fostering a sense of immersion and social presence like face-to-face interactions. Furthermore, users could engage in discussions, interact and collaborate on projects through these avatars.

VR Headsets. VR headsets are versatile tools suitable for a wide range of applications, including general VR experiences, gaming, educational applications, productivity tasks, training simulations, virtual meetings, architectural visualization, virtual collaboration, and other high-demanding VR environments where performance and reliability are crucial (Interaction Design Foundation, n.d.).

Five VR headsets were utilized during the VR training sessions: one Meta Quest Pro, three Meta Quest 2, and one Meta Quest 3. These headsets are designed as standalone systems, offering wireless, all-in-one VR experiences without the need for a PC or external sensors. Each headset features a high-resolution display and comes equipped with two intuitive touch controllers for precise interaction. Built-in sensors enable accurate tracking of head and hand movements. Prior to each VR training session, all headsets were fully charged to ensure optimal performance. Additionally, thorough sanitization procedures were implemented before every session to maintain hygiene standards.

Throughout the VR training, participants had the opportunity to use any of the available VR headsets to immerse themselves in the virtual environment created with MeetinVR. Each participant

received comprehensive instructions on how to effectively use the headsets and controllers within the virtual environment, ensuring a seamless and engaging experience.

2.7.2 VR Training Program

As part of the pilot study exploring the potential of integration VR technology as part of entrepreneurial soft skills education among students, an immersive VR training program was developed specifically for participating students. The program targeted three essential entrepreneurial competencies: Opportunity Recognition and Initiative, Creativity, and Innovativeness. The focus was given to these three competencies as part of the study of VR training for entrepreneurship soft skills development, because these skills are extensively reported to be critical for entrepreneurial success (*The Entrepreneurial Mindset - NFTE*, 2023). Extensive research supports their importance, highlighting how they enable entrepreneurs to identify and seize opportunities, think creatively, and drive innovation (Galloway et al., 2017; Youth Business International & Minic, 2023). Furthermore, these skills are highly sought after by employers, making them essential for aspiring entrepreneurs to develop (Accenture, 2017; Youth Business International & Minic, 2023).

Offering this VR training was crucial because it allowed the researcher to expose students to the VR experience and thus gain meaningful insights through the focus group. Additionally, this training served to explore the effects of using VR technology as part of education on students' confidence, awareness, and perceptions about their entrepreneurial soft skills. One month before the official training date, discussions with educators and VR development experts, and a trial run of the training were meticulously conducted to anticipate and address any technical issues, validate assumptions, and ensure that the VR environments and tools were optimally configured to deliver the intended training experience to participants.

The official VR training sessions took place from May 20th to May 24th, 2024, at the Department of Information Technology (KTI), Poznań University of Economics and Business (PUEB), and spanned approximately 4 hours each session, including scheduled breaks. Participants were divided into groups of four per session to facilitate interactive learning experiences. Ahead of each session, meticulous preparations were made. MeetinVR sessions and VR headsets were set up, ensuring multimedia presentations were seamlessly projected on VR screens. Also, rigorous sanitization protocols were implemented between groups to maintain hygiene standards.

Participants were warmly welcomed to the VR training sessions, where they completed informed consent forms and received comprehensive guidelines on ethics and safety measures. The trainer provided an overview of the training and research's objectives, emphasizing the significance of cultivating entrepreneurial mindset skills for their future endeavors. Participants were briefed on the structure of the training, with opportunities given for queries and clarifications. They were guided through the setup

process on the MeetinVR platform using pre-set or guest accounts to expedite familiarity with the VR environment and headsets.

Part 1: Opportunities Recognition & Creation: The first segment of the training focused on opportunity Recognition and creation. Through an interactive session and guided practical exercises, participants explored the definition and identification of entrepreneurial opportunities. Using audio-visual aids and real-world examples, they learned to discern sources of opportunities and triggers for entrepreneurial action. Brainstorming sessions encouraged participants to convert personal experiences into potential opportunities, fostering lively discussions and idea sharing. Participants worked collaboratively using canvases, whiteboards, and other tools available in the virtual environment and pitched their ideas explaining how to turn their personal experiences into entrepreneurial opportunities.

Part 2: Creativity and Innovation: The subsequent session delved into creativity and innovativeness development, guiding participants through frameworks and discussions on problem-solving and innovative thinking. Participants engaged in brainstorming exercises to generate creative ideas related to identified opportunities from Part 1. Utilizing VR tools, they sketched 3D representations of their ideas, and pitched their innovative solutions, receiving constructive feedback and guidance on refining their ideas. Discussions included strategies for overcoming challenges in the innovation process, encouraging active participation and critical thinking among participants.

Post-Training Evaluation: Following the training sessions, participants completed a post-training evaluation (using the same test for the pre-training evaluation) to provide first insights on changes in knowledge and entrepreneurial attitudes (appendix C.2). Detailed description of test completed by students and results are provided in section 4.2.

2.8 Ethics and Bias

2.8.1 Ethical Considerations

Ethical Approval: The pilot was conducted under the direct supervision and vigilance of the Department of Information Technology (KTI) of Poznan University of Economics and Business (PUEB), and under the research project "COMET Creation and exploration of multimedia environments and training materials for employees in Industry 4.0 using virtual and enriched reality and representation of domain knowledge". Ethical approval (Appendix A) was granted by PUEB's Committee on the Ethics of Scientific Research Involving Humans at the University of Economics on February 9, 2024, to Prof. Dr. hab. Krzysztof Walczak director of KTI.

Informed Consent: Participants were provided with a detailed informed consent form that outlined the purpose, procedures, risks, and benefits of the study. The form emphasized that participation was entirely voluntary, and participants could withdraw at any time without repercussions. It also clarified that participants would have the opportunity to ask questions and receive clear, comprehensive answers before consenting. This process ensured that participants were fully aware of

the nature and scope of the study and their role in it, thereby respecting their autonomy and right to make an informed decision about their participation.

Confidentiality and Data Storage: Confidentiality was maintained through several measures to protect participants' personal information. All data collected during the study were anonymized, with pseudonyms assigned to participants to ensure their identities were not revealed in any research notes, documents, or publications. Survey responses, test results, focus group transcriptions, and interview recordings were stored on a secure, password-protected Google Drive. Additionally, audio recordings and images from the VR sessions were anonymized and securely stored. Only the principal investigator had access to the raw data, ensuring participants' identities remained protected. To further safeguard confidentiality and integrity, data were securely transferred and deleted from other devices to prevent unauthorized access. Data will be retained for one year after the completion of the study and then securely destroyed, ensuring compliance with ethical standards and reinforcing participants' trust in the research process.

Conflict of Interest: There are no conflicts of interest that could potentially bias the results or interpretation in conducting this research. The researcher has no financial or personal relationships that might influence the outcome.

2.8.2 Safety Considerations:

Several safety measures were implemented during the VR training to ensure a secure and effective learning environment for all participants:

- Participants were asked about any conditions that might affect their engagement or participation.
- Participants received informed consent forms before the training session, outlining potential risks of the VR sessions.
- Before the VR training began, all participants received safety and ethics information and had the opportunity to seek clarifications.
- All headsets and controllers were sanitized between participant groups
- Reminders about safety and ethics were provided, emphasizing participants' ability to withdraw from the training at any time.
- Several breaks were included during the activity for rest, refreshment, and recharging outside the VR environment. Additional breaks were allowed upon request.
- Participants were asked to remain seated in delimited areas during the VR training to ensure comfort and prevent collisions with objects or other participants.

2.8.3 Reliability, Validity and Bias Mitigation Measures

Ensuring the reliability and validity of the data and analysis was essential to uphold the integrity of research findings. To achieve reliability, consistency was maintained in data collection methods throughout the study. This included using standardized instruments such as surveys, tests, and interview

protocols. Also, interviews and focus group sessions were conducted in a controlled manner to minimize variability. To enhance validity, multiple data collection methods were employed, combining quantitative tests with qualitative surveys and interviews. This approach made it possible to triangulate findings from different perspectives, enriching the depth and breadth of our analysis.

Throughout the study, the researcher remained reflective, acknowledging potential biases sources and actively seeking diverse viewpoints to enrich understanding. Careful consideration to address potential sources of bias and confounding factors was implemented to ensure transparency in data interpretation. This involved critically examining the research design and collected data to identify any factors that could influence results or interpretations. Additionally, transparency was maintained by openly discussing the limitations inherent in the research design and methodology with external advisers to the study. Professors were invited to the VR training and multiple meetings were held with experts in the field to discuss limitations in research design of the pilot. These measures collectively strengthened the reliability and validity of the research outcomes, providing a robust foundation for drawing meaningful conclusions and implications for future research.

3. RESULTS

This section presents the results of the explorative pilot study about the potential and challenges of integrating virtual reality (VR) technology into entrepreneurship education to enhance soft skills among students. Research objectives were achieved using a qualitative dominant mix-methods approach divided into two parts: an Explorative Comparative Quantitative Analysis and a Focused Multi-stakeholder Qualitative Analysis. The section first starts with an overview of the students' sample and alignment with the pilot objectives. Then, the Explorative Comparative Quantitative Analysis is detailed. Trends and changes in students' confidence and familiarity with entrepreneurial skills after VR training are explored, providing statistical insights to elaborate hypothesis about the implications of implementing VR methods in entrepreneurship education. On the other hand, the Focused Multi-stakeholder Qualitative Analysis delved into rich narratives from surveys, focus groups, and interviews with students, professors, and experts. Finally, results of both analyses are integrated and triangulated. This qualitative dominant mix-methods exploration offered nuanced perspectives on the experiences, perceptions, and challenges associated with VR technology in entrepreneurship education, thereby informing broader implications and recommendations for future research and educational practice.

3.1 Future Student Entrepreneurs

This study explored the potential integration of VR technology into innovative entrepreneurial education approaches aimed at supporting students on their journey to becoming future entrepreneurs. A crucial aspect of the analysis involved validating the characteristics of the sample to ensure they aligned with the study's objectives, thereby enhancing the validity and applicability of the subsequent findings. As part of this validation process, students participating in the pilot were surveyed to assess their interests in entrepreneurship, future entrepreneurial aspirations, and their attitudes towards technology in education. Key aspects investigated included demographic information such as gender and age, details of current academic enrollment, and motivations for participating in the VR training.

Additionally, participants were questioned about their previous exposure to virtual reality (VR) and similar technologies to gauge their familiarity and experience in this area. Questions related to entrepreneurship aimed to uncover individual definitions, experiences, and any prior educational background in entrepreneurial studies. Moreover, participants were asked about their innovative ideas and entrepreneurial initiatives, as well as their current engagement or intentions to pursue entrepreneurial activities. Overall, these inquiries were designed to explore students' entrepreneurial mindset, initiatives, and their familiarity with VR technology (Survey's results are presented in Appendix F).

The average age of students in the study was 21 years, ranging from 18 to 24 years, and the majority were male (62.5%). Most participants were enrolled in bachelor's or master's programs at PUEB, focusing on fields like international business, business administration, international economics and trade, and econometrics. When asked about their motivations for attending the VR-based training, 81.3% expressed interest in gaining knowledge about VR technologies and platforms, 50% were interested in

entrepreneurship and enhancing their entrepreneurial skills, and 12.6% cited interest in VR technology for educational and ecommerce applications. Most of participants were new or with limited exposure to VR technologies (87.5%).

The significant proportion of students interested in both VR technology and entrepreneurship aligns well with the study's focus on exploring the potential of VR in entrepreneurship education for soft skills development. This demographic composition supports the study's objectives and ensures relevance to the field of interest. Conversely, the inclusion of students less interested in VR technology or entrepreneurship also adds value by providing diverse perspectives. Also, the participation of some students with experience using VR technologies allowed the researcher to gain richer perspective from students with different levels of exposure to these technologies.

Students were also inquired about their knowledge, initiatives, and future perspectives towards entrepreneurship. When asked about their understanding of entrepreneurship, students responses revolved around the following themes: setting up a business, business management, resources allocation, solving needs, idea generation, and value creation. Additionally, students' answers connected entrepreneurship with soft skills such opportunity recognition, innovativeness, adaptability, decision making, risk taking, taking action, problem solving, and much more. These responses revealed the students' awareness of the topic under study, particularly highlighting the significant interest in soft skills among them. Most of them (81%) had not previously participated in courses focused on entrepreneurship development, indicating a potential lack of sufficient offerings and support for entrepreneurial education at the university.

Moreover, 56% of students reported having thought about creating a product or service that they believe could benefit society. One student reported: "*I thought about the product, but it was very general and more related to a service, like education. I tried some activities, but I was young and wasn't persistent enough to make a difference in my life, so I would rather not share it"*. A second student informed: *"Yes there were couple of products and services but they weren't original. Instead it was more of a upgrade in acutally existing service or product. Very often it was about changing the couple options or features which could drasticlly increase the effectiveness or simplicity*" [sic]. When asked whether they are currently thinking about, taking actions towards, or trying to ideate or create a business (Figure 3), 56.3% of students agreed or strongly agreed, while an additional 25% remained neutral. These responses indicate that a significant proportion of the sample is already engaged in entrepreneurial thinking or activities or has the potential to do so if provided with support for entrepreneurial mindset development. This latent entrepreneurial potential might be further ignited and supported by an entrepreneurial university ecosystem and network, with a strong focus on developing both hard and soft entrepreneurial skills among students.

The sample used in this study demonstrates strong alignment with the research objectives through several key criteria. The demographic relevance was ensured by working with young students enrolled in relevant bachelor's and master's programs at PUEB, aligning well with the target population for

entrepreneurial education. A significant portion of the sample expressed interest in gaining knowledge about VR technologies and enhancing their entrepreneurial skills, which was crucial for exploring the integration of VR into entrepreneurial education.

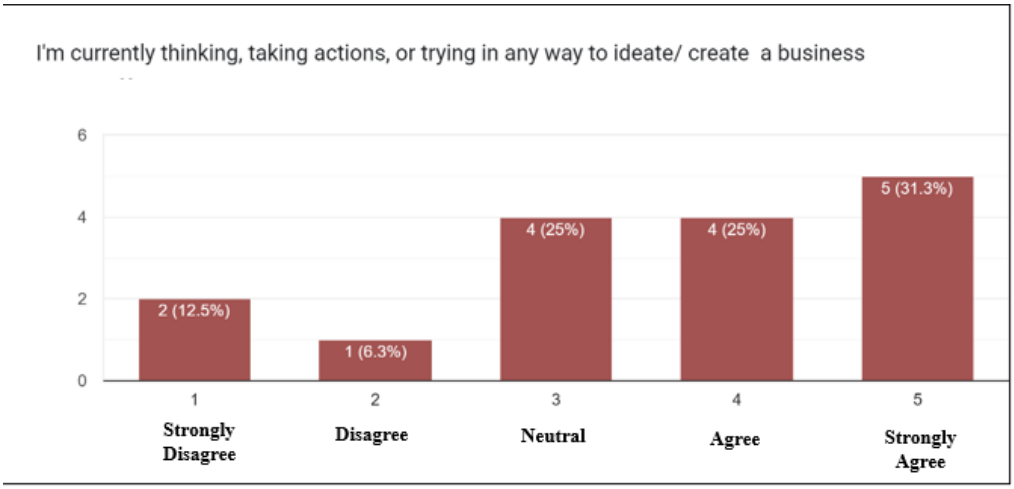

Figure 3. Entrepreneurial mindset among selected students

Additionally, their responses indicated active engagement or potential for future entrepreneurial activities, making them an ideal group for studying the impact of entrepreneurial education. Including students with varied levels of interest in VR and entrepreneurship enriches the study by capturing a broad spectrum of views and challenges, thereby enhancing the depth and applicability of the findings. Furthermore, the lack of previous entrepreneurship course experience among many participants highlights a gap that this study seeks to address. Finally, any prior experience with VR technologies among students provided useful insights to be considered in the VR training exploration. Collectively, these factors ensure that the sample was well-suited to address the research questions and objectives, providing a robust foundation for analyzing the potential impact and complexities of integrating VR technology into entrepreneurial education.

3.2 Explorative Comparative Quantitative Analysis

In this section, an explorative comparative quantitative analysis is presented. The objective of this analysis was to explore trends and changes in students' entrepreneurial mindset before and after a VR training focused on entrepreneurial soft skills development. As part of this analysis, a test consisting of ten questions was administered to students both before and after the VR training. This test aimed to examine the effects on two constructs associated with the entrepreneurial mindset: Opportunity Recognition and Creativity and Innovativeness. Please refer to Appendix G for a complete list of test questions and chart-based results for better visualization of students' answers.

Changes in students' entrepreneurial mindset related to opportunity recognition and creativity and innovativeness were assessed using three working variables: perceived self-confidence, knowledge/awareness, and entrepreneurial thinking. The perceived self-confidence level of students refers

to their self-assessed confidence when asked about recognizing opportunities or their creativity and innovativeness skills. Knowledge and awareness refer to students' familiarity with the discussed constructs, as evidenced by their ability to provide the correct answers when asked about the content delivered during the VR training. Entrepreneurial thinking refers to students' demonstration of opportunity recognition thinking and creative and innovative thinking when responding to scenario-based questions.

To provide a comprehensive understanding of the data, this section is divided into two main parts: Descriptive Analysis and Inferential Analysis. The Descriptive Analysis section covers the constructs, working variables, questions, and descriptive statistics of students' answers, while the Inferential Analysis covers Paired t-Test and McNemar's test analysis to explore on the potential for statistical significance and hypotheses generation for entrepreneurial mindset before and after the VR training.

3.2.1 Descriptive Analysis

Table 2 provides a summary of descriptive statistics, standard errors of the mean (SEMs), and percentage changes in students' entrepreneurial mindset constructs before and after the VR training. Descriptive statistics for the Pre and Post Training data were calculated using an Excel spreadsheet.

Table 2. Descriptive Statistics summary of the pre and post-training test scores

Entrepreneurial Mindset Construct	**Working Variables**	**Question**	**Type**	**Pre Mean Score**	**SD_{PRE}**	**SME_{PRE}**	**Post Mean Score**	**SD_{POS}**	**SME_{POS}**	**Δ**
Opportunity Recognition	Perceived Self-Confidence	1	5-point Likert	3.75	0.8660	0.2500	4.33	0.6513	0.1880	+15.6% ↑
		5	5-point Likert	2.33	0.6513	0.1880	3.25	1.4848	0.4286	-39.3% ↓
	Knowledge / Awareness	2	Multiple Option	68.8	-	-	83.3	-	-	+21.1% ↑
	Opportunity Recognition Thinking	3	Multiple Option	75	-	-	91.7	-	-	+22.3% ↑
		4	Multiple Option	68.8	-	-	83.3	-	-	+21.1% ↑
Creativity & Innovativeness	Perceived Self-Confidence	6	5-point Likert	3.25	0.9653	0.2787	4.17	0.9374	0.2706	+28.2% ↑
		7	5-point Likert	3.42	0.9003	0.2706	2.92	1.3790	0.3981	+14.6% ↑
	Knowledge / Awareness	8	Multiple Option	56.3	-	-	75	-	-	+33.2% ↑
		10	Multiple Option	56.3	-	-	66.7	-	-	+18.5% ↑
	Creativity / Innovativeness Thinking	9	Multiple Option	68.8	-	-	66.7	-	-	-3.1% ↓

Explanatory Note:

- Perceived Self-Confidence: 5-point Likert scale question
- Knowledge / Awareness & Creativity / Innovativeness: Multiple Option questions
- SD (Standard Deviation), SME (Standard Error of the Mean)

Some trends can be withdrawn from results. Except for two items, there's an apparent overall increase in most of the working variables addressing opportunity recognition and creativity and innovation skills development through VR training. When asked students if they could recognize

opportunities and turn them into entrepreneurship ideas (Q1), their self-confidence regarding opportunity recognition apparently increased after the VR training (+15,6%). This apparent increase is also observed with the working variable Knowledge/Awareness (Q2) where students reported an improvement in students' knowledge and awareness about opportunity recognition (+21.1%). When presented two scenarios (Q3, Q4) evaluating opportunities recognition thinking, students apparently performed better after the VR training (+22,3% and +21.1% respectively). These results might suggest that implementing VR training as part of entrepreneurship education for opportunity recognition development among students might have a positive effect. These results point towards a potential significant enhancement in students' self-confidence, knowledge/awareness, and thinking towards opportunity recognition.

On the other hand, when analyzing students' responses about their perceive creativity and innovativeness skills (Q6), students reported a higher self-confidence (+28,2%) in their creativity and innovativeness skills, suggesting a potential effective effect of VR training to enhance their confidence in these areas. Also, when asked about their perceived familiarity with the steps to generate and evaluate entrepreneurial ideas (Q7), students' answers showed an apparent increase in their self-perceived familiarity with the methodologies provided (+14.6%). And, when asked content-based questions (Q8, Q10) probing students' knowledge/awareness about creativity and innovativeness, students reported an apparent notable improved performance in this area (+33.2% and +18.5% respectively).

However, when asked if they knew how to use methodologies to recognize opportunities and turn them into entrepreneurial ideas (Q5) students reported a lower self-perceived confidence after the training (-39.3%). This is also observed when presented students with scenario-based questions (Q9) exploring their creativity and innovative thinking, in which a slight decrease in this area was also remarked (-3.1%). This apparent decrease in students self-perceived confidence in the use of methodologies might indicate that some students became more critical of their knowledge over opportunity recognition, possibly due to a better understanding of the complexities involved. This could perhaps be due to confusion when responding to a Likert-scale question with inverted values (1 for highest and 5 for lowest). However, this together with an apparent lower value in creativity and innovativeness abilities after the training, might be related to other important potential reasons, such as the trainer's facing difficulties to explain complex methodologies in VR environment, inefficacy of chose methodologies to deal with these constructs, the complexity of translating these constructs into a VR training, or perhaps mixing them as part of the VR training was counterproductive.

3.2.2 Inferential Analysis

- **Potential for Statistical Significance**

Preliminary results provide insights into the potential statistical significance of the observed effects. Figures 4 and 5 illustrate the changes in responses to multiple-choice and Likert scale questions. Notably, for most of the multiple-choice questions, changes in responses seemed to be substantial, with

increases above 18% (Q2, Q3, Q4, Q10) and a maximum increase of 33.2% for Q8. However, the change observed for Q9 was comparably small (-3.1%), suggesting a negligible potential for a statistically significant effect for this question under the conditions of this study. Regarding the Likert scale questions, an initial analysis of the mean differences indicates that the changes observed in Q1, Q5, and Q6 exceed the estimated standard error, suggesting a potential statistically significant effect. Conversely, the difference observed for Q7 falls within the standard error, indicating no potential significant statistical effect on this working variable under similar study conditions.

In other words, there's an apparent significant positive effect of the VR training over student's self-confidence, knowledge/awareness and thinking towards opportunity recognition, and an apparent significant negative effect over self-confidence when using methodologies about opportunity recognition. While for creativity and innovativeness, results point to an apparent significant positive effect of the VR training over students' self-confidence and knowledge, but not significant for any apparent effect over their creative and innovative thinking. Although further investigation is needed to confirm any of these effects, these preliminary findings highlight the areas where VR training might have a significant impact on students' entrepreneurial mindset and areas where a different type of design might be needed to ensure a comparable effect.

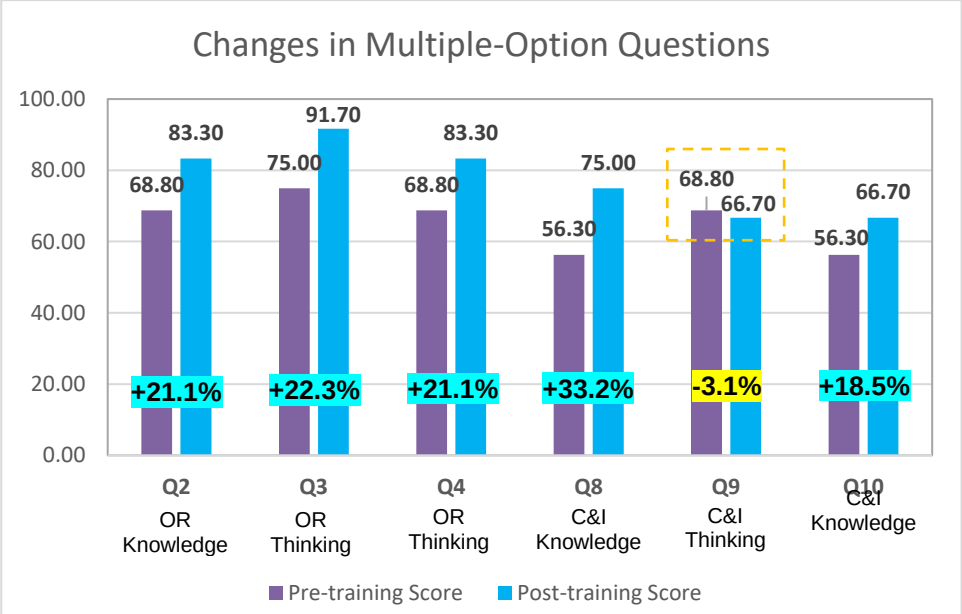

Figure 4. Changes in Multiple-Option Questions inquiring about opportunity recognition and creativity and innovation soft skills among students

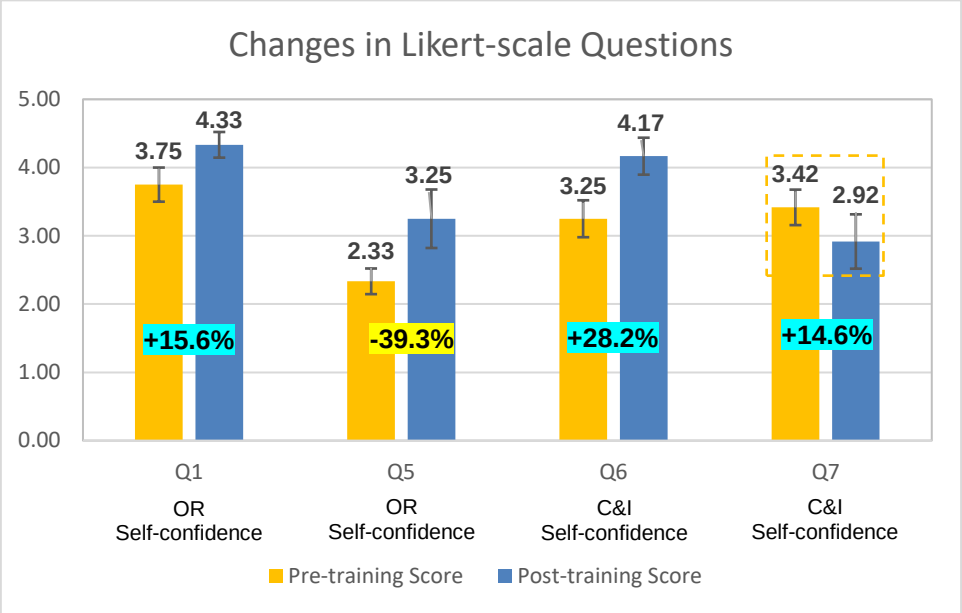

Figure 5. Changes in Liker-scale Questions inquiring about opportunity recognition and creativity and innovation soft skills among students. Note: Q5 and Q7 have inverted 5-point Likert scale values (1 for highest, 5 for lowest)

- **McNemar Paired Test for Multiple Option Questions:**

The McNemar test is used to determine if there are differences in the proportions of paired nominal data, typically in pre-post study designs where each participant is measured before and after an intervention (Pembury Smith & Ruxton, 2020). In the case of our pilot, a McNemar paired test was conducted to expand on the potential for significance of the answers provided by the students for multiple option questions, and the constructs under analysis. To conduct a McNemar test a contingency 2x2 table must be built to compare the number of students who changed their responses from pre- to post-training. Then, the McNemar test statistic is calculated following a chi-square distribution with 1 degree of freedom. Finally, using the chi-square distribution, a p-value is estimated to elaborate on the statistical significance of the comparative analysis results.

To conduct the McNemar test for our study a code using *R* programming was implemented. *R* is a programming language and environment widely used for statistical analysis and data visualization. It supports various statistical techniques like linear and nonlinear modeling, time-series analysis, and clustering. R is a popular tool in academia, research, and industry for analyzing and visualizing data (R Foundation, n.d.). Only pre-training test answers and post-training test answers for multiple option questions were used to create a dataset and then generate an *R* code to conduct the test. Please refer to appendix G to retrieve the R code used to conduct the test.

Table 3 presents a summary of the McNemar test results for multiple option questions, along with summarized interpretations of the findings. Overall, the McNemar test indicates that there are no

statistically significant changes in the answers (p-values are higher than defined significance level of 0.05) from pre-training to post-training for any of the questions (Q2, Q3, Q4, Q8, Q9, Q10). The observed trends in odds ratios suggest some possible improvements for Q2, Q8, and Q10, but these are not statistically supported given the high uncertainty reflected in the wide confidence intervals. Additionally, for questions Q3 and Q4, the test did not capture any effect from a statistical standpoint.

Table 3. Summary of the McNemar test results for multiple option questions related to opportunity recognition and creativity and innovativeness among students before and after VR training

Question	**b**	**c**	**p-value**	**Odds ratio**	**95% Confidence Interval**	**Interpretation**
Q2: Which of the following can be sources of opportunities for entrepreneurial ideas? **Purpose:** To assess changes in knowledge / awareness related to sources for opportunities recognition among students	4	2	0.6875	2	[0.2866, 22.1097]	No statistically significant change. Trend toward improvement but high uncertainty.
Q3: With the rise of remote work, there's an increasing demand for ergonomic home office furniture. What opportunity may arise from this situation? **Purpose:** To assess changes in opportunity recognition thinking among students	1	1	1	1	[0.0127, 78.4968]	No statistically significant change. No effect, high uncertainty.
Q4: Climate change awareness is growing, leading to increased demand for sustainable products. **Purpose:** To assess changes in opportunity recognition thinking among students	1	1	1	1	[0.0127, 78.4968]	No statistically significant change. No effect, high uncertainty.
Q8: Some of the steps in the Design thinking process are… **Purpose:** To assess changes in knowledge / awareness related to methodologies for creativity and innovativeness among students	5	2	0.4531	2.5	[0.4093, 26.2535]	No statistically significant change. Trend toward improvement but high uncertainty.
Q9: You are organizing a charity event to raise funds for a local animal shelter. However, you face the challenge of attracting attendees and donors. What innovative solution could you propose to increase participation and donations? **Purpose:** To assess changes in knowledge / awareness related to methodologies for creativity and innovativeness among students	1	2	1	0.5	[0.0085, 9.6045]	No statistically significant change. Trend toward decrease, high uncertainty.
Q10: Which one of the following statements is true? Purpose: Which one of the following statements is true? **Purpose:** To assess changes in creativity and innovativeness thinking among students	4	1	0.375	4	[0.3958, 196.9899]	No statistically significant change. Trend toward improvement but very high uncertainty.

Interpretation Key:

b: Number of students who answered incorrectly pre-training and correctly post-training.

c: Number of students who answered correctly pre-training and incorrectly post-training.

p-value: The probability that the observed distribution is due to chance.

Odds Ratio: A measure of association between pre- and post-training responses.

95% Confidence Interval: The range within which the true odds ratio is expected to lie with 95% confidence.

The results of the McNemar test indicate that, although the trends observed in Figure 4 suggest an apparent overall improvement in students' answers to multiple option questions, the uncertainties and unknowns associated are too significant to draw definitive conclusions over the potential of including VR technologies as part of entrepreneurial soft skills development. Additionally, the instrument has low or no statistical power to capture the effect for some constructs for which multiple option questions must be refined for future pilots. To validate the trends observed from a quantitative perspective, further pilot studies must be conducted with a more refined sample and improved instruments. These future studies might build upon the hypotheses proposed by this initial pilot study, ensuring a more robust and reliable evaluation of the observed effects and considering the insights gained from qualitative perspective.

- **Paired T-test for 5-point Likert scale Questions:**

A paired t-test is a statistical technique employed to assesses whether there is a statistically significant difference between the means of two related groups, typically involving measurements from the same individuals taken before and after a treatment (Kim, 2015). For this pilot, R code was utilized to perform the paired t-test (see Appendix G) through the following steps: 1) Gathering and organizing the paired data, 2) Calculating the difference between each pair of observations, 3) Determining the mean and standard deviation of these differences, 4) Using the t-distribution to find the t-value and the corresponding p-value, and 5) Comparing the p-value with the predefined significance level (0.05) to assess statistical significance. If the p-value was below the significance level, the null hypothesis was rejected, indicating a significant difference between the paired groups. Table 4 presents a summary of the paired t-test results for Likert scale questions, along with summarized interpretations of the findings.

According to the piloted paired t-test's results of Likert scale questions, there were statistically significant changes of students' self-perception in three areas: Improvement in recognizing opportunities and turning them into entrepreneurship ideas (Q1), decrease of self-confidence on methodologies to recognize opportunities and turn them into entrepreneurial ideas (Q5), increase of self-confidence in creativity and innovation skills to turn ideas into innovative solutions (Q6). On the one hand, these results strongly suggest an important potential for significant effect on students' opportunity recognition and creativity and innovativeness self-perceived confidence through VR training. However, these results also suggest that students self-perceived confidence in using methodologies for opportunity recognition and creativity and innovation was significantly affected.

Table 4. Summary of the Paired t-Test test results for Likert scale questions related to opportunity recognition and creativity and innovativeness among students before and after VR training.

Question	Mean Difference	t-value	df	p-value	95% Confidence Interval	Interpretation
Q1: I can recognize opportunities and turn them into entrepreneurial ideas. **Purpose:** To assess changes in self-perceived confidence related to opportunities recognition among students	0.5833	3.0225	11	0.0116	[0.1586, 1.0081]	Significant improvement in students' ability to recognize opportunities and turn them into entrepreneurial ideas.
Q5: I know how to use methodologies to recognize opportunities and turn them into entrepreneurial ideas **Purpose:** To assess changes in self-perceived confidence related to opportunities recognition among students	0.9167	2.5606	11	0.0265	[0.1287, 1.7046]	Significant decrease in students' knowledge of methodologies to recognize opportunities and turn them into entrepreneurial ideas.
Q6: How confident do you feel in your creativity and innovation skills to turn ideas into innovative solutions? **Purpose:** To assess changes in self-perceived confidence related to creativity and innovativeness among students	0.9167	3.5269	11	0.0047	[0.3446, 1.4887]	Significant improvement in students' confidence in their creativity and innovation skills to turn ideas into innovative solutions.
Q7: I'm familiar with the steps to generate and evaluate entrepreneurial ideas **Purpose:** To assess changes in self-perceived familiarity related to creativity and innovativeness among students	-0.5	-1.3179	11	0.2143	[-1.3350, 0.3350]	No significant change in students' familiarity with the steps to generate and evaluate entrepreneurial ideas.

Interpretation Key:

Mean Difference: The average difference between the paired observations (Post-Pre)

t-value: The ratio of the departure of the estimated value of a parameter from its hypothesized value to its standard error

df: The number of independent values which can be assigned to a statistical distribution.

p-value: The probability that the observed distribution is due to chance.

95% Confidence Interval: The range within which the true difference between the paired observations is expected to lie with 95% confidence.

This probably means that students become more highly sensitive of the methodologies and/or training approach used when implementing VR technology as part of entrepreneurial soft skills

development. Researchers and trainers should carefully select training instruments and approaches when implementing VR technology due to its potential to amplify positive or negative effects among students.

Additionally, results hint to no significant change in familiarity with the steps to generate and evaluate entrepreneurial ideas (Q7). This again makes evident the need for better understanding the interrelations and interplays between the implementation of VR technologies as part of entrepreneurial education, and the training methodologies/approaches being used in VR environments. Future pilots should place additional focus on investigating and validating the entrepreneurial methodologies and training approaches that can synergically work with VR technologies to enhance self-perceived confidence of students to use these methodologies.

3.2.3 Key Takeaways and Hypotheses for Future Pilots

- **Key Takeaways**

The analysis of the quantitative results suggests that the VR training might have possibly an overall positive impact on students' entrepreneurial mindset, particularly in terms of perceived self-confidence and knowledge/awareness in opportunity recognition and creativity/innovativeness. However, some of the results seem to have potential for statistical significance (Likert-sale based questions) while others (multiple option questions) showed no potential for significance under the conditions in which this pilot study was conducted. VR training seems to have potential for statistical significance on self-perceived confidence of students towards opportunities recognition and creativity and innovation, while there's apparently no significant effect when assessing their knowledge/awareness and thinking regarding these constructs.

Also, it remains uncertain whether the trends towards improvement observed graphically would be statistically significant and would remain the same under a refined research design, including a larger sample size, more comprehensive data collection, polished content delivery, and long-term follow-up. Future studies should focus on verifying that these initial "positive" trends are not merely the result of a temporary enthusiasm due to the novelty generated using VR technology. Additionally, it is also crucial to identify how each specific aspects of the VR training— technological features, training content, or trainer effectiveness—contribute (or not) to enhancing students' entrepreneurial soft skills, including self-perception, knowledge, and thinking. Understanding these partial contributions and isolating their impacts will be key areas for further research. Moreover, it is essential to clarify the interplays of incorporating VR technology into entrepreneurship education, and the training methodologies and training approaches employed.

Some of the recommendations for future pilots to ensure statistical significance of findings are to increase sample size, to refine data collection instruments, and carefully select methodologies and training approaches. Working with a larger sample size, improved data collection instruments, and refined training

methodologies and approaches might increase overall statistical power of the research design. Additionally, to robustly assess the impact of VR training on students' entrepreneurial mindset and skills, it is essential to repeat tests multiple times with different cohorts of students. This repetition might help validate any observed effects and establish potential statistical significance, ensuring that the results are not influenced by transient factors or chance.

These quantitative results will be further contrasted with qualitative feedback from students to understand the trends observed more comprehensively. Section five of this paper expands into these issues in greater detail, providing a focused discussion on the implications of these preliminary findings and offering recommendations for future research and pilot programs. In the next section, trends found are translated into guiding questions for future research, to be considered in future pilots for a more comprehensive evaluation of the VR technologies influence as part of entrepreneurship education for soft skills development.

- **Guiding Questions for future research**

Based on the results obtained from the McNemar paired test and the paired t-test, the following guiding questions are proposed for analysis in future pilot studies:

- **Guiding Question 1:** What are the individual influences of VR technologies, VR content, training approaches, and trainers on the development of entrepreneurship soft skills?
- **Guiding Question 2:** What significant changes in knowledge and awareness related to sources of opportunities for entrepreneurial ideas among students can be observed when incorporating VR training for entrepreneurship soft skills education?
- **Guiding Question 3:** What significant changes in knowledge and awareness related to methodologies for creativity and innovativeness among students can be observed when incorporating VR training for entrepreneurship soft skills education?
- **Guiding Question 4:** What significant changes in opportunity recognition thinking among students can be observed when incorporating VR training for entrepreneurship soft skills education?
- **Guiding Question 5:** What significant changes in creativity and innovative thinking among students can be observed when incorporating VR training for entrepreneurship soft skills education?

These questions will be refined after analysis of qualitative data to guide future pilot studies aiming to further investigate the trends observed in this initial analysis. To validate trends and findings observed from this pilot, future studies should focus on improving the study design, including refining the sample size, data collection methods, increase sessions of the VR training, and repeat the tests over time.

3.3 Focused Multi-stakeholder Qualitative Analysis

In this section, the results of the qualitative analysis are presented, aiming to gain deep insights into the experiences, perceptions, and expectations of multiple stakeholders directly involved in the potential implementation of VR technologies as part of entrepreneurship education for soft skills

development. This qualitative analysis encompassed thematic insights derived from surveys, focus groups with students, and interviews with experts. Key qualitative responses were coded and translated into themes and categories aligned with the research questions (RQ1 & RQ2). Through this process, recurring patterns, outliers, and divergent perspectives within the qualitative data were identified and examined. This analysis provided a comprehensive understanding of the potential and challenges of integrating VR technology into entrepreneurship education, offering nuanced perspectives that inform the broader implications and recommendations for future research and educational practice.

3.3.1 Survey: Students' expectations on VR technologies and entrepreneurship education

Additional insights gathered from the student survey prior participation in the VR training highlighted their expectations and skills development needs concerning the integration of VR technology into entrepreneurship education. These findings, which provided valuable context for understanding student perspectives on the use of VR for developing entrepreneurial skills, are summarized in Table 5.

Table 5. Expectations and skills needs of students concerning the implementation of VR as part of entrepreneurship education.

CODES	**Expectations for VR in Entrepreneurial Education**		**Skills Needed for Successful Entrepreneurship**	
STUDENT	**Individual Expectations**	**Meta Expectations**	**Individual Skills**	**Meta Skills**
S1	None	1. None 2. To be an effective tool 3. For accelerated learning 4. To be realistic 5. For Professional and Business Skills development 6. Part of future education	Situational awareness, literacy	**Soft Skills** 1. Proactiveness 2. Resilience 3. Innovative Thinking 4. Effective Leadership
S2	Effective sensory load		Persistence, purpose, concentration	
S3	Collaboration, teamwork, community and network building		Leadership, time management, problem solving	
S4	VR as real as first-person experience		Confidence, open mindset, resilience, responsibility, learning agility, lifelong learning and innovation	
S5	Fast learning		Self-confidence	
S6	Augment learning methods		Business regulations	
S7	Communication skills development		Self - confidence, action taking	
S8	None		Sales, organization and collaboration	
S9	Quicker learning, realistic business scenarios		Resourcefulness, prudence, risk taking	
S10	None		Finance, taxation, business regulations	**Hard Skills** 1. Sales 2. Finance
S11	Inevitable in the future		Communication, leadership	

S12	To be effective		Ambition, preparedness	3. Taxation
S13	Future way of education		Responsiveness, diligence, innovativeness	
S14	To be a helpful tool		Business regulations	**Knowledge** 1. Business regulations 2. Business Literacy
S15	Unnecessary in the future		Creativity, responsiveness	
S16	None		Calm, discipline	

When asked about their expectations regarding the role of technologies such as VR as a didactical tool in Entrepreneurial Education, the most frequent theme, accounting for about 25% of responses, was "None." This may reflect a lack of understanding or knowledge about VR technology among participating students. Indeed, 87.5% of students were new to or had limited exposure to VR technologies, and 81.3% expressed interest in gaining more knowledge about VR technologies and platforms. The second most common theme was the expectation that VR would "accelerate learning". For instance, S4 mentioned, "*I would like my communication skills to develop faster through VR, particularly through various animations that practice these abilities*". Similarly, S5 shared, "*I think that VR can place students in realistic business scenarios, allowing them to learn quicker*".

The third theme was the anticipation that VR would be "an effective tool". Participant S2 noted, *"…I think increasing sensory load is helpful, but not… without proper studies on how to use it effectively"*, emphasizing the importance of understanding how to use VR effectively, particularly concerning the sensory load users might experience. Other notable themes included the desire for VR "to be realistic", its potential application for professional and business skills development such as communication and teamwork, and its "inevitable integration in future education," as suggested by S11.

The expectations expressed by students highlight several critical implications and potential challenges for the integration of VR technologies into entrepreneurship education. The significant proportion of students who reported "None" as their expectation suggests a gap in awareness and understanding of VR's potential, which could hinder its acceptance and effective use. Also, the anticipation of VR as a tool to "accelerate learning" underscores the need for carefully designed VR content that can deliver accelerated learning outcomes without compromising depth and quality. This expectation also brings to light the challenge of creating VR experiences that are not only engaging but also pedagogically sound, requiring collaboration between educators, technologists, and instructional designers. The desire for VR to be an "effective tool" and concerns about its "sensory load" point to the necessity of evidence-based approaches in VR implementation. Ensuring that VR tools are grounded in educational research and tailored to avoid cognitive overload will be crucial. This includes developing guidelines and best practices for VR use in educational settings to maximize benefits while minimizing potential drawbacks.

Additionally, the expectation for VR "to be realistic" and its application in professional and business skills development imply that the VR experiences need to closely simulate real-world scenarios. This could present a significant challenge in terms of technology development and content

creation, requiring high-quality graphics, interactive elements, and realistic simulations. Finally, the perception of VR's "inevitable integration in future education" suggests that students are ready to embrace this technology, provided their concerns and expectations are met. This positive outlook can drive the momentum for VR adoption, but it also means that educational institutions must be prepared to invest in the necessary infrastructure, training, and ongoing support.

When asked about the personal skills or competencies they were interested in developing to become successful entrepreneurs, students' responses centered around three key meta-themes: Soft Skills, Hard Skills, and Knowledge. Notably, soft skills dominated the responses, with over 90% of students emphasizing their importance. Based on their responses, the following combined themes were identified:

- **Proactiveness:** action-taking, risk-taking, ambition, diligence, problem-solving, real-time actions, hard-working, and resourcefulness.
- **Resilience:** persistence, resilience, calm, prudence, preparedness, flexibility and adaptability, self-confidence.
- **Innovative Thinking:** creativity, innovativeness, an open mindset, continuous learning, improvement, and innovation.
- **Effective Leadership:** leadership, communication, time management, organization, collaboration, responsibility, discipline, purpose, and concentration.

It is noteworthy that Opportunity Recognition and Creativity and Innovativeness, the two constructs investigated in this pilot study, fall under the sub-themes of "Proactiveness" and "Innovative Thinking" respectively. This reflects the alignment of the training provided with the expectations of the students participating in the pilot. In the other side, as part of the meta-theme of "Hard Skills," students' interests focused on "sales, finance, and taxation," while under "Knowledge," they mentioned "business regulations and business literacy."

While students' expectations of VR in entrepreneurship education reveal a strong interest and potential for transformative learning experiences, they also highlight several challenges that need to be addressed. Students overwhelmingly focused on soft skills such as Proactiveness, Resilience, Innovative Thinking, and Effective Leadership, underscoring the pressing need on these skills, but also the potential, and challenge of designing VR-based entrepreneurial education methods to meet these expectations. Additionally, including VR technology as part of entrepreneurship education will need to consider enhancing student awareness about VR technologies, ensuring pedagogical effectiveness of VR trainings, managing cognitive load in virtual environments, creating realistic simulations, and preparing educational ecosystems for seamless VR integration. Addressing these challenges will be key to the successful implementation of VR technologies in entrepreneurship education.

3.3.2 Focus Group: Experiences and perspectives of students about VR tech for entrepreneurial soft skills development

One of the key steps in the qualitative analysis was gathering and examining valuable insights from students about their perceptions, experiences, and feelings regarding VR technology after participating in VR training focused on entrepreneurial soft skills development. This section presents the summarized results from four focus groups involving 13 students. Focus groups (three with 3 participants, and one with four participants) were conducted in the virtual environment to maximize relevance of participants' responses to their experiences during the VR training. Each focus group lasted in average 30 min, and seven (7) questions were asked in total: two about their experience during the VR training, and five about their perspectives on the implementation of VR in entrepreneurship education for soft skills development. Table 6 displays the categories addressed in the questions posed to students and the unified meta themes derived from the collected information. The data obtained from students was extensive, varied, and rich in insights. Therefore, this section provides a summarized description of the key words and phrases without including full student comments and discussions. For a more detailed understanding of the main ideas collected from each focus group and to support this summary, please refer to Appendix H.

Table 6. Experiences and perspectives of students about VR tech for entrepreneurial soft skills development

Categories	Meta Themes
Overall personal experiences after VR training	• Experience was Positive and Engaging • VR as a Tool was Useful, Interactive and Realistic • Feeling of Skill Learning and Development • Challenges to Adapt and Technical Issues
Favorable Aspects of VR training	• Innovative, Engaging and Joyful • Creative Empowerment • Virtual Mobility and Collaboration • Multi-functional VR Tools • Enhanced Experiential Learning • Realistic Experience • Collaborative Creation and Idea Sharing
Less Favorable Aspects of VR training	• Technical issues • Not for non-tech savvies • Learning curve • It could be uncomfortable • Reality adjustment discomfort • Avatars lacked realism
Implementation of VR in universities for entrepreneurial soft skills	• Potential for Implementation • Effective Knowledge Sharing • Accessibility and Collaboration • Cost Reduction • Need for Studies • Selective Implementation • Enhanced Entrepreneurship Education • Distance Education Enhancement • Technical Challenges • Safety and Comfort

Table 6. Experiences and perspectives of students about VR tech for entrepreneurial soft skills development (Continued)

Categories	Meta Themes
Impact of VR on entrepreneurial soft skills among students	• Potential Negative Impacts of VR on Students' Skills: -Loss of Traditional Method Benefits -Limited Acquisition of Real-Life Skills -Communication Barriers -Hindered Creativity and Innovation -Low Teaching Effectiveness • Potential Positive Impacts of VR on Students' Skills: -Innovation and Creativity Enhancement -Enhanced Entrepreneurial Mindset and Skills -Virtual Education and Business Skills Enhancement
Advantages of VR tech in education for entrepreneurial soft skills	• Unlimited Classroom Space • Enhanced Remote Education • Interactivity and Innovation • Engaging Classes • Cost-Effective Learning • Safe Experiential Learning • Increased Focus and Memory Retention
Dis-advantages of VR tech in education for entrepreneurial soft skills	• Limited Usage and Associated Risks • Class Management Challenges • Technical Issues • Training Requirements • Careful Evaluation for Positive Impact • Accessibility Issues • Complex Implementation • Development Complexity • Server Dependency • Potential Hindrance to Social Skills • Risk of Boredom
Challenges and Difficulties of VR tech in education for entrepreneurial soft skills	• Large-Scale Implementation Difficulties • High Costs • Market is not ready • Health Risks • Potential Job Loss • Environmental Impact
Other Relevant Insights	• Expectations that VR tech integration in education will happen soon • VR education is not for all • Evidence of entrepreneurial mindset and soft skills activation among participants • Concern on long term impact/effects of VR in the industry • Feeling of freedom promoted in VR platform

Students' personal experiences after VR training

The first question asked to students was to describe their personal experience during the VR training for entrepreneurial soft skills development. According to students the overall **experience was positive and engaging**, with most of them using the following words to describe their experience: "*positive, fun, exciting, innovative, novel, engaging, interesting, great, nice experience, amazing, awesome, exceeded expectations, appreciative, feel as being a part of the process, pleasant, inspiring, glad"*. Additionally, students believe that **VR as a tool is useful, interactive and realistic**. Key

comments supporting this are: "*interesting tool, realistic, seamless, very useful, intuitive to use, easy to learn and to use, feel of being present and focused, feel more natural than other online platforms, motivated to learn more about VR, nice tool for many aspects, helpful, some things are easier to explain, interactivity*". Also, students had the feeling of having gone through a **skill learning and development experience**. During the focus groups their key insights were: "*Learning process, feeling of skills development, solutions-oriented, feel more confident for entrepreneurial projects".*

However, students also highlighted their **challenges to adapt to VR tech and the technical issues** encountered during the VR training. Some of the key comments pointing out these were: *"Adaptation time, trouble perceiving information properly, needs training, should be simpler for children, tools in VR feel a bit unnatural, needs time to learn, technical problems, goggles are heavy, hard to use at the beginning".*

Overall, students' personal experiences during the VR training with VR tech was positive and engaging, and VR tech for them was useful, interactive and very realistic, which led them to have the feeling of a skills learning and development experience. However, students also highlighted some challenges to adapt and technical issues during the VR training. These students' perceptions hint to the potential that implementing VR tech in education for entrepreneurial soft skills development might have and some of the challenges this implementation would imply.

Favorable Aspects of VR training

To further expand on their experiences during the VR training, students were asked to elaborate on what aspects they found most enjoyable about the VR training. The first theme that emerged was that **VR was innovative, engaging and joyful**. Students expressed this using the following statements: *"Interactive, innovative, fun, fun work, excitement, and curiosity promoted in the environment".* Also, another theme that emerged among students might be referred as to **Creative Empowerment**. Students stated this using the following phrases: "*Lead and control of the creation process; being able to control (manipulate) things in 3D; doing things which cannot be done in the real world; possibility to create what you imagine*".

Participants also highlighted the **Virtual Mobility and Collaboration** capabilities that might be enabled by VR. Some of their comments were: *"Freedom of movement in the VR environment, even if you're sitting in the real world; being anywhere in the world, and still enable people to work on the same activities, and together in the same room, at the same time than others"*. Furthermore, one key theme highly noted by them as part of their conversations in the focus groups was about the **Multi-functional VR Tools**. The following comments exemplify the key features of VR mentioned during their conversations: "*VR tools: 3D pen, iPad, post-sticks, access to websites, screen board, 3D writing/drawing; VR environments; applicability to many aspects of our lives; Avatars: raising your hands*".

Students also commented on their perception of the VR training as an **Enhanced Experiential Learning**. Some key comments were that VR may promote: *"Learning enhancement, skills development, short-term concentration increase; Learning by doing, hands-on work, laboratory-like experience"*. Following that, the VR training as a **Realistic Experience** was discussed by students. Their conversations revolved around the following statements: *"Realism; the feeling that it's really you who is doing something and not someone else; it feels natural"*. In the end, the VR training as an experience for **Collaborative Creation and Idea Sharing**, was remarked by students. Student's comments supporting this theme were: "*Cooperate and create things with others; showing your ideas using 3D notes; the feeling of freedom of sharing your idea; knowledge sharing; 3D screen board sharing"*.

In summary, the key favorable aspects highlighted by students about the VR training for entrepreneurial soft-skills education were: Innovative, Engaging and Joyful; Creative Empowerment; Virtual Mobility and Collaboration; Multi-functional VR Tools; Enhanced Experiential Learning; Realistic Experience; and Collaborative Creation and Idea Sharing. These aspects further support the potential benefits that implementing VR tech in education for entrepreneurial soft-skills development might have from the perspective of students.

Less Favorable Aspects of VR training

On the other hand, when asked students to elaborate on what aspects they found less favorable about the VR training students also provided multiple valuable insights. One of the less favorable aspects was the **Technical Issues**. In this regard, students complained about: "*Videos lagging, errors, and constant system messages"*. Also, participants remarked that VR tech is **Not for non-tech savvies**, recognizing the fact that some "*technologically unskilled or tech novice individuals might take some time to adapt, learn, use, and control VR tech*". They directly related this aspect to the **Learning curve** that might experience a user when starting using VR for the first time. They exemplified this reporting: *"Some difficulties moving in VR as wished; some difficulties sharing information"*.

Also, participants recognized the fact that using VR tech **could be uncomfortable**. Some of them reported: "*eyes tiredness, troubles to watch streamed videos; Goggles are heavy".* Additionally, some of them reported **Reality adjustment discomfort**: *"It felt sometimes weird when you come in and out the VR to the reality"*. At the end, some focus groups participants denoted that **Avatars lacked realism** by signaling that *"Avatar's movements and expressions could be more human-like".*

Overall, the key less favorable aspects of VR remarked by students were Technical Issues; Not for non-tech savvies; Learning curve; It could be uncomfortable; Reality adjustment discomfort; and Avatars lacked realism. Considering these unfavorable aspects are crucial when considering VR technologies as part of entrepreneurship education, for effective soft skills development.

Implementation of VR in universities for entrepreneurial soft skills

When asked students whether universities should incorporate VR technologies and experiences to enhance the learning of entrepreneurial skills, participants highlighted above all the potential for selective implementation of VR in education. Students considered that VR has **Potential for Implementation** in universities**,** and that "*VR technology should be implemented for its potential to enhance education";* they noted that *"While VR has not been perfected, it's a valuable option to consider in education".* They further expanded on these opinions by discussing that VR tech might provide an **Enhanced Entrepreneurship Education.** Students discussed that *"Universities can implement VR to enhance entrepreneurship skills learning, like creativity".* From their perspectives, *"VR increases student engagement, participation, and collaboration, potentially attracting more students to traditional courses".* Other key aspect highlighted by them is that *"Learning by doing is much greater in VR; It might facilitate more efficient learning for creating new or innovative ideas".* Participants further shared that *"VR allows exposure to different "ways of expressions and feelings" possibly enhancing productivity and optimizing research".* Experiential learning possibilities was also commented by participants by saying that *"VR supports virtual visits, interactions with processes and machines, group exercises, projects, case studies, negotiations, role-playing (e.g., as a company CEO), brainstorming, problem-solving discussions, prototyping, ideation, and showcasing sessions".*

Other important students' arguments were that including VR in education might provide **Effective Knowledge Sharing**, exemplifying that "*knowledge and ideas can be shared in more effective, innovative, and creative ways than traditional means (e.g., paper)". Also*, they talked about the potential of VR to increase **Accessibility and Collaboration** in universities. According to them, "*University education may be accessible anywhere, enabling working and studying with anyone in the world".* They mentioned the potential for **Cost Reduction**, commenting that "v*irtuality might lower some university costs*", especially those related to materials use and physical resources. Lastly, they commented about the potential for **Distance Education Enhancement** through VR. Some of them discussed that "*Many universities already offer online classes; VR can be a tool among many others used in universities, offering better ways of distance education by making things more realistic and providing the feeling of a real classroom*". From their point of view, "*VR technology offers another approach and practical touch to some subjects, including virtual conferences and business meetings".*

On the other side, students also shared crucial critical insights to consider when thinking about incorporating VR technologies and experiences in universities, to enhance entrepreneurial skills learning. Some students commented about the **Need for Studies** and explained that *"Studies are needed on what and how to teach in VR, including interaction methods, information sharing, and its advantages over traditional learning".* Some argued that VR in education should followed a **Selective Implementation**, by saying that *"VR should be implemented only when needed, such as in a class or meetings"*. Also, they suggested that "*Mixing/combining VR with normal lessons is more efficient and interesting*". Some

stressed that "*In-person education is also important, and standard/traditional lectures should not be fully replaced by VR*". Furthermore, some students reflected on the **Technical Challenges** that trainers and professors might face when trying to incorporate VR tech as part of their lectures: *"Technical limitations are unclear. Controlling a large class in VR, providing support to many students while dealing with VR would be a challenge".* Lastly, **Safety and Comfort** was part of the concerns among students. Students argued that "*VR lessons need time limits for safety and to avoid exhaustion"*, and that "*Lesson duration may be increased as VR technology becomes more comfortable"*. From their perspective, "*VR is a good method but not for normal lectures; it requires an open-minded approach and poses time constraints".*

In summary, when asked students whether universities should incorporate VR technologies and experiences to enhance the learning of entrepreneurial soft-skills, participants recognized the Potential for Implementation, possibilities for Enhanced Entrepreneurship Education, Effective Knowledge Sharing, Accessibility and Collaboration, Cost Reduction in universities, and Distance Education Enhancement. They also stressed the Need for Studies, Selective Implementation, consideration of Technical Challenges, and Safety and Comfort, among students and professors.

Impact of VR on entrepreneurial soft skills among students

Students were also asked about their perspectives on the potential impact of including VR in education for entrepreneurial soft skills development among students. Varying opinions among students on the impact of VR on entrepreneurial soft skills development was perceived. Some believe "*VR poses no limitations and can only help"*, while others acknowledge potential limitations and risks associated with VR abuse.

The potential negative Impacts of VR abuse on students' soft skills were:

- **Loss of Traditional Method Benefits.** Some students believed that "*Excessive reliance on VR may lead to neglecting traditional learning methods, which offer significant benefits for soft skills development"*.
- **Limited Acquisition of Real-Life Skills.** Students argued that overuse of VR might "*hinder the development of soft skills that require real-life human interaction.* According to these students *"certain behaviors and skills are best learned through face-to-face communication*".
- **Communication Barriers.** Students argued that "*VR may pose challenges in conveying some ideas as effectively as real-life interactions, where non-verbal cues play a crucial role*".
- **Hindered Creativity and Innovation.** Participants also claimed that "*focusing too much on VR might hinder creativity and innovation, which often stem from real-life experiences and the challenges they present".*
- **Low Teaching Effectiveness.** Some students stated that "*without proper preparation and training, teaching effectiveness in VR might decrease, leading to increased time and costs".*

The potential positive impacts of VR on students' soft skills mentioned by participants of the focus group were:

- **Innovation and Creativity Enhancement.** Participants shared that "*VR might foster the creation of innovative and entrepreneurial ideas by providing immersive and engaging environments*".
- **Enhanced Entrepreneurial Mindset and Skills.** Students also shared that "*VR might offer more tangible and realistic approaches to develop and create ideas, making it easier for students to share and visualize knowledge in real-time".* Because of this, they believe that *"this might enhance overall entrepreneurial skills and knowledge"*.
- **Virtual Education and Business Skills Enhancement.** Students shared that *"VR might enable participation in remote classes, courses, and business meetings, simulating real-life business environments and enhancing skills among students".*

In general, while students emphasized the significant positive impact that incorporating VR could have on developing entrepreneurial soft skills, they also highlighted potential risks associated with the overuse of VR, which could undermine the effectiveness of their development.

Advantages of VR tech in education for entrepreneurial soft skills

Students were also inquired about the advantages of including VR tech in education might have over traditional education (e.g.: In-person instruction, and interaction, physical classrooms, materials, "unplugged", etc.) to enhance entrepreneurial skills, such as opportunity recognition, creativity, and innovation, among students. Key meta themes are listed and examples of supporting ideas are presented in quotation marks as follows:

- **Unlimited Classroom Space.** "*VR might eliminate physical space constraints, allowing unlimited participants in a virtual environment".*
- **Enhanced Remote Education**. *"Particularly beneficial during pandemics or conflicts, enabling interactive, engaging, and creative remote learning. It allows students to "visit" places, see inside objects, and interact with environments that are impossible to replicate in a traditional classroom, such as factories or machines. VR facilitates global interactions in a fun and practical way, making remote lectures more engaging.*
- **Interactivity and Innovation.** "*VR might offer new and impactful ways to interact with people and information, promoting innovative and creative behaviors through 3D prototyping and interaction with 3D objects".*
- **Engaging Classes.** "*VR makes classes more interesting, amusing and engaging than traditional methods, enhancing overall class participation and limiting boredom".*
- **Cost-Effective Learning.** *"Reduced need for physical materials lowers the investment in class materials, making education more affordable in the long run".*

- **Safe Experiential Learning.** *"VR provides a safe environment for experiential learning and material manipulation, minimizing risks associated with hands-on activities".*
- **Increased Focus and Memory Retention.** "*VR might keep users fully engaged and free from external distractions, unlike other virtual meeting platforms or traditional lectures. This enhanced focus can improve memory retention and overall educational outcomes".*
- **Practical and Time-Efficient.** "*VR-based education is faster than traditional methods, eliminating commuting time and streamlining the learning process".*
- **New Frontiers for Creativity and Innovation.** "*Creation of products and experiences that are impossible in traditional education, significantly enhancing creativity and innovation".*
- **Overcoming Fears and Skill Development.** *"VR can help students overcome fears, such as public speaking, and facilitate the development of various skills in a safe and controlled environment".*

Dis-advantages of VR tech in education for entrepreneurial soft skills

When questioned students about the potential dis-advantages that including VR tech in education might have over traditional education (e.g.: In-person instruction, and interaction, physical classrooms, materials, "unplugged", etc.) to enhance entrepreneurial skills, such as opportunity recognition, creativity, and innovation, among students. Similarly, key meta themes are listed and examples of supporting ideas are presented in quotation marks as follows:

- **Limited Usage and Associated Risks.** "*VR cannot be used for extended periods due to the risk of eyesight issues, headaches, and physical discomfort. The equipment can be heavy and unsuitable for long lectures, and it may not be suitable for everyone".*
- **Class Management Challenges.** *"VR can be chaotic if mismanaged, as students might get distracted or engage in unrelated activities. Effective management is crucial to maintain focus and order".*
- **Technical Issues.** *"Technical problems can significantly impact the user experience, causing difficulties in hearing, cooperating, and overall interaction within the VR environment".*
- **Training Requirements. "***There is a learning curve associated with VR technology, necessitating pre-training and adaptation time for students and educators before effective use in the classroom".*
- **Careful Evaluation for Positive Impact**. *"The implementation of VR must be carefully evaluated to ensure it is beneficial and does not detract from the educational experience".*
- **Accessibility Issues.** *"VR technology is not feasible for all students, as not everyone will have access to the necessary equipment. It may only be practical for use in university labs or conference rooms, limiting its widespread adoption".*
- **Complex Implementation.** *"VR requires significant prerequisites for implementation, making it more complex than traditional classes. However, the rapid advancement of technology might mitigate these challenges in the future".*

- **Development Complexity.** "*Creating realistic VR simulations involves advanced programming and the development of complex environments, leading to high costs. While AI advancements may reduce these barriers over time, they remain a consideration".*
- **Server Dependency**. *"VR relies on a stable server connection to function properly, which can be a limitation if the server fails or is inaccessible".*
- **Potential Hindrance to Social Skills.** *"Excessive use of VR might limit the development of social skills, as human interaction in VR lacks the natural elements of seeing and perceiving others' emotions. This can be a communication barrier, especially for introverted individuals".*
- **Risk of Boredom.** *"The novelty of VR might wear off, leading to boredom if students are confined to one position or if the VR experience becomes monotonous".*

Challenges and Difficulties of VR tech in education for entrepreneurial soft skills

Students were also asked about the challenges and difficulties they foresaw in using VR technology to enhance entrepreneurial skills in universities. One of the first themes discussed among students was its **Large-Scale Implementation Difficulties**. They commented on its *"costliness, limited battery duration, and dependency on specific technical requirements, and that it's not user-friendly for everyone".* Also, they noted again its **High Costs**, and that *"VR technology is expensive, and unaffordable for many students and educational institutions, which limits its accessibility and widespread adoption"*. Furthermore, students shared the opinion that the **Market is not ready** for VR**.** They further discussed that *"The universities are not fully prepared for VR technology"*. Additionally, they emphasized the *"lack of knowledge and understanding about VR",* and that *"many individuals need to be introduced, familiarized, and trained on how to use it effectively"*. This adjustment period will *"require time and resources".*

Again, students mentioned the potential **Health Risks** by discussing that *"increased use of VR technology can lead to more time spent with digital devices, which may pose various health risks, including eye strain, headaches, and other physical discomforts".* One interesting topic discussed by participants was **Potential Job Loss** that VR implementation in universities might entail. They indicated that "*the development and implementation of VR in education could potentially lead to job displacement or loss, as some roles may become obsolete"*. Lastly, some students commented that the **Environmental Impact** of VR technology is not yet fully understood. They declared that the potential implementation of these technologies in universities needs to consider the *"Energy consumption and the environmental footprint associated with the production, usage, and disposal of VR equipment"*.

Overall, from the perspective of students, the key challenges associated with the potential implementation of VR technologies as part of entrepreneurial education are its Large-Scale Implementation Difficulties, High Costs, that the Market is not ready, associated Health Risks, Potential Job Loss, and Environmental Impact.

Other Relevant Insights

There were some final relevant insights gained from students' focus groups. First, students shared their **Expectations that VR tech integration in education will happen soon**. Students consulted believe that *"the potential of VR technology for entrepreneurial education is significant if well implemented",* and that this potential *"it's rather linked to our new growing population rather than past generations";* and *"it can be implemented most effectively with the new generation of students"*. Additionally, students agreed that **"VR education is not for all"**. According to them "*VR technology is not for all types of learning or content, not everything can be taught using VR; it might lose efficiency"*. This was further exemplified by comments like: *"Some experiences might not make sense to be conducted in VR, such demonstrations in which the real experience needs to be delivered"; "Well-known and well working methods should not be replaced, but rather enhanced with the incorporation of new technology"; "Translating everything to the metaverse is not a good idea"; "If something can be done in physical classroom, like a standard lecture, it should be conducted without VR"; "Real-life trainings should be implemented whenever is possible, and VR training incorporated when necessary".*

Additionally, they commented on **Implementing VR technology in education will help to learn about VR,** and that **"***It would be a good idea for universities to offer small courses related to virtual reality"*. Several students also agreed that their experiences during the VR training was **Evidence of entrepreneurial mindset and soft skills activation among students**. As a matter of example one student commented: "*some ideas really came to my mind after all of that VR, because now I'm thinking that I'm doing e-commerce and… that it's really cool … if this technology would be widespread …to the ordinary consumer, and people just can go to your website and see your product using VR technology and maybe in 3D. So, yeah, so even I see the result of just a test lecture we had today. I see the result even now. Yeah, I see the big potential in that technology".* Two final themes that were commented on by students were their **Feeling of freedom promoted in VR platform**", and their **Concern on long term impact/effects of VR in the industry**.

3.3.3 Interviews: Perspectives of technology experts and entrepreneurship educators on VR implementation as part of entrepreneurship education for soft skills development in university settings

In the final phase of the qualitative analysis, a series of interviews were conducted with experts specializing in XR technology implementation for education, business development, and entrepreneurship. The objective was to gather and evaluate insights from key stakeholders regarding the potential integration of VR technology in entrepreneurship education to enhance soft skills development among university students. This section presents a summary of findings from 1-h interviews with six experts from four esteemed institutions: University College Dublin (Ireland), Trinity College Dublin (Ireland), Poznan University of Economics and Business (Poland), and the University for Continuing Education Krems (Austria). These experts brought substantial expertise in areas such as AR/VR tech

development, business and university applications, startup ecosystem development, business acceleration, management, international business, entrepreneurial education, IoT, and transversal skills development. For more comprehensive information about the backgrounds and expertise of the interviewees, please refer to Appendix H.

Table 8 outlines the categories covered by each question posed to participants and the unified meta-themes that emerged from their responses. The data obtained was extensive and diverse, offering rich insights into the subject. Consequently, this section provides an overview of the key themes identified, omitting full discussions. For a detailed exploration of the main ideas discussed by each interviewee, please refer to Appendix H.

Table 8. Perspectives of Experts on VR tech incorporation in entrepreneurial education for soft skills development among students

Categories	Meta Themes
University role	• Market-Driven Focus • Supporting Skill and Mindset Development • Diverse Methods and Environments for Skill Development • Encouraging Technological Innovation • Research and Innovation • Entrepreneurial Ecosystem
Potential impact of VR in entrepreneurial soft skills	• Enhanced Visualization of Ideas • Opportunities for Prototyping • Enhanced Soft Skills Development in a Safe Environment • Enhanced Multicultural Remote Collaboration • Innovative Entrepreneurial Education • Potential Negative Impact on Social Connections if Overused • Ineffective Education Risks • Challenges for Older Students
Implementation of VR for entrepreneurial soft skills development	• Positive Student Feedback but Need for Evidence • Educator Interest and Curiosity • Role of Universities in VR Integration • Targeted Implementation • Preparation and Investment • Conditional Implementation • State-of-the-Art Pursuit
VR advantages and disadvantages	**Advantages:** • Immersive and Innovative Remote Collaboration • Augmented Experience for Soft Skills Development • Versatile Immersive Learning Methods **Disadvantages:** • Undesirable Potential Effects • Complex Implementation • Costly • Technology Issues • Challenges for Older Students • Potential to Limit Teaching Efficacy • Accessibility Issues
Combining traditional education and VR	• Complementary Integration of VR and Traditional Education • Promoting Participation and Engagement • Case-Specific Applications • Enhancing Real-World Scenarios • Adapting to Course Needs

	• Supportive Technology • Diverse Learning Methodologies
Challenges implementing VR in universities	• High Costs and Budget Constraints • Technical Limitations • Health and Legal Concerns • Engagement and User Experience • Demonstrating Effectiveness • Teacher Readiness and Institutional Resistance • Student Acceptance and Satisfaction • Expression and Identity in VR • Integration with Traditional Methods • Time Constraints and Implementation Complexity • Market Momentum and Adoption • Trustful Collaboration
Prerequisites for incorporating VR in universities	• Open-Minded and Supportive Environment • Clear Educational Use Cases • Financial and Technical Resources • Specialized Facilities and Applications • Training and Expertise • Technical Support and Readiness • Cost-Benefit Analysis • Governmental and Institutional Support • Health and Safety Considerations • Demand and Need
Other relevant remarks	• Extended and Immersive Learning • Advancement with AI • Realism vs. Perceived Interaction • Defining Safe Virtual Spaces • Time for Skill Development • Awareness of VR Limitations • Cost Reduction through Globalization • Technical Challenges

The Role of Universities

Experts were asked about the role of universities in developing soft skills such as opportunity recognition, creativity, and innovativeness to promote an entrepreneurial mindset among students. The first theme that emerged was the **Market-Driven Focus** of universities. Experts emphasized that universities *"must tailor their roles according to market needs and their unique academic offerings in the global market"*. They noted that aligning the university's focus with market demands *"ensures relevant skill development"*. Another significant theme was **Supporting Skill and Mindset Development**. Experts highlighted that *"universities play a critical role in supporting students in developing both hard and soft skills"*. They agreed that it was important to provide entrepreneurial knowledge and training, as well as *"activating entrepreneurial thinking and enhancing the entrepreneurial spirit among students"*. Some of their examples were: *"promoting emotional competencies, self-awareness, and leadership skills, which are essential for future entrepreneurs"*.

Following that, providing **Diverse Methods and Environments for Skill Development** was also highlighted by experts as a university function. They suggested that *"universities should provide a variety of tools, environments, and learning methods to foster soft skills development"*. The approaches considered by experts include problem-based techniques, state-of-the-art research, and virtual-based education. They pointed out that *"presenting students with various mechanisms, tools,*

and technologies for learning enables a more comprehensive educational experience". **Encouraging Technological Innovation** was another derived theme. Some experts considered that *"universities should encourage students to become technology change-makers"*. This involves *"teaching students how to use, apply, and understand new technologies, as well as their advantages and disadvantages"*. Empowering students to *"lead their own soft-skills development and apply technology to solve real-world problems*" was considered vital. According to them, this would ensure that *"students are well-prepared for the evolving technological landscape"*.

The theme of **Research and Innovation** also emerged strongly as a key role of universities. Experts noted that "*conducting research, gaining knowledge, and creating scientific breakthroughs are key roles of universities"*. Experts commented that *"fostering innovation and advancing various fields of study should be central to university initiatives, enhancing educational outcomes and contributing to the broader scientific and entrepreneurial communities"*. Subsequently, experts emphasized the importance of universities as **Entrepreneurial Ecosystems**. As per experts' elaborations, universities can serve as *"entry points for entrepreneurial ecosystems, gathering multiple stakeholders to collaborate on different applications"*. Experts stressed the importance of *"exposing students to successful entrepreneurs and connecting them with speakers and supporting clubs", and "providing a network that fosters entrepreneurial growth and collaboration is essential for nurturing future business leaders"*.

In line with experts' contributions, universities might support the development of entrepreneurial soft skills such as opportunity recognition, creativity, and innovativeness among students by tailoring their focus to these market needs, supporting skill and mindset development among students, and providing diverse methods and environments for the development of entrepreneurial soft skills. Also, they might do this by encouraging internal technological innovation, increasing research and innovation in these areas, and prioritizing the development of a strong internal entrepreneurial ecosystem.

Potential impact of VR in entrepreneurial soft skills

Important insights were collected when experts were consulted about the potential impact of including VR as part of entrepreneurial education for entrepreneurial skills development among students. One of the first themes was the **Enhanced Visualization of Ideas** facilitated by VR. Experts noted that VR technology *"enables better visualization of concepts, opportunities, and risks"*. One expert mentioned: *"VR allows for visual presentations of pitches, bringing ideas to life for the audience"*. Experts agreed that this *"enhanced visualization facilitates more effective communication of ideas"*. Another significant theme was the **Opportunities for Prototyping** made possible by integrating VR. According to the experts, VR facilitates *"virtual experimentation, simulation, and prototyping before real-world implementation"*. An expert highlighted that doing this in VR might *"reduce potential costs and risks by promoting a trial-and-error approach"*. They also suggest that this

capability allowed students to refine their entrepreneurial ideas without the financial burden of physical prototypes.

The possibility of **Enhancing Soft Skills Development among students in a Safe Environment** was also emphasized. Experts exemplified that *"VR provides a safe, controlled environment for overcoming the fear of presenting to large audiences"*. One commented, "*VR enables situational-based learning and decision-making without financial risks"*. They also commented that VR might allow students to *"practice entrepreneurial skills in low-risk scenarios, positively impacting their confidence and abilities"*. Next, the theme of **Enhanced Multicultural Remote Collaboration** also emerged strongly. Experts illustrated that VR *"might help connecting individuals globally, enabling collaborative brainstorming and work sessions"*. Experts appreciated that VR *"includes live translation features to enhance collaboration among diverse nationalities"* making it *"easier to gather diverse perspectives and build more robust products"*. **Innovative Entrepreneurial Education** was another key theme. Experts inferred that *"VR's immersive and engaging learning techniques might make entrepreneurship education more effective"*. Experts noted that VR "*might enhance understanding of entrepreneurship through attractive and stimulating audiovisual methods"*. According to them, the highly immersive experiences provided by VR *"might help students grasp complex entrepreneurial concepts more effectively and engage younger students through gamified scenarios"*.

However, experts also discussed the **Potential Negative Impact on Social Connections if Overused**. They cautioned that *"VR may distance users from real-world interactions, limiting genuine human connection"*. One expert pointed out that *"communication is mediated by 3D avatars, restricting expressions and natural behaviors"*. This mediation can lead to a *"loss of personal touch in interactions, requiring users to be trained to distinguish between real and digital interactions"*. Another concern raised was the **Risk of Ineffective Education**. One expert claimed that "*VR needs to be implemented in such a way that users can utilize their imagination in 'useful ways', which can be challenging"*. Additionally, another expert mentioned that *"in VR trainers' feedback to students might be hindered due to a lack of real gestures and reactions, especially for presentation skills"*. This limitation can be restrictive for trainers who rely on observing real-time student reactions to provide effective feedback. Lastly, experts highlighted **Challenges for Older Students**. They noted that VR *"might be difficult for older students who are not familiar with or open to the technology"*. One noted, "*it may not be suitable especially for those seeking real-world situations for soft skills development"*. This technological gap can hinder older students' ability to fully benefit from VR-based entrepreneurial education.

As per interviewees responses, incorporating VR technology as part of entrepreneurial education for soft skills development among students might have both positive and negative impacts. VR might provide significant enhanced visualization of ideas, opportunities for prototyping, soft skills

development in a safe environment, enhanced multicultural remote collaboration, and innovative entrepreneurial education. However, VR might also impact negatively social connections if overused, be an ineffective method for education if misused, and represent challenges for older students.

Implementation of VR for entrepreneurial soft skills development

When the experts were prompted to share their opinions about the possibility of universities incorporating VR technologies to enhance the learning of entrepreneurial skills, those with expertise with VR for education indicated experience with **Positive Student Feedback but Need for more evidence**. These experts acknowledged that their students report positive experiences with VR, but they also emphasized the *"need for comparative studies to clarify the real benefits on entrepreneurial skills development"*. This highlights a positive initial reception but underscores the importance of further research. Another common topic was **Educators Interest and Curiosity**. They noted: *"Educators are interested and curious about exploring different ways to interact and engage with students"*. This indicates a demand for innovative teaching methods and a willingness to experiment with new technologies to enhance student engagement.

Role of Universities in Technology Integration was again emphasized by the experts. They highlighted the proactive role universities should play in technology integration, suggesting, "*Universities should incorporate XR and other technologies as they can"* stressing that "*universities have a role in bringing current trends and technologies to students, generating opportunities, and providing resources and materials for exploration"*. This emphasizes the institution's responsibility to keep pace with technological advancements. The topic of **Targeted Implementation** also emerged strongly. Experts recommended targeted implementation of VR technology, suggesting, *"VR should be implemented for specific purposes, such as research and remote classes, rather than replacing all traditional activities"*. Some of them suggested that VR is "*particularly beneficial for certain learning styles and can make content more accessible to neurodivergent students and those with learning difficulties*". Additionally, they commented that *"VR can offer a safer environment for conducting studies, making it a valuable tool for specific educational contexts"*.

Interviewees also highlighted the **Conditional Implementation** of VR. Some indicated, *"VR should be implemented if certain pre-conditions are fulfilled"*, advocating for the use of VR in *"short sessions or specific virtual classrooms to avoid overexposure to digital devices and information overload"*. They also emphasized that *"each department should decide on VR implementation based on their specific needs and goals, ensuring that VR is used where it is most effective"*. Necessary **Preparation and Investment** were seen as crucial for effective VR integration. Experts stated, *"Universities need to be prepared and knowledgeable about how VR works"* and emphasized that *"investment in VR and other technologies is necessary"*. Lastly, the theme of universities' pursuit of **State-of-the-Art** was highlighted. With this, experts encouraged that universities must strive to be state-

of-the-art in adopting new technologies and methodologies. They indicated, *"Universities should strive to be state-of-the-art in adopting new technologies and methodologies to enhance learning experiences"*.

Overall experts' contributions on implementing VR for entrepreneurial skills development counts with positive reception and interests among students and professors but the need for sound evidence of impact is necessary. Additionally, they stressed that this implementation needs to be targeted and conditioned to the fulfillment of specific prerequisites to ensure its effectiveness. Finally, they highlighted the crucial role of universities in being state-of-the-art and the need for preparation and investment.

VR advantages and disadvantages

Experts provided insights on the advantages and disadvantages of VR-based education compared to traditional education for enhancing entrepreneurial skills such as opportunity recognition, creativity, and innovation among students. One advantage mentioned was possibilities for more **Immersive and Innovative Remote Collaboration**. VR experts indicated that *"VR facilitates a sense of presence, allowing collaboration with people from anywhere in the world"*. They expanded on this commenting that VR *"enhances remote learning, socialization, and collaboration, making it possible to gather diverse opinions and ideas, particularly useful for market discovery"*. Another expert emphasized that VR *"enhances brainstorming and social learning with individuals not in geographical proximity,* and that this *"broadens the scope of collaborative opportunities beyond physical boundaries"*. Additionally, **Augmented Experience for Soft Skills Development** was remarked as an important possible contribution. This based on the immersive nature of VR that *"might provide an engaging learning experience significantly enhancing student interest and participation"*. Experts noted that VR *"offers an immersive learning experience that might enhance student engagement and interest"* and "*provides visually appealing and creative virtual classrooms, possibly fostering creativity and innovativeness among students"*. VR experts indicated that simulated environment allows for the *"creation and manipulation of immersive settings, stimulating creative thinking and innovative approaches to problem-solving"*. Additionally, experts commented on **the Versatile Immersive Learning Methods** as a key advantage. Experts remarked that VR *"provides versatile and varied virtual environments with 3D working tools"*, enabling *"instant displacement between different settings, such as virtual offices and tours"*. This versatility was suggested to be *"particularly effective for teaching during situations like pandemics"*. Additionally, VR *"might reach younger students familiar with technology through gamified working scenarios"*, making learning more interactive and appealing.

However, there were various disadvantages mentioned by experts, starting with **Undesirable Potential Effects**. Experts expressed that VR "*raises health concerns and unclear long-term*

psychological impacts, especially related to social interactions and collaboration". Furthermore, *"it may distance users from real-world interactions, leading to mistrust and a lack of personal contact"*. One expert mentioned, *"users may struggle with not seeing the real person behind the avatar"* which *"can hinder genuine connection and trust"*. Another disadvantage was **Complex Implementation**. Experts highlighted that VR *"requires a long adoption time, and a significant technical capital and effort to develop, implement, and use"*. The technology development and preparation of virtual environments are *"complicated, and limited content availability can hinder its effectiveness"*. This complexity can be a *"substantial barrier to widespread VR integration in educational settings"*.

Costly was another theme that emerged. The high costs of purchasing and maintaining VR technology were commented to pose significant barriers to its adoption. Experts pointed out that *"high costs of purchase and upkeep pose significant barriers"*, making it challenging for educational institutions to implement VR widely. They said: *"Financial constraints can limit the accessibility and availability of VR tools for students"*. **Technology Issues** and limitations were also considered to present a significant challenge. Experts noted issues such as *"limited battery duration, screen resolution, and usage time"*, and that *"headsets are often heavy and uncomfortable"*. Additionally, *"tracking sensors need improvement to capture the full body, and technical limitations and software problems make VR usage time-consuming and unpredictable"*. One expert mentioned that *"VR technology is still developing and not yet fully ready"*, indicating that the current state of the technology may not be ideal for seamless educational use. Lastly, **Accessibility Issues** were highlighted as a significant barrier: *"VR technology inequal accessibility can create unfair situations, especially in a general social and economic sense"*. Experts pointed out that "*not all students may have access to the necessary VR equipment"*, representing a significant barrier to equal educational opportunities. This disparity *"may exacerbate existing inequalities and limit the reach of VR-based educational programs"*. Again, **Challenges for Older Students** in adapting to VR technology, and the **Potential to Limit Teaching Efficacy** was another disadvantage noted were commented

In summary, experts provided crucial insights on the numerous advantages and disadvantages implementing VR for entrepreneurial skills development might entail. The recognized the potential for immersive and innovative remote collaboration, augmented experience for soft skills development, and the versatile immersive learning methods. Also, they stressed undesirable potential effects, complex implementation, costs, technical and accessibility issues.

Combining traditional education and VR-based education methods

Experts shared their opinions on combining traditional education with VR-based education to enhance entrepreneurial skills among students. One of the primary themes was the **Complementary Integration of VR and Traditional Education**. Experts suggested that "*VR should be used to enhance the impact of traditional teaching methods rather than replace them"*. They emphasized that

"combining both approaches can create a more effective learning environment" indicating that *"a balanced integration can harness the strengths of both methods"*. They explained that this combination *"might provide a safe and effective way of teaching through business simulations and interactive games",* leveraging the immersive benefits of VR while ensuring thorough understanding through traditional follow-up. The theme of **Supportive Technology** also emerged, with experts viewing VR as a *"complementary tool".* They noted that *"VR can serve as supportive technology, but its effectiveness in some scenarios remains uncertain".* One expert stated, *"It's crucial to evaluate how VR can best complement traditional teaching methods"* suggesting that careful consideration is needed to optimize its use.

Furthermore, the themes of VR **Case-Specific Applications** and **Adapted to Course Needs** were also prevalent. Experts commented that VR might be *"effective for collaborative brainstorming, simulations of environments (e.g., stores), and scenarios that benefit from 3D visualization"*. Also, experts stressed that *"VR frameworks need to be adapted to the specific needs of each course".* They remarked that *"clear use cases are essential for making VR integration necessary and effective".* indicating the importance of tailoring VR applications to meet course objectives. This underscores the need for targeted application of VR where it can add the most value.

Following was **Enhancing Real-World Scenarios**. Some experts noted that *"VR can simulate real-world scenarios, providing practical, hands-on experience",* and that *"enhancing real meetings with virtual interactions might create a more dynamic learning experience"*. The theme of **Diverse Learning Methodologies** was highlighted. Combining different teaching methodologies caters to various learning styles and preferences. Experts remarked that *"a mixed approach can address the diverse ways in which students learn and retain information"*. Another theme was **Promoting Participation and Engagement**. One expert mentioned, that "*including VR methods can promote the participation of shy or less engaged students",* while another pointed out that *"enhancing lessons with VR can make them more interactive and engaging".*

Experts' contributions suggest that combining VR-based education with traditional methods for entrepreneurial skills development might create a more inclusive and dynamic learning atmosphere if well used. Also, they underscore the importance of a hybrid case-specific educational model that accommodates individual learning needs.

Challenges implementing VR technology to enhance entrepreneurial skills among students in university settings

Experts were asked about the challenges they foresee in using and implementing VR technology to enhance entrepreneurial skills among students in university settings. Again, its **High Costs and Budget Constraints**, **Technical Limitations**, **Time Constraints and Implementation Complexity**, and **Health and Legal Concerns** emerged. Experts expanded on this last one commenting the potential

"legal issues related to public use of VR technology", referring to the potential risks and regulatory hurdles associated with VR usage in university settings. The challenge of **Demonstrating Effectiveness** was also highlighted. Experts noted the need in *"proving the advantages and effectiveness of VR methods over traditional ones"*, and the challenge of *"justifying the cost-to-benefit ratio"*. This underscores the need for robust evidence to support the value of VR in education. **Teacher Readiness and Institutional Resistance** was another relevant theme. Experts pointed out the "*lack of readiness among teachers to implement and run VR technology in classrooms,"* and the *"resistance to change at the institutional level, particularly among 'digital immigrants'"*. This indicates the need for professional development, new ways of thinking and cultural shifts within institutions to embrace VR technology.

Engagement and User Experience was identified as a crucial challenge. Experts indicated the difficulty of "*keeping students engaged and interested without causing boredom or fatigue from using headsets"*. They also stressed the need for the *"VR environments to be varied and specific to the teaching process"*, to ensure that it effectively supports learning objectives. **Student Acceptance and Satisfaction** also emerged as a concern of experts, commenting that *"ensuring students accept and are satisfied with VR incorporation in classrooms"* and *"meeting students' expectations during VR-enhanced learning*", is challenging. The topic of **Expression and Identity in VR** was discussed as well. Experts considered how *"VR avatars serve as a way of expression and identity, which can be limited or enhanced depending on their characteristics and usage"*. This points to the need for thoughtful design of avatars to support meaningful self-expression in classrooms. This is also connected to their concerns about **Trustful Collaboration**. Experts pointed out the challenge of "*building trust among students to work with people they don't know in VR settings"*, and the importance of *"creating a positive atmosphere for effective group interactions and learning experiences"* . This emphasizes the need for strategies to foster trust and collaboration in virtual environments.

An effective **Integration with Traditional Methods** was again emphasized as one challenge. Experts stressed the difficulty of *"smoothly combining VR experiences in traditional classrooms, and real-world activities to create effective learning experiences"*. Lastly, **Market Momentum and Adoption** also emerged as a theme. Experts discussed the importance of finding the right "*market momentum*" to successfully implement VR and noted that the *"interest of trainers is limited by VR system malfunctions, complexity, and lack of realism in avatars and environments"*. This underscores the need for reliable and user-friendly VR systems to justify its adoption in academia.

Overall, experts perceive numerous challenges in implementing VR technology to enhance entrepreneurial skills among students in university settings from an academic, technological, financial, institutional, and market levels.

Prerequisites for incorporating VR in universities to support the education of entrepreneurial skills among students

Experts were asked to identify the prerequisites for incorporating VR technologies at universities to support the education of entrepreneurial skills among students. **Clear Educational Use Cases** was a frequent theme. Experts stressed the importance of defining *"specific educational needs and use cases where VR can be genuinely beneficial".* They cautioned against implementing VR for its own sake, urging that it should *"address real pain points, such as supporting students with special learning needs".* The theme of **Demand and Need** was highlighted. Experts emphasized the importance of ensuring there is a *"clear demand and need from the student body for VR-based learning"* and assessing and confirming that *"VR will have a positive effect on entrepreneurial skills and educational outcomes".* This underscores the necessity of aligning VR initiatives with the actual needs and preferences of students to ensure their effectiveness.

Conducting a **Cost-Benefit Analysis** was also identified as essential by experts. They recommended thorough analyses to *"ensure that the investment in VR technology is justified"* and to *"guarantee that VR tools and environments work perfectly and are user-friendly".* The theme of **Financial and Technical Resources** was also frequently commented on by experts. They noted the need to *"secure financial support to cover the costs of VR implementation"* and to "*ensure availability of necessary hardware, such as a significant number of headsets from the same provider"*. Additionally, they emphasized the importance of providing *"adequate technical infrastructure, including a strong Wi-Fi connection and compatible computers/laptops"*. This was expanded by the topic **Specialized Facilities and Applications** where experts recommended developing *"dedicated facilities for safe and comfortable VR experiences"* and VR experts proposed creating a *"standalone VR application exclusive to the university, supported by a team of developers"*.

The topic **Training and Expertise** was further discussed stressing the importance of training staff members to *"effectively implement and use VR technology"* and employing *"expert trainers and professionals knowledgeable in VR and its educational applications"*. **Technical Support and Readiness** emerged as another supportive theme. Experts noted the necessity of "*robust technical support to address any issues promptly"* and verifying that *"staff and students are ready and willing to adopt VR technology in their educational activities"*. Experts emphasized the need of building an **Open-Minded and Supportive Environment**. They discussed the importance of *"fostering a culture that embraces change and understands the evolving nature of technology"*, and to *"encourage an environment where students, staff, and colleagues are open to adopting new technologies"*. They also encouraged *"creativity and imagination to explore new and appropriate ways of using VR"*. This highlights the critical role of training skilled and innovative personnel in the successful adoption of VR.

The theme of **Health and Safety Considerations** was also prominent. Experts stressed the need to *"assure the health and safety of students and professors when using VR"* and to *"address potential*

health concerns and ensure safe usage practices". Lastly, **Governmental and Institutional Support** was also seen as critical. Experts indicated that *"governmental support and funding to aid in the implementation of VR technology"* was crucial. This emphasizes the importance of institutional and external support in facilitating VR adoption.

Overall experts stressed the importance of careful evaluation of the practical, technical, and financial implications of VR implementation. They also emphasized the need for a receptive, supportive and adaptive institutional culture, to maximize the benefits of VR technology in university settings for entrepreneurial skills education. In summary, experts covered four key over-arching requisites for VR implementation: a clear demand, sufficient resources, human capital building, and institutional and governmental support.

Other relevant remarks

Experts provided several important remarks during the interviews regarding the use of VR technology in entrepreneurial education. Experts agreed that the **Advancement with AI** would *"accelerate the development of XR technology"*, with future advancements potentially including *"faster creation of 3D models and environments, potentially even through voice commands"*. Additionally, they spoke about the potential for **Cost Reduction through Globalization**. Experts suggested that as VR technology becomes more globalized and widespread, *"the lower the costs might be"* but this widespread adoption heavily relies on *"demonstrating the usefulness and necessity of VR*".

Realism vs. Perceived Interaction. Experts pointed out that there is *"uncertainty about whether more realistic models and avatars would enhance interaction and collaboration"*. They stressed that *"the perception of realism's impact on virtual interactions needs further exploration"* highlighting the need for research into how realism affects user experience in VR. Additionally, **Defining Safe Virtual Spaces** was another crucial remark. Experts were concerned about not having *"clear definitions of acceptable actions, mobility limitations, and social norms in VR"* to ensure safe and effective interaction within virtual spaces. They emphasized that *"ensuring a safe virtual environment is crucial for user comfort and engagement"*. Lastly, the theme of **Time for Skill Development** in VR was also discussed. Experts noted that *"developing soft skills takes time, which may be a limitation in VR settings"* and that *"the time constraint in VR environments can affect the depth of soft skills development"*. This points to the potential challenges of developing complex skills within the time limits often associated with VR sessions.

4. INTEGRATED DISCUSSION OF RESULTS

The Analysis section of this study expands on the exploration of the multifaceted impact that integrating virtual reality (VR) into entrepreneurship education might have for soft skills development. Summary of key quantitative and qualitative data are examined providing first understandings of how VR might influence students' entrepreneurial mindset, self-confidence, and skill acquisition. Also, the qualitative data collected from students and experts in the fields of entrepreneurship education and XR technology development, are integrated and analyzed. This integration of both quantitative and qualitative data offered valuable insights on potential benefits and challenges associated with VR training, to be considered as part of future research, and development strategies for its potential of educational implementations.

4.1 Potential impact of VR in Entrepreneurship education for soft-skills development from a quantitative and qualitative perspective (RQ1)

Table 9 reports the general trends observed when implementing VR as part of an entrepreneurship training for soft skills development among students. Also, key insights from students' experiences during the VR training, and the key features of VR technology highlighted by consulted stakeholders, relevant to entrepreneurial soft skills development. Lastly, integrated perspectives about the potential of VR in entrepreneurship education for soft skills development, collected from consulted stakeholders are summarized in this table.

VR has the potential as an aiding method to activate entrepreneurial mindset among students

In analyzing the results of the pilot study on the potential of virtual reality (VR) in entrepreneurship education for soft skills development, interesting insights are revealed into how VR can influence the learning experience and impact the entrepreneurial mindset among students. From a quantitative perspective, the data hints that VR training might have a positive overall impact on students' entrepreneurial mindset, specifically in enhancing their perceived self-confidence regarding opportunity recognition and creativity/innovativeness. With an increase of over 15% in these areas, this suggests that students felt more equipped to identify opportunities and innovate within entrepreneurial contexts following VR training. The fact that these effects show potential for statistical significance (p-values < 5% CL) justifies in-detailed research exploring the efficacy of VR trainings for entrepreneurial education VR.

However, while the findings regarding self-perceived confidence are promising, they also underscore a limitation in the study: the lack of statistical significance in the effects observed on knowledge/awareness and thinking related to opportunity recognition and creativity (p-values > 5% CL). This suggests that while students may feel more confident in their abilities, under the conditions proposed in this study, any corresponding observed increase in actual knowledge or cognitive

engagement with the subject matter was not significant. These results are associated to the limited scope and limitations in the design of this pilot study, hindering the power of this pilot to elaborate on the real effectiveness of implementing VR as part of entrepreneurship education. Future pilots and research must consider refining training content, delivery methods, and data collection instruments to better capture the constructs under study, and better assess the effectiveness of including VR as part of entrepreneurship education for soft skills development.

The qualitative insights gathered from students' experiences with VR training provide a richer context to understand the quantitative findings. First, students described their experiences with VR as engaging, useful, and realistic. This suggests that VR not only captures students' attention but also makes learning relevant and applicable to real-world scenarios. A significant insight from participants was the feeling of skill learning and development. This subjective perception is crucial as it indicates that students felt they were acquiring valuable skills through the VR training, even if this did not translate into measurable knowledge gains product of the 4-hour VR training. Additionally, students reported a self-perceived activation of their entrepreneurial mindset and soft skills, indicating that VR experiences may foster a deeper emotional and cognitive connection to the learning material. These qualitative insights are in alignment with the apparent increase in the perceived self-confidence in opportunity recognition, innovativeness and creativity. The fact that students reported a perceived increased self-confidence from a quantitative and qualitative perspective lends credence to the argument that VR option merits further exploration for the development soft skills in entrepreneurship education.

In line with these findings, consulted stakeholders provided rich and sound perspectives supporting the potential of VR for enhancing soft skills development. Integrated insights points to the ability of VR to facilitate creative expression in a safe environment allowing students to explore innovative ideas without the fear of real-world consequences and risks. The interactive and engaging nature of VR was experienced by students from a sense of joyful learning and was commented by experts as a valuable aspect that might enhance motivation and retention of information in classroom. Additionally, VR technology was seen from students and experts' perspective as a resource that provides opportunities for collaborative creation and idea sharing, allowing students to work together regardless of geographical constraints. Furthermore, the possibility of working in risk-free spaces, enabling students to experiment and learn from their mistakes, was especially considered to be valuable for entrepreneurial education. Implementing VR tools (and the opportunities that enable) might be valuable resources for soft skills development by providing students with experiential learning and helping to make complex concepts more accessible and relatable. Lastly, the engaging and realistic aspects of VR might contribute to improved focus and retention, making it easier for students to remember what they have learned, and ultimately enhance their entrepreneurial mindset.

Table 9. Potential impacts of VR in Entrepreneurship education for soft-skills development from a quantitative and qualitative perspective (RQ1)

<table>
<tr><th colspan="2">Trends observed when implementing VR as part of an entrepreneurship training for soft skills development among students</th></tr>
<tr><td colspan="2">VR training has an apparent overall positive impact on students' entrepreneurial mindset, particularly in terms of perceived self-confidence in opportunity recognition and creativity/innovativeness (>15%)</td></tr>
<tr><td colspan="2">VR training effects seem to have potential for statistical significance on self-perceived confidence of students towards opportunities recognition and creativity and innovation (p-values < 5% CL)</td></tr>
<tr><td colspan="2">Effects observed over knowledge/awareness and thinking regarding these constructs have no potential for significance under the conditions proposed in this study (p-values > 5% CL)</td></tr>
<tr><th colspan="2">Key insights from students' experiences with VR in entrepreneurship education pointing to soft-skills development</th></tr>
<tr><td colspan="2">• Positive, engaging, useful, interactive and realistic.
• Feeling of skill learning and development.
• Self-perceived entrepreneurial mindset and soft skills activation among participants
• Challenges to adapt and technical issues</td></tr>
<tr><th colspan="2">Key features of VR technology highlighted by consulted stakeholders, relevant to entrepreneurial soft skills development</th></tr>
<tr><td>• Creative Empowerment
• Innovative, Interactive, Engaging and Joyful
• Virtual Mobility, Collaboration, Education
• Multi-functional VR Tools
• Enhanced/Augmented/Immersive Experiential Learning</td><td>• Realistic Experience
• Collaborative Creation and Idea Sharing
• Increased Focus and Memory Retention
• Safer Learning Environment
• Unlimited Classroom Space and Materials</td></tr>
<tr><th colspan="2">Potential of VR in entrepreneurship education for soft skills development from the perspectives of consulted stakeholders</th></tr>
<tr><td>Potential Positive Impacts:
• Innovation and Creativity Enhancement
• Enhanced Entrepreneurial Mindset
• Virtual Education Enhancement
• Superior Visualization of Ideas
• Riskless Opportunities for Prototyping
• Greater Soft Skills Development in a Safe Environment
• Increased Multicultural Remote Collaboration
• Innovative Entrepreneurial Education</td><td>Potential for Implementation
• Effective Knowledge Sharing
• Accessibility and Collaboration
• Cost Reduction of Academic Materials
• Enhanced Entrepreneurship Education
• Distance Education Enhancement
• Safety and Comfort
• Positive Student Feedback
• Educator Interest and Curiosity
• State-of-the-Art Pursuit</td></tr>
<tr><td>Potential Negative Impacts:
• Loss of Traditional Method Benefits
• Hindered Acquisition of Real-Life, Entrepreneurial, and Social Skills, if overused.
• Communication Barriers
• Low Teaching Effectiveness
• Ineffective Education Risks
• Challenges for Older Students</td><td>Ways of Integration of VR
• Selective, Targeted, Conditional, Complementary, Supportive, and Case-specific Integration of VR and Traditional Education
• Participation and Engagement of Individuals with special needs
• Enhancing Real-World Scenarios
• Adapted to Course Needs
• Diverse Learning Methodologies</td></tr>
</table>

It's worth noting that quantitative (higher self-confidence, apparent increased knowledge/awareness/thinking) and qualitative findings (positive perceptions of participants) observed from this pilot agree with one larger pilot taken as a referential seminal study for this pilot. PwC in

collaboration with Oculus for Business and Talespin, worked together to develop and implement a virtual reality (VR) training module aimed at enhancing soft skills, particularly inclusive leadership, among new managers (pwc, 2020). The VR pilot project aimed to assess the effectiveness and cost-effectiveness of VR-based training compared to traditional classroom and e-learning modalities in 12 locations across the US. Participants underwent pre-assessments before the training, followed by post-assessments immediately after, and another assessment 30 days later to evaluate retention. Key findings indicate that V-learn, utilizing virtual reality for employee training, outperformed classroom and e-learning methods in teaching soft skills. According to pwc's report, users trained with VR *"were up to 275% 'more confident to act' on what they learned after training, were almost 2.5 times 'more confident in discussing' diversity and inclusion issues after taking the training in virtual reality and nearly three times 'more confident in acting' on diversity and inclusion issues after the VR training*". According to pwc their findings are significant because *"when it comes to soft skills, confidence is a key driver of success. Believing in themselves and having confidence helps learners connect better with others, while also feeling more satisfied with the time spent training".* These findings, although might not be fully extrapolated to the entrepreneurship education in an academic context, supports the need for further investigation on the effectiveness and potential of VR as part of entrepreneurship education for soft skills development.

Despite the inability of the present pilot to demonstrate learning/thinking via assessment, some participants showed spontaneous creative/innovative behaviors during the VR training and highlighted these spontaneous attitudes during the focus group. This indicates that activating entrepreneurial attitudes and learning in VR might indeed take place, even though the implemented assessment is unable to demonstrate it.

VR technology needs to be carefully evaluated when implemented as part of entrepreneurial education

Despite the overall positive feedback, students also faced challenges adapting to the VR environment and encountered technical issues. These hurdles highlight the necessity for adequate training design, and support during VR integration into educational frameworks. Furthermore, stakeholders highlighted several potential negative impacts that need careful consideration when implementing VR in entrepreneurship education. One of the primary concerns is the potential loss of traditional method benefits. Consulted stakeholders stressed that trainers should not be over-reliant on VR and neglect traditional educational methods that offer unique advantages, such as direct human interaction and hands-on learning experiences. Another significant concern was the hindered acquisition of real-life entrepreneurial and social skills. While VR can simulate various scenarios, students might not develop the same level of practical skills and social interactions that they would in real-world settings. If VR is overused, and other methods are neglected, it may impede the natural development of these critical skills.

Communication barriers are also a potential issue. VR environments might create obstacles to effective communication that are not present in face-to-face interactions. This could affect the quality of learning and collaboration among students. There are concerns regarding the overall teaching effectiveness of VR, particularly for older students who may find it challenging to adapt to new technologies. The effectiveness of VR as a teaching tool needs to be critically assessed to ensure it meets the educational needs of all students. The risk of ineffective education is another important consideration. If VR is not implemented correctly, it could lead to poor educational outcomes and even potential job losses due to a lack of preparedness in students. Health and legal concerns also require attention. Issues such as motion sickness can affect students' ability to engage with VR environments, and there are legal implications related to the public use of VR technology that need to be addressed to ensure safe and lawful implementation.

An approach towards the effective Integration of VR

Stakeholders believe that VR can be more effectively implemented in entrepreneurship education through several strategic approaches. Selective and complementary use of VR is essential. VR should target specific areas where it can add value and complement traditional educational methods rather than replace them entirely. This ensures that the benefits of both VR and traditional methods are maximized. Special needs engagement is another critical area where VR can make a significant impact. VR can enhance participation and engagement for individuals with special needs, providing them with tailored learning experiences that traditional methods may not offer. Enhancing real-world scenarios through VR can provide students with practical, hands-on experience that is invaluable for entrepreneurial training. This approach might help bridge the gap between theoretical knowledge and practical application. Course-specific adaptation of VR frameworks ensures that the technology meets the unique needs of each course. This relevance and effectiveness are crucial for the successful integration of VR into educational curricula. Finally, combining VR with diverse learning methodologies can cater to various learning styles and preferences. This approach enhances overall educational outcomes by addressing the different ways in which students learn and retain information.

Key Takeaways about the potential of VR as part of entrepreneurial education

In summary, the results of the pilot study indicate that incorporating VR into entrepreneurship education has the potential to significantly enhance students' soft skills development, particularly in fostering self-confidence related to opportunity recognition and creativity. The qualitative feedback reinforces these findings by emphasizing the engaging and immersive nature of VR, which facilitates skill learning and the activation of an entrepreneurial mindset. However, the findings also highlight the need for deeper scrutiny into the efficacy of VR in entrepreneurship education, addressing technical challenges and ensuring that confidence translates into measurable knowledge gains. Also, careful

consideration of potential negative impacts and the importance of strategic, targeted integration of VR into educational frameworks. By addressing these challenges and leveraging the strengths of VR, educational institutions might enhance entrepreneurial training and better prepare students for the dynamic demands of the entrepreneurial landscape. Overall, the insights gained from this research not only contribute to understanding the impact of VR in education but also lay the groundwork for future studies that can refine and expand upon these initial findings.

4.2 Complexities of VR implementation as part of entrepreneurship education for soft skills development in university settings (RQ2)

Table 10 summarizes the disadvantages and challenges in the deployment, and usage of VR as part of entrepreneurship education for soft skills development in university settings. Also, the expectations, needs, and preconditions of students, trainers, and VR for education developers in relation to the implementation of VR technologies in the context of entrepreneurship soft skills education, are presented.

A Complex Transition to VR: Challenges for Innovating and Sustaining University Environments

Integrated results from students and experts provided revealed that implementing VR in entrepreneurship education for soft skills development in university settings involves various challenges and potential drawbacks. Consulted stakeholders noted several disadvantages of using VR, including the limited usage across different courses, class management challenges, and frequent technical issues. Both students and educators would require significant training, which can be time-consuming and costly. Accessibility issues, complex development processes, and potential over-reliance on VR technology also pose concerns. Excessive use of VR might hinder the acquisition of real-life social and entrepreneurial skills, leading to potential boredom, health issues, and high costs. Additionally, older students may struggle to adapt to VR, and there are risks of reduced teaching efficacy and undesirable effects. Key challenges for large-scale implementation in universities include high costs and budget constraints, and the lack of readiness of the market. Potential job losses, environmental impacts, and technical limitations further complicate VR adoption. Ethical, health and legal concerns, engagement and user experience issues, and the need to demonstrate effectiveness are also significant. Resistance from teachers and institutions, student acceptance, and the integration of VR with traditional methods are critical hurdles.

How to leverage the potential of VR in entrepreneurship education and what might be the Role of Universities?

To overcome these challenges and leverage the full potential of VR in entrepreneurship education, several preconditions must be met, according to consulted stakeholders. These include

creating an open-minded and supportive environment, identifying clear educational use cases, and securing financial and technical resources. Developing specialized facilities and applications, providing comprehensive training and technical support, and conducting cost-benefit analyses are essential. Governmental and institutional support, addressing health and safety concerns, and proving VR's effectiveness through research and pilot studies are also necessary. Adequate preparation and investment are crucial for successful VR integration.

Universities would need to develop a comprehensive and robust institutional strategy. This strategy should involve effective funding mechanisms to ensure the sustainable implementation of VR initiatives. Additionally, forming strategic partnerships and collaborations with industry leaders in the field of VR development can facilitate access to cutting-edge technology, expertise, and cost reductions. Establishing dedicated research departments and teams of developers and trainers will be crucial for creating tailored VR content that meets specific educational needs, and ethical and environmental considerations. Furthermore, universities should invest in ongoing professional development for educators to enhance their understanding and effectiveness in using VR tools. By fostering a culture of innovation and adaptability, universities can effectively integrate VR into their entrepreneurship programs, ensuring that students gain valuable skills and are well-prepared for the challenges of the modern entrepreneurial landscape.

Universities play a crucial role in the successful implementation of VR in entrepreneurship education. They must focus on adapting quickly to industry needs, supporting the development of entrepreneurial skills and mindsets, and utilizing diverse teaching methods. Promoting technological innovation, conducting continuous research, and building a supportive entrepreneurial ecosystem are essential for leveraging VR's potential in education. By addressing these complexities and leveraging VR's strengths, universities can enhance entrepreneurship education and better prepare students for the dynamic demands of the entrepreneurial landscape.

Table 10. Complexities of VR implementation as part of entrepreneurship education for soft skills development in university settings (RQ2)

Disadvantages and challenges in the deployment, and usage of VR as part of entrepreneurship education for soft skills development in university settings	
Disadvantages	**Challenges**
• Limited Usage	• Large-Scale Implementation Difficulties
• Class Management Challenges	• High Costs & Budget Constraints
• Technical Issues	• Market is not ready
• Training Requirements	• Potential Job Loss
• Accessibility Issues	• Environmental Impact
• Complex Development and Implementation	• Technical Limitations
• Technology Dependency	• Health and Legal Concerns
• Potential Hindrance to Social Skills	• Engagement and User Experience
• Risk of Boredom	• Demonstrating Effectiveness
• Undesirable Potential Effects	• Teacher Readiness and Institutional Resistance

<table>
<tr><td>

- Costly
- Challenges for Older Students
- Potential to Limit Teaching Efficacy

</td><td>

- Student Acceptance and Satisfaction
- Expression and Identity in VR
- Integration with Traditional Methods
- Time Constraints and Implementation Complexity
- Market Momentum and Adoption
- Trustful Collaboration

</td></tr>
<tr><td colspan="2">

Other Relevant Remarks

- Advancement with AI
- Realism vs. Perceived Interaction
- Defining Safe Virtual Spaces
- Time for Skill Development
- Concern on long term impact/effects of VR in the industry

</td></tr>
<tr><td colspan="2">Expectations, needs, and preconditions of students, trainers, and VR for education developers in relation to the implementation of VR technologies in the context of entrepreneurship soft skills education</td></tr>
<tr><td>

Key Soft Skills

- Proactiveness
- Resilience
- Innovative Thinking
- Effective Leadership

</td><td>

Preconditions for VR Implementation

- Open-Minded and Supportive Environment
- Clear Educational Use Cases, Demand and Need
- Financial and Technical Resources
- Specialized Facilities and Applications
- Training and Expertise
- Technical Support and Readiness
- Careful Evaluation of Cost-Benefit
- Governmental and Institutional Support
- Health and Safety Considerations
- Proof of Effectiveness
- Preparation and Investment

</td></tr>
<tr><td>

Expectations

- To be an effective tool
- For accelerated learning
- To be realistic
- For professional and business skills development
- Part of future education

</td><td>

Role of Universities

- Market-Driven Focus
- Supporting Skill and Mindset Development
- Diverse Methods and Environments for Skill Development
- Encouraging Technological Innovation
- Research and Innovation
- Entrepreneurial Ecosystem

</td></tr>
</table>

4.3 Contributions for future research of entrepreneurship soft skills development in virtual environments (RQ1 & RQ2)

Some crucial questions are proposed as part of this pilot study and that might feed a comprehensive research program aiming to develop innovative entrepreneurship education programs for soft skills development, with VR technologies.

- **Guiding Question 1:** What significant changes in knowledge / awareness / thinking / attitudes, related to opportunity recognition / creativity / innovativeness, can be observed when incorporating VR training for entrepreneurship soft skills education?
- **Guiding Question 2:** What are the individual influences of VR technologies, VR content, training approaches, and trainers, on the development of entrepreneurship soft skills?
- **Guiding Question 3:** What is the cost/benefit ratio of implementing VR technology as part of an entrepreneurship education program?

- **Guiding Question 4:** How can we better conceptualize the development of entrepreneurial soft skills among students when implementing VR as part of an entrepreneurship education program?

Some theories that might support the development of soft skills when incorporating VR as part of entrepreneurship education

- Transformative Learning Theory
- Experiential Learning Theory
- Theory of Planned Behaviour (TPB)
- Self-determination theory (SDT)
- Grounded Theory
- David McClelland's Achievement Motivation Theory
- NFTE's theory of change and Framework
- Theory – J. Mezirow, and framework
- Outcome-based education theory and the flipped classroom model
- Unified Theory of Acceptance and Use of Technology (UTAUT)

Some actionable recommendation for future pilots about entrepreneurial soft-skills development in VR environments

Based on the limitations of this pilot study, and these guiding questions, here are some actionable recommendations to consider for future research studies:

- Consider larger and more diverse samples to improve the generalizability and statistical power of the findings, including students from different universities, regions, and educational backgrounds to capture a wider range of experiences and perspectives.
- Refine data collection methods including more detailed quantitative and qualitative measures, implementing tests and questionnaires under supervised and controlled environments and following a longitudinal research approach.
- Design longer and more comprehensive VR training sessions to better assess the impact on entrepreneurial soft skills development over time, evaluating the long-term effects of VR training on students' entrepreneurial mindsets and skills.
- Develop and test refined VR content tailored to specific entrepreneurial skills and learning outcomes, collaborating with VR content developers and educators to ensure the content is aligned with entrepreneurship education and research goals.
- Investigate the role of trainers in delivering VR content effectively by comparing outcomes between different trainers with varying levels of experience and training in VR education.
- Explore solutions for improving VR hardware and software reliability, usability, and accessibility for students, including those with special needs, during VR training.
- Research the optimal balance between VR sessions and traditional teaching methods to maximize educational benefits, testing various integration models to identify the most effective ways to combine VR with traditional pedagogies.

- Conduct comprehensive cost-benefit analyses to evaluate the financial viability of VR implementation in educational settings.
- Investigate potential health and safety concerns associated with prolonged VR use, with focus on developing clear guidelines and best practices for safe and effective use of VR in educational environments.
- Engage with students, educators, other university, and industry stakeholders to gather feedback and refine VR training programs.

5. CONCLUSIONS

This explorative qualitative-dominant mixed-method pilot study explored the potential of VR technology in entrepreneurship education, particularly for developing soft skills. Preliminary quantitative results suggested the potential for an increase in self-perceived confidence—over 15% improvement—in opportunity recognition, creativity, and innovativeness among students. Although these results lack statistical significance due to the pilot study's limitations, qualitative feedback indicates that students manifested feelings/attitudes related to entrepreneurial mindset activation, and feelings of skill development during the VR training. Both students and experts acknowledged multiple potential benefits of VR, including enhanced innovation and creativity, superior visualization of ideas, opportunities for prototyping, a safer learning environment, increased multicultural remote collaboration, and improved focus and memory retention.

Despite the potential benefits, implementing VR in entrepreneurship education presents several complexities that require careful consideration. Experts highlighted potential negative impacts, such as the loss of benefits associated with traditional methods, potential hindrance in acquiring real-life entrepreneurial and social skills, and various technical and logistical challenges. High costs, technical limitations, health and legal concerns, and the need for teacher readiness and institutional support were identified as significant hurdles. Additionally, ensuring student and trainers acceptance and satisfaction, integrating VR smoothly with traditional methods, and managing time constraints and implementation complexities are crucial for successful VR adoption.

The limitations of this study, including the short duration of the VR training session, uncontrolled testing environments, and small sample size, emphasize the need for future research with larger samples, refined data collection instruments, and more controlled environments. Future pilots might focus on understanding the specific contributions of technological features, training content, and trainer effectiveness in enhancing entrepreneurial soft skills. Repeating tests with different cohorts and assessing long-term impacts will help validate the observed effects and establish statistical significance.

This pilot study has made significant contributions to the field by providing valuable first insights and practical guidance on integrating VR technologies into entrepreneurial soft-skills development. Conducting VR training for entrepreneurial soft skills development is a unique field of study that is gaining momentum among international institutions, consulting firms, and the start-up community. The qualitative-dominant partially mixed-method approach proposed in this pilot proved to be a potent yet demanding approach to be considered in future research for a comprehensive understanding of the intersection between VR and entrepreneurship education. Furthermore, the research protocols and training content developed as part of this study can serve as a valuable reference for future research, offering a foundation for further exploration and refinement. This study's findings

and methodologies can inspire future research, contributing to the development of effective VR training protocols and content for entrepreneurship education.

Finally, this research re-stated the need for entrepreneurial soft skills development among students, particularly Proactiveness, Resilience, Innovative Thinking, and Effective Leadership; and the need for innovative entrepreneurial education and further research on how VR might be an effective tool for entrepreneurial mindset development. Additionally, this research emphasized how universities can play a crucial role in designing innovative entrepreneurial education to support future student entrepreneurs. By quickly adapting to industry needs, supporting skill and mindset development, and encouraging technological innovation, universities can create diverse methods and environments for skill development. Through ongoing research and fostering an entrepreneurial ecosystem, universities can contribute to better tackling the pressing challenges of our society. Their proactive involvement in integrating ethically VR and other cutting-edge technologies into education is essential for nurturing the next generation of entrepreneurs equipped to address complex global issues effectively.

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APPENDIX A

ETHIC RESEARCH ASSURANCE

A.1 Ethics Committee Approval

UNIWERSYTET EKONOMICZNY W POZNANIU

Uchwała nr 6/2024
Komisji ds. Etyki Badań Naukowych prowadzonych z udziałem ludzi na UEP
z 9 lutego 2024 roku
w sprawie wniosku prof. dr hab. inż. Krzysztofa Walczaka

Komisja ds. Etyki Badań Naukowych prowadzonych z udziałem ludzi na UEP, działając na podstawie Regulaminu pracy Komisji ds. Etyki Badań Naukowych prowadzonych z udziałem ludzi na UEP, w obecności 5 członków, 5 głosami „tak" **zaopiniowała pozytywnie** wniosek 6/2024 prof. dr hab. inż. Krzysztofa Walczaka (złożony 29 stycznia 2024 roku), dotyczący projektu badawczego „COMET – Tworzenie i eksploracja multimedialnych środowisk i materiałów szkoleniowych dla pracowników w Przemyśle 4.0 z zastosowaniem wirtualnej i wzbogaconej rzeczywistości oraz reprezentacji wiedzy dziedzinowej", w ramach którego prowadzone jest badanie „Ewaluacja adaptacyjnych interfejsów użytkownika w środowiskach wirtualnej rzeczywistości", realizowane przez dr. inż. Jakuba Flotyńskiego, mgr. Mikołaja Maika, mgr. Pawła Sobocińskiego, mgr. inż. Michała Śliwińskiego..

Przewodniczący Komisji ds. Etyki Badań Naukowych
prowadzonych z udziałem ludzi na UEP

Szwarc

dr Krzysztof Szwarc

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al. Niepodległości 10
61-875 Poznań
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NIP: 777-00-05-497
REGON 00000-1525

www.ue.poznan.pl

A.2 Informed Consent Students

INFORMED CONSENT FORM – STUDENTS

TITLE OF STUDY
The Potential of VR-based Entrepreneurship Education for Business Soft-Skills Development: A Pilot Study Assessment on Future Student Entrepreneurs

PRINCIPAL INVESTIGATOR
Armando Carias-Henriquez, 91386@student.ue.poznan.pl

This study is organized as part of the Erasmus MSc. Degree in Transition, Innovation, and Sustainability Environment (TISE) jointly offered by Poznan University of Economics and Business (PUEB), Universität für Weiterbildung Krems (UWK), University College Dublin (UCD), Universidade Nova de Lisboa (UNL)

Supervisor UWK: Prof. Dr. Liliya Satalkyna (liliya.satalkina@donau-uni.ac.at)
Contact PUEB: mgr inż. Michał Śliwicki (Michal.Sliwicki@ue.poznan.pl)

PURPOSE OF STUDY
You are being asked to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. Please read the following information carefully. Please ask the principal investigator if there is anything that is not clear or if you need more information.

The purpose of this study is to explore the potential of VR-based entrepreneurship education for business soft-skills development, as part of a pilot study assessment on future student entrepreneurs. The study consists of a novel two-step interdisciplinary research design that integrates perspectives from students and experts in the field of entrepreneurship education. This study aims to answer the primary question: *"What are the potentialities and challenges related to the implementation of VR-based education, in fostering the development of entrepreneurial soft skills among students?"* Through this research, we aim to delve into the intricacies that shape the development of entrepreneurial skills within VR environments. Additionally, we seek to explore the hurdles that come with integrating these methods into university settings. By doing so, we hope to enhance the efficacy of entrepreneurial education and foster the growth of more resilient and sustainable future student entrepreneurs. The study unfolds in two main phases. Firstly, a VR training program with students, which includes a pre and post-test, along with a survey and a focus group session. Secondly, an interview round with experts in the fields of entrepreneurship education, research, and VR technology development.

STUDY PROCEDURES

If you choose to volunteer for this study, you will proceed through the following steps:

1. **Survey**: Complete an online survey consisting of 13 questions investigating demographics, knowledge, attitudes, and initiatives related to entrepreneurship and VR technology (a maximum of 15 min)
2. **Assessment Test**: Answer an assessment 10-question test before and after the VR training to evaluate the impact of the training (a maximum of 20 min)
3. **VR Training**: Participate in VR training focused on developing entrepreneurial soft skills (a maximum of 2 hours)

4. **VR-based Focus Group**: Participate in a VR-based focus group discussion involving 3- 4 students (30 min).

The VR training and VR-based focus group will take place in a virtual environment facilitated by MeetingVR, utilizing Oculus VR headsets. The researcher will capture the session and images of the virtual activity, storing this data on a password-protected hard drive for security. To safeguard your identity and personal information, avatars, pseudonyms, and temporary accounts will be employed in the virtual environments, ensuring full anonymization.

Furthermore, survey and test responses will be stored on a secure, password-protected Google Drive by the researcher.

RISKS

Participating in this study poses minimal risks or harms. However, participants may encounter discomfort such as fatigue, eye strain, headaches, or motion sickness. To address these potential issues, the VR training will be conducted in short sessions lasting less than 40 minutes each, with frequent breaks to allow participants to rest and disconnect from the virtual environment. Participants are also free to request additional breaks or withdraw from the training at any time. Safety precautions will be in place to limit movement within a designated area, and most activities will involve sitting to minimize the risk of physical harm to objects in real-world surroundings.

The virtual environment will simulate an office building, complete with furniture and chairs. Participants have the option to refrain from answering any questions during the Survey, Test, or Focus Group, and they can choose to end their involvement in the study at any point.

BENEFITS
Participating in this study provides valuable insights into entrepreneurship education, entrepreneurial skills development, and virtual reality platforms. Your involvement will contribute to a comprehensive understanding of the potentialities and complexities of implementing VR-based education for developing entrepreneurial soft skills among students. Furthermore, this knowledge will inform the design of innovative curricula for entrepreneurship education in university settings.

As part of the training, you will engage in a highly engaging and immersive experience that will enhance your entrepreneurial mindset. You will have the opportunity to learn and manipulate virtual reality platforms, connect with fellow student participants, and receive additional support throughout the process. Moreover, upon completion of the training, you will receive a certificate of attendance as recognition of your participation.

Your involvement is highly valued and greatly contributes to the advancement of more efficient and innovative entrepreneurial education practices.

CONFIDENTIALITY

Your involvement in this research will be treated with the utmost confidentiality. Your participation will be anonymized, and all personal information collected during the survey, test, focus group, and training will be kept strictly confidential. Specific personal data and

communications will be anonymized and used solely for research purposes. Measures to preserve confidentiality include:

- All information provided will be held in strict confidence and securely safeguarded.
- Participants will be assigned pseudonyms for anonymity in all research notes and documents.
- The findings of the study may be disseminated by the respective universities involved. Any information shared by participants may be included in these publications, with participants identified only by pseudonyms and avatars to protect their identity.
- Notes, focus group transcriptions, and any other participant-related information will be stored on a secure Google Drive. This data will be retained for one year and then securely destroyed.

Participant data will remain confidential, except in cases where the researcher is legally mandated to report specific incidents, such as cases of abuse or suicide risk.

CONTACT INFORMATION

Should you have any inquiries concerning this study or encounter any adverse effects from your participation, you are encouraged to reach out to the investigator, whose contact details are available on the initial page. For inquiries regarding your rights as a research participant or any issues that may arise that you are uncomfortable discussing with me, please feel free to contact one of the university professors supervising this research.

VOLUNTARY PARTICIPATION

Participation in this study is entirely voluntary, and the decision to take part is entirely yours. If you choose to participate, you will be requested to provide consent by signing a consent form. Even after providing consent, you retain the freedom to withdraw from the study at any point and for any reason, without any repercussions on your relationship, if any, with the researcher. Should you opt to withdraw before the completion of data collection, your data will either be returned to you or securely disposed of.

CONSENT

I have read, and understand the provided information, and I have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's signature _____ Date _____
Principal Investigator's signature _____ Date _____

A.3 Informed Consent – Experts

INFORMED CONSENT FORM – EXPERTS

TITLE OF STUDY
The Potential of VR-based Entrepreneurship Education for Business Soft-Skills Development: A Pilot Study Assessment on Future Student Entrepreneurs

PRINCIPAL INVESTIGATOR
Armando Carias-Henriquez, armando.cariashenriques@ucdconnect.ie

This study is organized as part of the Erasmus MSc. Degree in Transition, Innovation, and Sustainability Environment (TISE) jointly offered by Poznan University of Economics and Business (PUEB), Universität für Weiterbildung Krems (UWK), University College Dublin (UCD), Universidade Nova de Lisboa (UNL)

Supervisor UWK: Prof. Dr. Liliya Satalkyna (liliya.satalkina@donau-uni.ac.at)

PURPOSE OF STUDY
You are being asked to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. Please read the following information carefully. Please ask the principal investigator if there is anything that is not clear or if you need more information.

The purpose of this study is to explore the potential of VR-based entrepreneurship education for business soft-skills development, as part of a pilot study assessment on future student entrepreneurs. The study consists of a novel two-step interdisciplinary research design that integrates perspectives from students and experts in the field of entrepreneurship education. This study aims to answer the primary question: ***"What are the potentialities and challenges related to the implementation of VR-based education, in fostering the development of entrepreneurial soft skills among students?"*** Through this research, we aim to delve into the intricacies that shape the development of entrepreneurial skills within VR environments. Additionally, we seek to explore the hurdles that come with integrating these methods into university settings. By doing so, we hope to enhance the efficacy of entrepreneurial education and foster the growth of more resilient and sustainable future student entrepreneurs. The study unfolds in two main phases. Firstly, a VR training program with students, which includes a pre and post-test, along with a survey and a focus group session. Secondly, an interview round with experts in the fields of entrepreneurship education, research, and VR technology development.

STUDY PROCEDURES

If you choose to volunteer for this study, you will proceed through the following step:

1. **Interview round:** Participate in an interview round focused on exploring the potential of VR-based entrepreneurial education for business soft-skills development (a maximum of 1 hour). As part of the interview, we will discuss about the potentialities, challenges, advantages, and disadvantages, and of implementing VR training in university settings.

The interview will be conducted in Zoom. The researcher will video-record the session and images of the activity, storing this data on a password-protected Google Drive by the researcher. To safeguard your identity and personal information, pseudonyms will be used ensuring full anonymization.

RISKS

Participating in this study poses minimal risks or harms. Participants are also free to withdraw from the interview at any time.

BENEFITS
Participating in this study provides valuable insights into entrepreneurship education, entrepreneurial skills development, and virtual reality platforms. Your involvement will contribute to a comprehensive understanding of the potentialities and complexities of implementing VR-based education for developing entrepreneurial soft skills among students. Furthermore, this knowledge will inform the design of innovative curricula for entrepreneurship education in university settings.

Your involvement is highly valued and greatly contributes to the advancement of more efficient and innovative entrepreneurial education practices.

CONFIDENTIALITY

If you opt to keep your identity fully anonymous, your involvement in this research will be treated with the utmost confidentiality. Your participation will be anonymized, and all personal information collected during the interview will be kept strictly confidential. Specific personal data and communications will be anonymized and used solely for research purposes. Measures to preserve confidentiality include:

- All information provided will be held in strict confidence and securely safeguarded.
- Participants will be assigned pseudonyms for anonymity in all research notes and documents.
- The findings of the study may be disseminated by the respective universities involved. Any information shared by participants may be included in these publications, with participants identified only by pseudonyms to protect their identity.
- Notes, transcriptions, and any other participant-related information will be stored on a secure Google Drive. This data will be retained for one year and then securely destroyed.

Participant data will remain confidential, except in cases where the researcher is legally mandated to report specific incidents, such as cases of abuse or suicide risk.

Alternatively, if you agree to disclose your identity, you will be requested to provide consent to use pieces of these interviews for academic communication purposes related solely to this study. Extracts of the interview in the form of videos or pictures might be published on social media of the research team participating in this study, and universities part of the TISE consortium. The purpose of this communication is to disseminate information about the study among the research community.

CONTACT INFORMATION

Should you have any inquiries concerning this study or encounter any adverse effects from your participation, you are encouraged to reach out to the investigator, whose contact details are available on the initial page. For inquiries regarding your rights as a research participant or any issues that may arise that you are uncomfortable discussing with me, please feel free to contact one of the university professors supervising this research.

VOLUNTARY PARTICIPATION

Participation in this study is entirely voluntary, and the decision to take part is entirely yours. If you choose to participate, you will be requested to provide consent by signing a consent form. Even after providing consent, you retain the freedom to withdraw from the study at any point and for any reason, without any repercussions on your relationship, if any, with the researcher. Should you opt to withdraw before the completion of data collection, your data will either be returned to you or securely disposed of.

CONSENT FOR PARTICIPATING IN THE STUDY

I have read, and understand the provided information, and I have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's signature _____ Date _____
Principal Investigator's signature _____ Date _____

CONSENT FOR DISCLOSING YOUR IDENTITY AND SHARING MEDIA WITH YOUR IDENTITY

I have read, and understand the provided information, and I have had the opportunity to ask questions. I consent and authorize the use of extracts of this interview in the form of audio or video, for communication purposes in social media. I understand that by doing so my identity will be fully disclosed. However, I am free to withdraw at any time, without giving a reason and without cost, and any video recording disclosing my identity will not be considered in the final publication. I understand that I will be given a copy of this consent form, and a copy of the final video for my approval before publication. I voluntarily agree to take part in this study.

Participant's signature _____ Date _____
Principal Investigator's signature _____ Date _____

APPENDIX B

RECRUITMENT OF PARTICIPANTS

B.1 Recruitment Email for VR Training

Join Our VR Adventure: Develop Your Entrepreneurial Skills in Virtual Reality!

Hi there!

My name is ***Armando CARIAS***, an international student in the Erasmus M.Sc. Degree in Transition, Innovation, and Sustainability Environments (TISE), jointly offered by UNL (Portugal), UCD (Ireland), PUEB (Poland), and UWK (Austria).

If you're a student with a keen interest in entrepreneurship and extended reality technologies, I'd like to extend an invitation for you to participate in an engaging training session designed to enhance your entrepreneurial mindset and skill set.

About the Entrepreneurship VR Training

As part of our study to investigate the ***potential of virtual reality technology in enhancing entrepreneurial skills among young students***, you will take part in an immersive VR training, and learn about key domains of entrepreneurial thinking.

The planned content of the VR training will revolve around the following topics:

Opportunity Thinking	Creativity & Innovation Thinking
• Opportunity: Recognition, Discovery, and Creation • Identifying Entrepreneurial Opportunities • Opportunities Essence • Your Turn! VR Brainstorming and Pitch • Opportunity Canvas	• Creativity and Innovation • Brainstorming • Idea Maps • Design Thinking: A Framework for Creativity and Innovation • Your Turn! VR-based Design and Pitch

What will you get?

1. **Enhance your entrepreneurial mindset** and practical skills applicable to your academic and professional pursuits.
2. **Connect with fellow participants and professionals**, expanding your network for potential collaborations.
3. **Receive a certificate** recognizing your active participation and completion of the VR training program.
4. **Gain hands-on experience in Virtual Reality** technology and environments, a skill increasingly valued in today's tech-driven world.
5. **Follow-up online session** to incorporate the learnings into your professional and entrepreneurial career
6. **Access to entrepreneurial practical resources** for entrepreneurial skills and competencies development

When and Where?

Slots for the VR training are **extremely limited** and will be available from the **20th to the 24th of May 2024**, from 10 am to 6 pm. Training will occur at Poznań University of Economics and Business. Enrolled participants will receive specific guidelines about the training through email, and will be asked to specify their preferred date and time slot for the training.

How can I secure a spot in the VR Training?

To Enrol in the VR training and get more information about the study **Just Click Here** or contact me at 91386@student.ue.poznan.pl

Thanks for reading, I appreciate you.

Armando CARIAS
Student in the Erasmus M.Sc. in Transition, Innovation, and Sustainability Environments (TISE).

B.2 Promotion of VR training on social media

Ticket sales end soon

Monday, May 20

VR-based Training for Entrepreneurial Skills Development

Join Our VR Adventure: Develop Your Entrepreneurial Mindset in Virtual Reality!

VR Training for Entrepreneurship Mindset — 1

Free

Reserve a spot

By BiEm: Entrenando Emociones — Following

Select date and time

Monday, May 20 · 10am - 2pm CEST
More options

Monday May 20 10:00 AM	Monday May 20 2:00 PM	Tuesday May 21 10:00 AM	Tuesday May 21 2:00 PM	Wednesday May 22 2:00 PM	More options

Location

Poznań University of Economics and Business al. Niepodległości 10 | 61-875 Poznań, building D
10 Aleja Niepodległości 61-875 Poznan Poland
Show map

About this event

Are you ready to embark on an exciting journey into the world of entrepreneurship?

Do you want to develop essential skills that will set you apart in today's competitive business landscape?

If so, we invite you to participate in our groundbreaking study exploring the potential of VR-based entrepreneurial education!

About the VR Training - Study

Our study aims to investigate the potential of virtual reality technology in enhancing entrepreneurial mindset among young students. If you enroll, you will take part in an immersive VR training, and learn about key domains of entrepreneurial thinking, including:

- Opportunity Recognition and Initiative
- Creativity and Innovation
- Critical Thinking and Problem Solving, and
- Risk-taking

Expected General Agenda* (< 3h)

1. Reception and General Information
2. VR session on Opportunity Recognition
3. VR session on Creativity and Innovation
4. Final Test
5. VR-based focus group

*You will receive a detailed agenda of the training upon enrolment

Benefits of Participation:

- **Skill Development:** Enhance your entrepreneurial mindset and gain practical skills applicable to your academic and professional pursuits.
- **Networking Opportunities:** Connect with fellow participants and professionals, expanding your network and potential collaborations.
- **Certificate of Participation:** Receive a certificate recognizing your active participation and completion of the VR training program.
- **Valuable Experience:** Gain hands-on experience in Virtual Reality technology and environments, a skill increasingly valued in today's tech-driven world.
- **Follow-up online session** to incorporate the learnings into your professional and entrepreneurial career
- **Access to Entrepreneurial Practical Resources** for entrepreneurial skills and competencies development

Please read the FAQs for more details about the VR training

B.3 Other Communications with VR Training Participants

Hi [redacted]

Greetings and welcome to The VR Training for Entrepreneurial Soft Skills Development!

This email serves as a confirmation of your booking for **Thursday 23rd at 10 am.**

To gain deeper insights into the effectiveness of our program, I kindly request your participation in the following pre-program assessment that will **confirm your place for the VR training**. This assessment aims to gauge your current level of knowledge and confidence across specific areas.

Upon completion of the program, I will ask you to undertake a similar assessment to evaluate the impact of VR Training for Entrepreneurship Skills Development experience on your knowledge and confidence development.

The pre-program assessment comprises two small steps: (1) Survey, and (2) Pre-Test. **You must complete both** to confirm your place in the training.

We trust that this assessment will serve as a valuable tool for self-reflection, allowing you to identify your strengths and areas for further growth.

Please access the two-part assessment through the links provided below:

(1) Survey
(2) Pre-Test

You will receive detailed instructions about the training and location once completed the Survey and Pre-Test.

Should you encounter any issues with completing the two-part assessment, please let me know.

Looking forward to meeting you next week.

Warm regards,

Armando CARIAS
MSc. In Transition, Innovation, and Sustainable Environments (TISE)
91386@student.ue.poznan.pl

Hi [redacted]

Thank you for answering the pre-program assessment and securing your place in the VR training for Entrepreneurial Soft Skills development.

Please find below more details about the venue for the VR training:

Uniwersytet Ekonomiczny w Poznaniu
Building D, Lab Computer KTI (room 1.19)
Department of Information Technology
Poznań University of Economics and Business
al. Niepodległości 10 | 61-875 Poznań
Google Maps

Expected General Agenda (< 3h)

- Reception, General Information, and basic training (20min)
- VR session on Opportunity Recognition (45 min)
- Break (15 min)
- VR session on Creativity and Innovation (45 min)
- Final Test (<15min)
- VR-based focus group (30 min)

The planned content of the VR training will revolve around the following topics:

Opportunity Thinking	Creativity & Innovation Thinking
• Opportunity: Recognition, Discovery, and Creation • Identifying Entrepreneurial Opportunities • Opportunities Sources • Your Turn! VR Brainstorming and Pitch • Opportunity Canvas	• Creativity and Innovation • Brainstorming • Idea Maps • Design Thinking: A Framework for Creativity and Innovation • Your Turn! VR-based Design and Pitch

Please make sure to arrive **15 min** before your session starts, to avoid affectations to other participants, and delay of the session. Also, please come with comfortable clothes according to local weather conditions.

Before the VR training, you will receive safety measures information, and a voluntary participation informed consent for you to sign.

If you have additional questions or encounter any issues, please don't hesitate to contact me on my direct WhatsApp here Armando.

Finally, we still have slots available! You're allowed to share the information about this unique VR training with your colleagues. Perhaps some of your friends would love to join.

I eagerly look forward to meeting you next week.

I appreciate you.

Armando CARIAS
Student in the Erasmus M.Sc. in Transition, Innovation, and Sustainable Environments (TISE).
91386@student.ue.poznan.pl

Dear Prof [redacted]

I hope this message finds you well. My name is Armando CARIAS, a student in the Erasmus MSc. Degree in Transition, Innovation, and Sustainability Environments (TISE), jointly offered by UCD (Ireland), PUEB (Poland), UNL (Portugal), and UWK (Austria).

Following Prof. Liliya Satalkina's recommendation, I am writing to formally request your valuable support and I would like to invite you to participate in an interview round expected from the **27th to the 31st of MAY**. Your experience and perspective would be extremely beneficial to my MSc. thesis project.

Here is a bit more of the context:
I'm conducting a novel research thesis study as part of my MSc. degree, titled ***"The potential of VR-based entrepreneurship education for business soft-skills development: A pilot study assessment on future student entrepreneurs".***

The study seeks to bring together varied perspectives to address the subject in a comprehensive manner. In the first stage, the study contemplates VR-based training with students to collect valuable quantitative and qualitative data. In the second stage, I will conduct an interview round to collect perspectives and insights from experts, regarding the potentialities and challenges of using VR training for entrepreneurial skills development among students.

How might you support this novel study?

Please kindly let me know as soon as possible about your interest and availability for the week of the 27th to the 31st of MAY. The interview is expected to last 1 hour and will revolve around your perspectives on the potentialities and challenges related to the implementation of VR technologies for entrepreneurial education. Feel free to suggest a day and time that works best for you, and we will make it possible. I would be extraordinarily grateful for your presence and contributions.

If you have any questions or need more information about my study, please don't hesitate to get in touch.

I appreciate your time and, hopefully, your participation!

Best Regards,

Armando Carias
MSc. in Transition, Innovation, and Sustainability Environments (TISE)

B.4 Recruitment Email to Professors and Experts

Dear Professor,

I hope this message finds you well. My name is Armando CARIAS, a student in the Erasmus MSc. Degree in Transition, Innovation, and Sustainability Environments (TISE), jointly offered by UCD (Ireland), PUEB (Poland), UNL (Portugal), and UWK (Austria). I am writing to request your valuable support and I would like to invite you to participate in an interview anytime this week or the next one. Your experience and perspective would be extremely beneficial to my MSc. thesis project.

Here is a bit more of the context:

I'm conducting a novel research thesis study as part of my MSc. degree, titled ***"The potential of VR-based entrepreneurship education for business soft-skills development: A pilot study assessment on future student entrepreneurs".*** In my study, I'm inquiring about the potentialities, challenges, advantages, and disadvantages of using virtual reality (VR) technologies for entrepreneurial education among students. The research design includes a survey, pre-training and post-training assessments, VR training, a VR-based focus group with students, and expert interviews.

The study seeks to bring together varied perspectives to address the subject in a comprehensive manner. In the first stage, the study contemplated VR-based training with students to collect valuable quantitative and qualitative data. In the second stage, I'm conducting an interview round to collect perspectives and insights from experts in entrepreneurship education and training, regarding the potentialities and challenges of using VR training for entrepreneurial skills development among students. Please find attached to this email a document with some working definitions.

A summary of my research and outcomes of my VR-based training for Entrepreneurship Education:

Two weeks ago, I conducted a VR-based Entrepreneurship Training as part of my research thesis. Please find attached to this email two extracted videos of some of the activities conducted during my VR training with students. Additionally, please find attached some pictures of the VR training for your reference.

During the VR training, thirteen (13) students gained experiential knowledge in three crucial constructs for developing an entrepreneurial mindset: Opportunity Recognition, Creativity, and Innovativeness. By combining VR-based teaching with brainstorming, idea pitching, canvas working, sketching, and other collaborative work using the tools available in the virtual environment, students engaged in a pioneering experience that contributes to rethinking entrepreneurship education.

The ultimate goal of my research is to contribute to the development of innovative entrepreneurship education methods to increase students' chances of becoming future entrepreneurs, enhance the survival rate of future startups, and contribute to the success rate of students as intrapreneurs in organizations.

Additional Information for Our Interview

Finally, I'm attaching as well the protocol of our interview for your reference. I trust that sharing the protocol with you will help you better prepare for the interview, and have more clarity on the research design, research questions, and the subject matter questions of the interview. Also, please find attached the informed consent for you to read and sign. You can send a scanned version with your signature.

As part of the informed consent, you might choose to keep your identity and contribution anonymous, or you might opt to voluntarily disclose your identity. If you do the last one, you will authorize to use extracts of the interview as part of a video that will collect insights from experts, for communication purposes about the study through social media of the universities involved.

If you have any questions or doubts before our interview, please do let me know. Additionally, we could briefly discuss any other inquiry before we start our interview.

I thank you in advance for your kind consideration and precious time.

Look forward to speaking with you this Monday,

My best regards,

Armando CARIAS
MSc. in Transition, Innovation, and Sustainability Environments (TISE)

A Glimpse of the VR Training
VR-Based Focus Group (Extract)
VR-Based Training (Perspective of the trainer) - No Audio

APPENDIX C

DATA COLLECTION INSTRUMENTS

C.1 Survey (students)

Questions Responses 4 Settings

(1)

Entrepreneurship VR-training Survey

Thank you for participating in our VR training program aimed at enhancing entrepreneurship skills. This survey aims to gauge your interests and initial knowledge before the training begins. Your responses will remain strictly confidential and will only be used for the purposes of analysis associated with this study.

This training initiative is part of a research project titled "The Potential of VR-based Entrepreneurship Education for Business Soft-Skills Development: A Pilot Study Assessment on Future Student Entrepreneurs," led by Armando CARIAS, a student in the MSc. Degree in Transition, Innovation, and Sustainability Environments (TISE) program, under the supervision of the KTI at Poznan University of Economics and Business (PUEB).

Please note that all data collected will be anonymized and stored securely. It will be deleted after one year from the completion of the study. Your participation is greatly appreciated and will contribute to our understanding of VR-based entrepreneurship education.

Please let me know if you have any further questions at 91386@student.ue.poznan.pl

This form is automatically collecting emails from all respondents. Change settings

(2)

Name *

Short-answer text

Age *

Short-answer text

Gender *

- Female
- Male
- Prefer not to say
- Other...

Are you currently enrolled as a student? If yes, please specify the name of your program and university *

Short-answer text

(3)

What motivated you to attend this training? Multiple selections allowed *

- To gain knowledge about VR technologies and platforms
- Gain insights into entrepreneurship and enhance my entrepreneurial skills
- Other...

Have you used any virtual reality (VR), extended reality (XR), or similar enhanced reality platforms before? If yes, please specify the platform and context of usage. *

Long-answer text

Do you have any expectation on the role of technologies such as VR as a didactical tool in Entrepreneurial Education? Please specify *

Long-answer text

Do you have any special needs or conditions that may affect your ability to use virtual reality tools? If yes, please briefly specify. *

Short-answer text

(4)

In your own words, how would you define entrepreneurship? Please feel free to provide examples or share any personal experiences that help illustrate your definition.

Long-answer text

Have you previously participated in any courses focused on entrepreneurship development? If yes, please specify. *

Long-answer text

Have you ever thought about a product, or service that you believe could benefit society? If so, please provide a brief explanation of the idea and any steps you've imagined or taken to bring it to fruition thus far. *

Long-answer text

I'm currently thinking, taking actions, or trying in any way to ideate/ create a business *

	1	2	3	4	5	
Strongly disagree	○	○	○	○	○	Strongly agree

What personal skills or competencies would you be interested in developing to become a successful entrepreneur? *

C.2 VR Training test (students)

(1)

Entrepreneurship VR-training Pre-Test

Thank you for participating in our VR training program aimed at enhancing entrepreneurship skills. This test aims to gauge your initial knowledge before the training begins. Your responses will remain strictly confidential and will only be used for the purposes of analysis associated with this study.

This training initiative is part of a research project titled "The Potential of VR-based Entrepreneurship Education for Business Soft-Skills Development: A Pilot Study Assessment on Future Student Entrepreneurs," led by Armando CARIAS, a student in the MSc. Degree in Transition, Innovation, and Sustainability Environments (TISE) program, under the supervision of the KTI at Poznan University of Economics and Business (PUEB).

Please note that all data collected will be anonymized and stored securely. It will be deleted after one year from the completion of the study. Your participation is greatly appreciated and will contribute to our understanding of VR-based entrepreneurship education.

Please let me know if you have any further questions at 91386@student.ue.poznan.pl

This form is automatically collecting emails from all respondents. Change settings

I can recognize opportunities and turn them into entrepreneurship ideas *

	1	2	3	4	5	
Strongly disagree	○	○	○	○	○	Strongly agree

(2)

Which of the following can be sources of opportunities for entrepreneurial ideas? *

- Products, services, process and organization improvement
- Market size and localization, population, and geography
- People's needs, market gaps and trends, personal and work experiences, special skills
- Cultural events, political activities, and tourism seasons

With the rise of remote work, there's an increasing demand for ergonomic home office furniture. What opportunity may arise from this situation? *

- Develop an online platform to connect freelance designers with customers looking for customized home...
- Open a chain of physical stores specializing in traditional office furniture.
- Launch a line of luxury home office furniture targeting high-income earners.
- Invest in a traditional office furniture manufacturing company.

Climate change awareness is growing, leading to increased demand for sustainable products. *

- Create a line of eco-friendly reusable household products, such as bamboo utensils and cloth grocery ba...
- Start a coal mining operation to meet the demand for energy.
- Invest in companies known for their unsustainable practices to encourage them to change.
- Open a fast-food chain using only biodegradable packaging.

(3)

I know how to use methodologies to recognize opportunities and turn them into entrepreneurial ideas

	1	2	3	4	5	
Strongly Agree	○	○	○	○	○	Strongly Disagree

How confident do you feel of your creativity and innovation skills to turn ideas into innovative solutions? *

	1	2	3	4	5	
Not confident at all	○	○	○	○	○	Highly confident

I'm familiar with the steps to generate and evaluate entrepreneurial ideas *

	1	2	3	4	5	
Highly familiar	○	○	○	○	○	Not familiar at all

Some of the steps in the Design thinking process are *

- Ideate, Explore, Register, Execute
- Define the Opportunity, Ideate, Prototype, and Implement
- Brainstorm, Select, Evaluate, and Sell
- Recognize, Identify, Create, and Enact

(4)

You are organizing a charity event to raise funds for a local animal shelter. However, you face the challenge of attracting attendees and donors. What innovative solution could you propose to increase participation and donations? *

- Implement a virtual reality (VR) experience at the event where attendees can interact with rescued anima...
- Host a traditional bake sale with homemade treats to entice people to donate
- Distribute flyers in the neighborhood to spread awareness about the event
- Partner with local businesses to offer discount vouchers for attendees who donate

Which one of the following statements is true? *

- Creativity is to evaluate and communicate ideas
- Creativity is a process, a cyclic human process in fact
- Innovation can be described as creativity implemented
- Innovation is putting ideas into perspective

C.3 VR-Based Focus Group Protocol (students)

VR Focus Group Protocol and Questions

TITLE OF STUDY:
The Potential of VR-Based Entrepreneurship Education for Business Soft-Skills Development: A Pilot Study Assessment on Future Student Entrepreneurs

OBJECTIVES OF THE FOCUS GROUP:

Gather valuable insights from students about their experiences and views on the use of VR in entrepreneurship education. Expected outcomes include:

- Personal experiences during the VR training
- Opinions on the implementation of VR technologies in educational settings
- Perceptions of the impact of VR training on entrepreneurial skill development
- Advantages and challenges associated with VR-based learning

Introductory Information:

As part of your voluntary participation in the VR training, you agreed to partake in this research study. Your involvement was through a selection process following an advertised solicitation. This study investigates the potential of VR-based entrepreneurship education for business soft-skills development among future student entrepreneurs. This focus group is a voluntary part of the study conducted by Armando Carias-Henriquez, a student in the Erasmus MSc. Degree in Transition, Innovation, and Sustainability Environments (TISE), offered by UCD (Ireland), UWK (Austria), UNL (Portugal), and PUEB (Poland).
Before we begin, I will provide some basic information about this study and request your consent to participate. If you agree, you will answer questions about your experience after the VR training. This session will take approximately 30 minutes.
Participation is strictly voluntary. This session will be recorded for future review and analysis and may be published as raw data. To maintain confidentiality, please do not use your name or the names of others. You may skip any question or terminate your participation at any time.

Do you have any questions about this process before we begin?
Answer 1: No
Answer 2: Yes

Statement of Consent in the VR Environment Before Starting the Recording:
Has the participant read and agreed to the Informed Consent Form prior to consenting to participate in this focus group session?
Answer 1: Yes
Answer 2: No (If no, provide the consent form and obtain the participant's signature)

Transcript Outline:
Begin Recorder

Introduction to Focus Group:

Researcher: Hello and good morning/afternoon. My name is Armando Carias. I am an Erasmus MSc. student in the Transition, Innovation, and Sustainability Environments (TISE) program, jointly offered by UCD (Ireland), UWK (Austria), UNL (Portugal), and PUEB (Poland). I am conducting a study on the Potential of VR-Based Entrepreneurship Education for Business Soft-Skills Development among future student entrepreneurs. This session is being conducted in MeetingVR at AM/PM on_____ (date). It is being recorded, and field notes may be taken for future analysis and/or publication as raw data.
To protect your identity, no names or personally identifiable information will be requested during this focus group, unless voluntarily provided. Participants will be identified only as "Participant."
Participant, have you read and agreed to the consent information regarding this research study?

Participant: [Yes/No] (If yes, continue. If no, complete the statement of consent.)

Researcher: Now that we have recorded your consent, we will begin the focus group. Remember, you may end this session at any time without consequence. All questions are voluntary and can be skipped if you wish.

Researcher: The following questions are designed to explore key concepts of this study. These open-ended questions allow you to share any relevant information. If any question is unclear, please ask for clarification. Are you ready to continue?

Participant: [Yes/No] (If no, please let me know when you are ready to continue.)

SUBJECT MATTER: ABOUT THE EXPERIENCE OF PARTICIPANTS DURING THE VR TRAINING

Researcher:
How would you describe your **personal experience** with the VR training for entrepreneurial skills development?

Participant: [Answer]

Researcher:
Can you elaborate on what aspects you found **most enjoyable** and what aspects you found **less favorable** about the VR training?

Participant: [Answer]

SUBJECT MATTER: ABOUT THE PERSPECTIVES OF PARTICIPANTS ON IMPLEMENTING VR TECHNOLOGIES AND ENVIRONMENTS FOR ENTREPRENEURIAL EDUCATION

Researcher:
Do you believe **universities** should incorporate VR technologies and experiences to enhance the learning of entrepreneurial skills? Please provide your reasoning.

Participant: [Answer]

Researcher:

4. Considering your experience in this VR training, to what extent do you think this can **impact** (enhance or limit) the development of entrepreneurial skills among students? Please share your insights.

   Participant: [Answer]

   Researcher:
5. What **advantages** might VR-based education have over *traditional education* (e.g.: In-person instruction, and interaction, physical classrooms, materials, "unplugged", etc.) to enhance entrepreneurial skills, such as opportunity recognition, creativity, and innovation, among students?

   Participant: [Answer]

   Researcher:
6. What **disadvantages** might VR-based education have over *traditional education* (e.g…) to enhance entrepreneurial skills, such as opportunity recognition, creativity, and innovation, among students?

   Participant: [Answer]

   Researcher:
7. As a student, what **challenges and difficulties** do you foresee in using VR technology to enhance entrepreneurial skills among students?

   Participant: [Answer]

   Conclusion
   Researcher: That is the end of the scheduled focus group questions. Do you have any comments or questions for me now that we have concluded?

   Participant: [Yes/No]. If yes, [Answer].

   Researcher: I want to thank you again for your participation in this focus group. You can always contact the researcher and university's supervisors through the contact details provided in case you have any questions or concerns throughout the research process. I will now stop the recording of this interview.
   - Turn off the recorder

   Wrap-Up
   This concludes this portion of the research study. The researcher, Armando CARIAS, would like to thank you for assisting in better understanding the potential of VR-based entrepreneurship education for business soft-skills development: A pilot study assessment on future student entrepreneurs.

   Researcher: Armando CARIAS-HENRIQUEZ
   Student in the Erasmus MSc. Degree in Transition, Innovation, and Sustainability Environments (TISE)

   Please contact the researcher at 91386@student.ue.poznan.pl if you have any questions or concerns that may arise. As a reminder, you may also contact Prof. Dr. Liliya Satalkina at liliya.satalkina@donau-uni.ac.at for any issues regarding the ethical review process.
   Thank you again. Your participation is greatly appreciated!

C.4 Interview Protocol with Professors and Experts

Interview with Experts - Protocol and Questions

TITLE OF STUDY:
The Potential of VR-Based Entrepreneurship Education for Business Soft-Skills Development: A Pilot Study Assessment on Future Student Entrepreneurs

OBJECTIVES OF THE INTERVIEW ROUND:

Gather insights from experts about their views and perspectives on the use of VR in entrepreneurship education. Expected outcomes include:

- Opinions on the implementation of VR technologies in educational settings
- Perceptions of the impact of VR training on entrepreneurial soft-skill development
- Advantages, disadvantages, and challenges (ev. barriers) associated with VR-based learning (incl. individual and institutional perspectives)

Introductory Information:

As part of your voluntary participation in the interview round with experts, you agreed to partake in this research study. Your involvement was through a selection process following an advertised solicitation. This study investigates the potential of VR-based entrepreneurship education methods for business soft-skills development among future student entrepreneurs. This interview round is a voluntary part of the study conducted by Armando Carias-Henriquez, a student in the Erasmus MSc. Degree in Transition, Innovation, and Sustainability Environments (TISE), offered by UCD (Ireland), UWK (Austria), UNL (Portugal), and PUEB (Poland).
Before we begin, I will provide some basic information about this study and request your consent to participate. If you agree, you will answer questions about your expertise and perspectives related to the implementation of VR-based entrepreneurship education. This session will take approximately 1 hour.
Participation is strictly voluntary. This session will be audio-recorded for future review and analysis and may be published as raw data. If you opt to maintain confidentiality, please do not use your name or the names of others. You may skip any question or terminate your participation at any time.

Additionally, you might opt to openly disclose your identity to appear in video recording. If you agree to participate in video recording, you will be requested to provide consent to use pieces of these interviews for academic communication purposes related solely to this study in social media of the research team participating in this study, and universities part of the TISE consortium.

Do you have any questions about this process before we begin?
Answer 1: No
Answer 2: Yes

Statement of Consent Before Starting the Audio-Recording:
Has the participant read and agreed to the Informed Consent Form prior to consenting to participate in this interview session?
Answer 1: Yes
Answer 2: No (If no, provide the consent form and obtain the participant's signature)

Statement of Consent Before Starting the Video - Recording:
Has the participant read and agreed to the Informed Consent Form prior to consenting to the disclosure of their identity, and usage of part of this interview as video recorded material for academic communication purposes in social media of the researcher in charge of this study, and/or universities involved in this study?
Answer 1: Yes
Answer 2: No (If no, provide the consent form and obtain the participant's signature)

Transcript Outline:
Begin Recorder

Introduction to the Interview:

Researcher: Good morning/afternoon. My name is Armando Carias. I am an Erasmus MSc. student in the Transition, Innovation, and Sustainability Environments (TISE) program, jointly offered by UCD (Ireland), UWK (Austria), UNL (Portugal), and PUEB (Poland). I am conducting a study on the Potential of VR-Based Entrepreneurship Education for Business Soft-Skills Development among future student entrepreneurs. This session is being conducted in Zoom at AM/PM on_____ (date). It is being recorded, and field notes may be taken for future analysis and/or publication as raw data.

If you choose to protect your identity, no names or personally identifiable information will be requested during this interview, unless voluntarily provided. Participants will be identified only as "Participant."
If you voluntary chose to disclose your identity you will be addressed by your name.

Participant (name), have you read and agreed to the consent information regarding this research study?

Participant: [Yes/No] (If yes, continue. If no, complete the statement of consent.)

Researcher: Now that we have recorded your consent, we will begin the interview. Remember, you may end this session at any time without consequence. All questions are voluntary and can be skipped if you wish.

Researcher: The following questions are designed to explore key concepts of this study. These open-ended questions allow you to share any relevant information. If any question is unclear, please ask for clarification. Are you ready to continue?

Participant: [Yes/No] (If no, please let me know when you are ready to continue.)

SUBJECT MATTER: ABOUT THE EXPERIENCE OF PARTICIPANTS RELATED TO ENTREPRENEURIAL EDUCATION, AND/OR XR DEVELOPMENT TECHNOLOGY.

Researcher:

1. Do you have any experience with entrepreneurship/business education/XR-technology development for educational purposes?
   Participant: [Answer]

2. Have you been involved in projects or educative activities related to entrepreneurial and business education, and/or XR technology development for education purposes?

3. (Additional question if needed) Do such education approaches exist at your university?

Participant: [Answer]

Researcher:

4. Have you ever used/ participated in the implementation of technology to enhance education outcomes among students? If Yes, please elaborate.

Participant: [Answer]

Researcher:

5. From your perspective, what is the role of universities in the development of soft skills such as opportunity recognition, creativity, and innovativeness, to promote entrepreneurial mindset among students?
   Participant: [Answer]

SUBJECT MATTER: ABOUT THE PERSPECTIVES OF EXPERTS ON VR TRAINING FOR ENTREPRENEURSHIP SOFT SKILLS DEVELOPMENT

Researcher:
As part of the study, I conducted a VR-based training program for entrepreneurial soft skills development among students. 13 students from PUEB (Poland) participated in a 3-hour training program focused on introducing students to VR environments and providing experiential training on entrepreneurial soft skills such as Opportunity Recognition, Creativity, and Innovativeness. The training combined theoretical knowledge, and practical activities in virtual environments.

Present videos and pictures of the VR training to experts…

Researcher:

1. Considering your experience in entrepreneurial education/or XR development, to what extent do you think this type of training can **impact** (enhance or limit) the development of entrepreneurial skills among students? Please share your insights.

Participant: [Answer]

Researcher:

2. What **advantages** and **disadvantages** might VR-based education have over *traditional education* (e.g.: In-person instruction, and interaction, physical classrooms, materials, "unplugged", etc.) to enhance entrepreneurial skills, such as opportunity recognition, creativity, and innovation, among students?

Participant: [Answer]

Researcher:

3. What is your opinion about **combining traditional education and VR-based education** to enhance entrepreneurial skills among students?

Participant: [Answer]

APPENDIX D

D.1 MeetinVR Environments and Tools

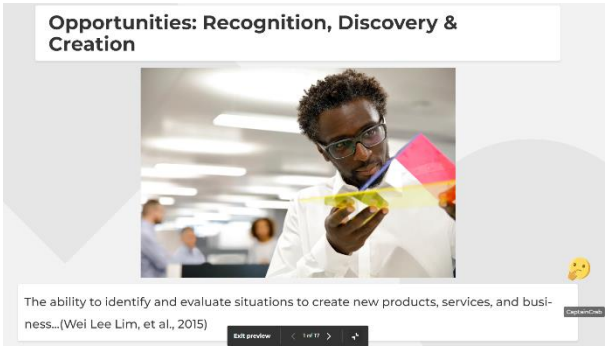
D.2 VR headsets

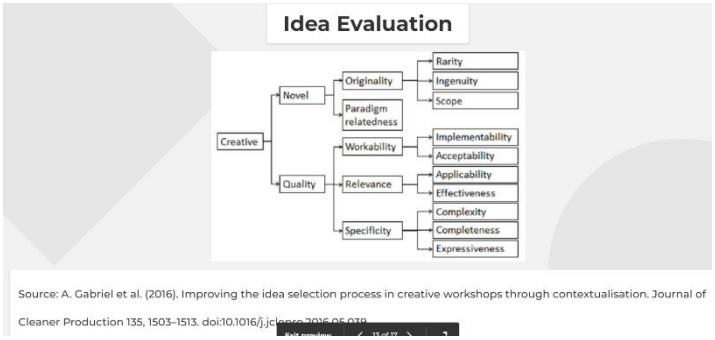
Meta Quest Pro

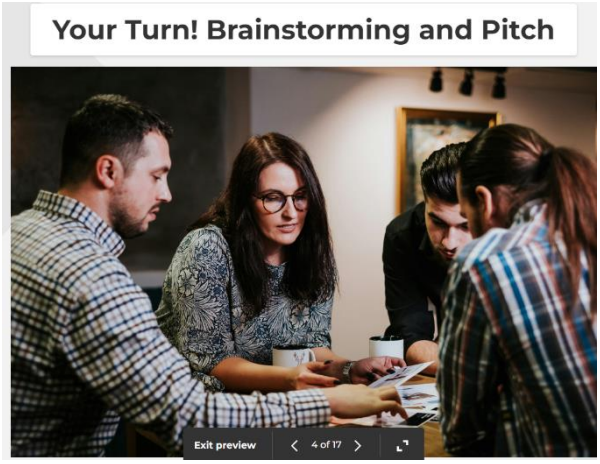
Meta Quest 2

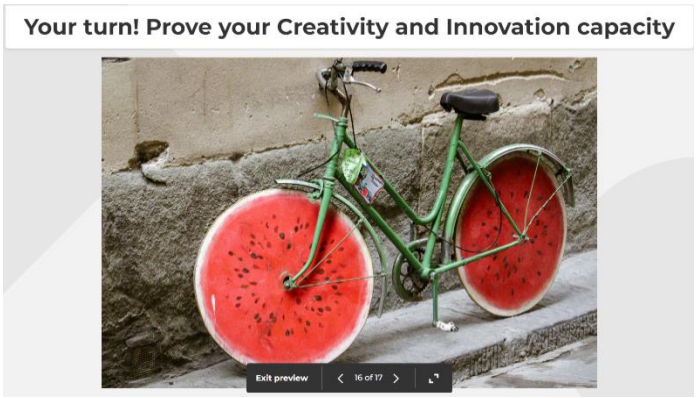
Meta Quest 3

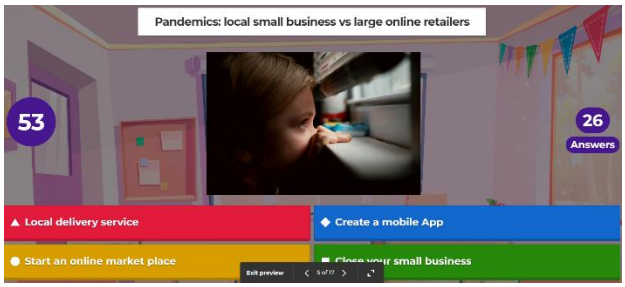
D.3 VR Training Content (Extract from Kahoot)



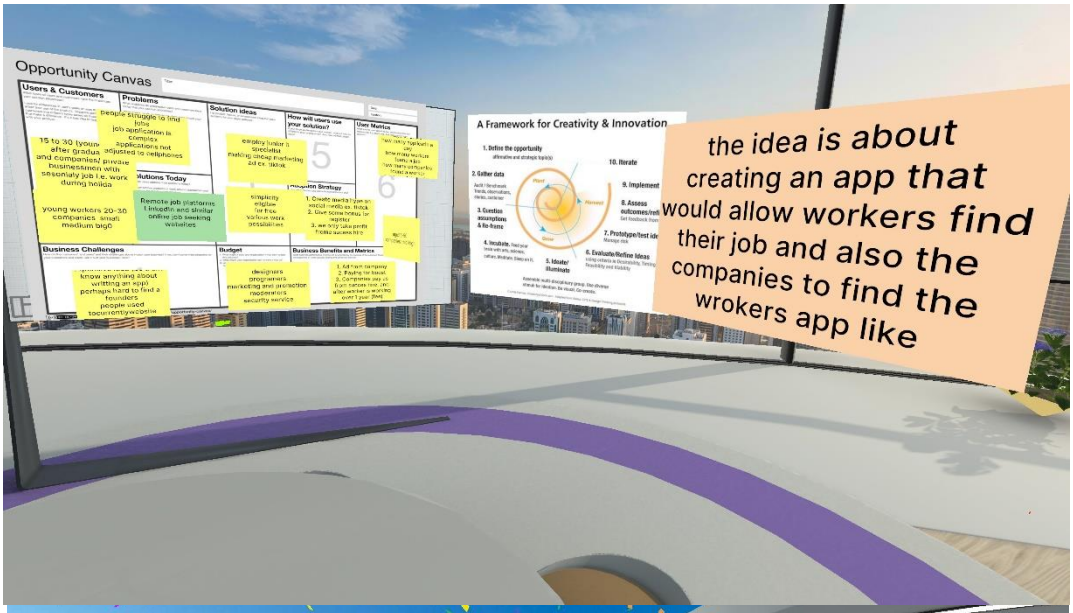








D.4 VR Training Experiences

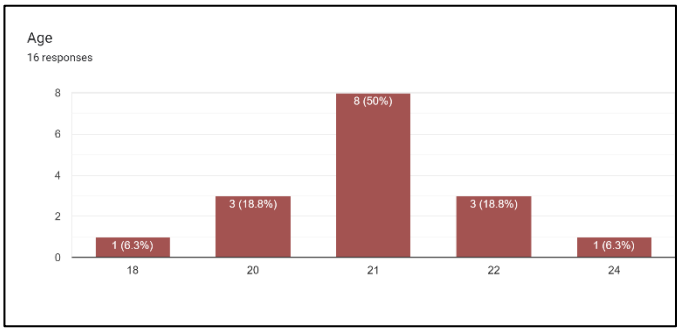

Opportunity Canvas
A Framework for Creativity & Innovation
the idea is about creating an app that would allow workers find their job and also the companies to find the wrokers app like

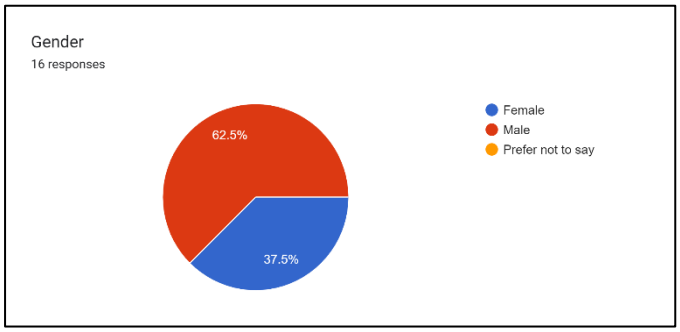

Energy independance
nuclear plants
lengthy electric cars
charge
ready to take bateries


Armando5 Carias
Armando4 Carias

APPENDIX F

SURVEY RESULTS





Are you currently enrolled as a student? If yes, please specify the name of your program and university

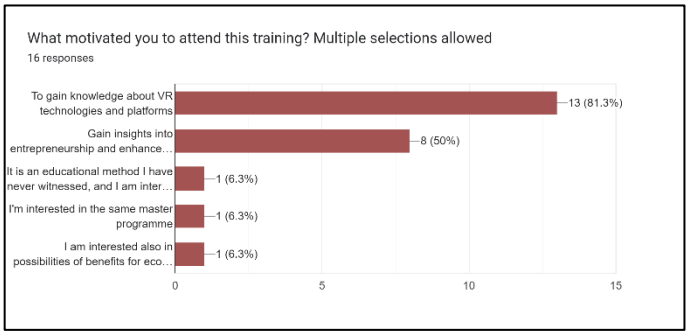
16 responses

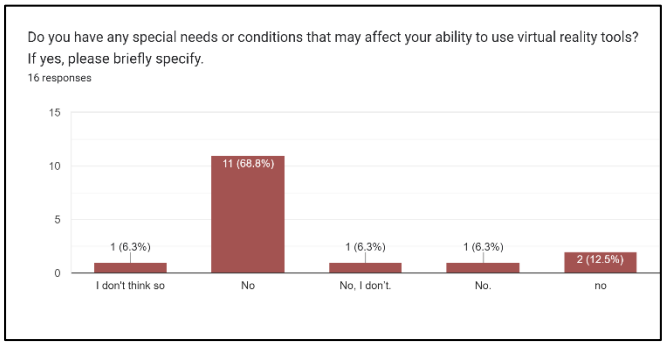
Yes - international business in pueb
Yes, Bachelor of Business Administration, Poznan University of economics and business
Yes. I am studying Bachelors in Business Administration and my university is Poznan University of Economics and Business
BBA - International business
Medicine on Poznań University of Medical Science
Informarics and Econometrics PUEB
Międzynarodowe stosunki gospodarcze - Uniwersytet ekonomiczny w Poznaniu
Poznan University of Business and Economics, IT and Econometric

Are you currently enrolled as a student? If yes, please specify the name of your program and university

16 responses

Poznan University of Business and Economics, IT and Econometric
International economic relations
Międzynarodowe Stosunki Gospodarcze, Uniwesytet Ekonomiczny w Poznaniu
yes, BBA III year
PUEP informatics and econometrics
International trade at Economic University in Poznań
International Business
UEP- MSG
MSG, UEP





Have you used any virtual reality (VR), extended reality (XR), or similar enhanced reality platforms before? If yes, please specify the platform and context of usage.

16 responses

No
Not really
Yes, I used it in games
Very shortly, only for testing, this VR glasses.
Tried VR at pop-culture convent.
No, I have not.
Yes, it was a

Have you used any virtual reality (VR), extended reality (XR), or similar enhanced reality platforms before? If yes, please specify the platform and context of usage.

16 responses

Very shortly, only for testing, this VR glasses.
Tried VR at pop-culture convent.
No, I have not.
Yes, it was a
no, have not had any experience of that.
No, I didn't
VR headset
Special chairs with vr, i was an employee
no

Have you ever thought about a product, or service that you believe could benefit society? If so, please provide a brief explanation of the idea and any steps you've imagined or taken to bring it to fruition thus far.

16 responses

No

Not yet

I thought about the product, but it was very general and more related to a service, like education. I tried some activities, but I was young and wasn't persistent enough to make a difference in my life, so I would rather not share it

Not sure

I thought about own business based on AI implementation, but I've never clarified it.

Web/mobile app for student to learn together, share notes and get/provide help while studying.

No, I have not.

Have you ever thought about a product, or service that you believe could benefit society? If so, please provide a brief explanation of the idea and any steps you've imagined or taken to bring it to fruition thus far.

16 responses

I thought about own business based on AI implementation, but I've never clarified it.

Web/mobile app for student to learn together, share notes and get/provide help while studying.

No, I have not.

VR with smells and noises to gain advantage to ecommerce business.

It would be app. It will be analizing your photos and creating your outfit.

I guess not really

Yes there were couple of products and services but they weren't original. Instead it was more of a upgrade in acutally existing service or product. Very often it was about changing the couple options or features which could drasticlly increase the effectiveness or simplicity.

I was in VR project

In your own words, how would you define entrepreneurship? Please feel free to provide examples or share any personal experiences that help illustrate your definition.

16 responses

Entrepreneurship is ability to see opportunities and use them.

Entrepreneurship is the process of identifying opportunities, taking risks, and creating value by starting and managing a new business venture. Of one the most popular entreprenuer is Elon Musk, which is a trailblazer in his industy.

Doing Business and being active on the market

Just business, and ways to make it

Entrepreneurship is the act of identifying a market opportunity, creating a business idea, and taking on financial risks to launch and grow a new venture. It involves innovation, strategic planning, and the ability to adapt to changing conditions.

For example, an entrepreneur might notice a high demand for eco-friendly products and start a business selling biodegradable household items. They would research the market, develop a business plan, secure funding, and manage operations to meet customer needs and grow the business.

Have you previously participated in any courses focused on entrepreneurship development? If yes, please specify.

16 responses

No

I haven't

We got a class at university called Entrepreneurship and Innovation

Yes, in scout team

No.

No, I have not.

yes, Google Export course

Unfortunately no

no

In your own words, how would you define entrepreneurship? Please feel free to provide examples or share any personal experiences that help illustrate your definition.

16 responses

Being able to spot opportunities and to be adaptable

Entrepreneurship, for me, is a process of expressing one's purpose, goals, and beliefs through actions to achieve them in the market

An individual who sets up his/her own business by taking up risks and enjoying the rewards that come with it. For example, Mark Zuckerberg created Facebook. He played a huge role in connecting people globally.

It is the process that defines venturing to create and carry out a new business idea, whether for profit or not, and going through all the difficulties that this entails.

The ability to be an enterpreneur

Ability to make right decisions based on technical knowledge and experience.

Its may be so simple, but I understand entrepreneurship as having a specified amount of money and make various things to have it more, just using our skills or contacts. In my opinion contacts are the most important thing.

In your own words, how would you define entrepreneurship? Please feel free to provide examples or share any personal experiences that help illustrate your definition.

16 responses

Organized solving of market and peoples needs.

I believe it's having the capacity to generate ideas and successfully manage a business, as also being resourceful.

It is ability, which helps people to manage their money, shows possibilities how to earn from abnormal sources or run their business successfully.

the ability to have your own goal and pursue it. For me it not always involve financial sight.

Entrepreneurship is ability to see opportunities and use them.

Entrepreneurship is the process of identifying opportunities, taking risks, and creating value by starting and managing a new business venture. Of one the most popular entreprenuer is Elon Musk, which is a trailblazer in his industy.

Doing Business and being active on the market

Do you have any expectation on the role of technologies such as VR as a didactical tool in Entrepreneurial Education? Please specify

16 responses

No

I don't have many expectations for that in the following decade, but possible after. I think increasing sensory load is helpful, but not to the point where it could make a significant difference without proper studies on how to use it effectively

I think it might help in collaboration and team work. For example, students can collaborate on projects in virtual spaces. This will foster a sense of community and network.

Yes, we could have virtual simulations that can actually feel as a first person experience

It could help People to learn faster

It may augment learning methods.

Do you have any expectation on the role of technologies such as VR as a didactical tool in Entrepreneurial Education? Please specify

16 responses

It may augment learning methods.

I would like my communication skills to develop faster through VR, particularly through various animations that practice these abilities.

Yes, I think that VR can place students in realistic business scenarios, allowing them to learn quicker.

Yes, i think it is inevitable in the future.

Yes, I would like it would be effective.

Yes, I assume that it is a innovation and future way of education

It would be a helpful tool

Yes, i think in the future Vr will be unnecessary

no

What personal skills or competencies would you be interested in developing to become a successful entrepreneur?

16 responses

Selling, organizing collaboration.

Resourcefulness, prudence, but also keeping in mind that you get nowhere without a little bit of risk

Wider knowledge about finance, tax and legal legislations related to running a business.

communication, leadership

Ambition and being ready for everything.

Real-time actions, hard-working, try to do innovative things

I would like to know more about law which affect business

creativity and immediate action

calm and discipline

What personal skills or competencies would you be interested in developing to become a successful entrepreneur?

16 responses

Being attuned to the environment around me, and having a grasp of academic knowledge to help push me in the correct direction

Persistence, purpose, concentration would be my general answer. But I am not sure that lessons could help with those, so general knowledge of how to start it practically would be helpful

Leadership, time management, problem solving

confidence, open mind, security, strength, courage, not getting carried away by mistakes and learning from them, responsibility and hunger for knowledge to continue learning, improving and innovating

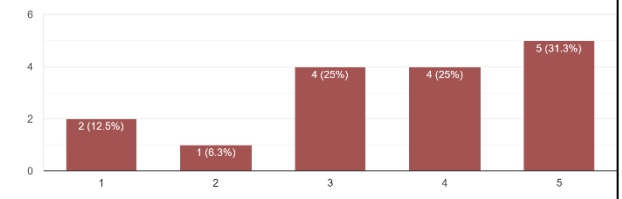
Be more self - confident

Knowledge about hard topic of law constraints that concerns running business.

Self - confident, taking action

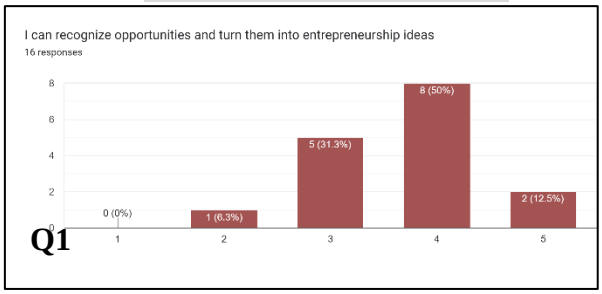
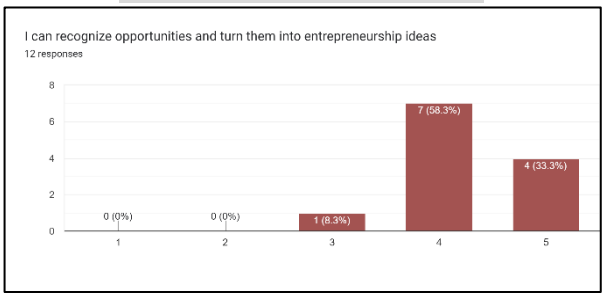
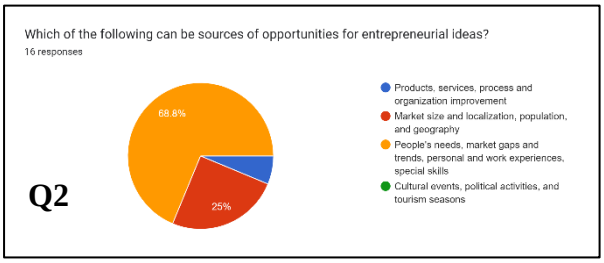
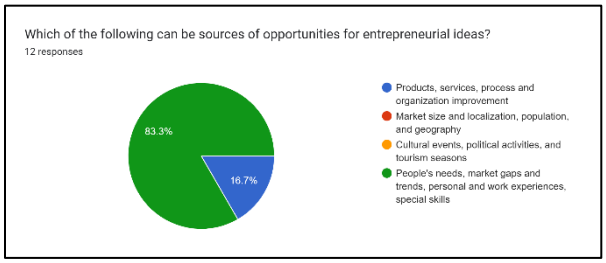
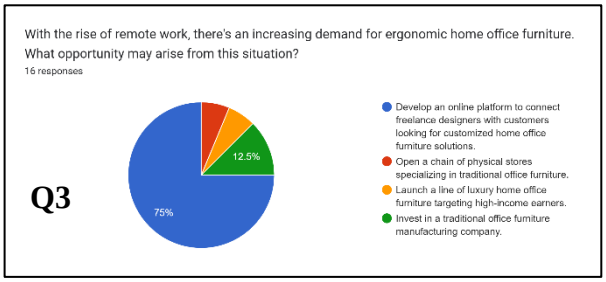
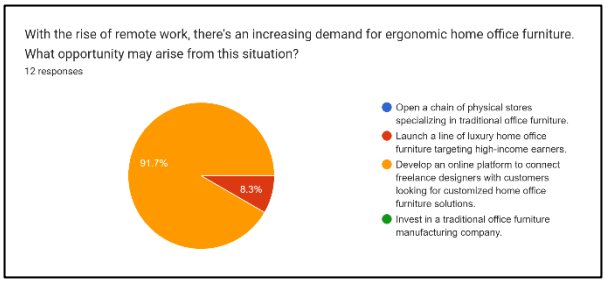
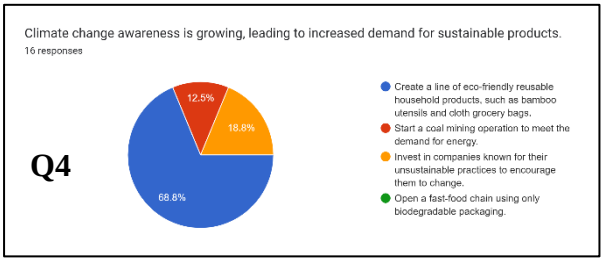
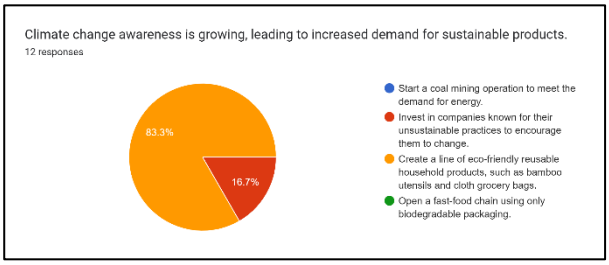
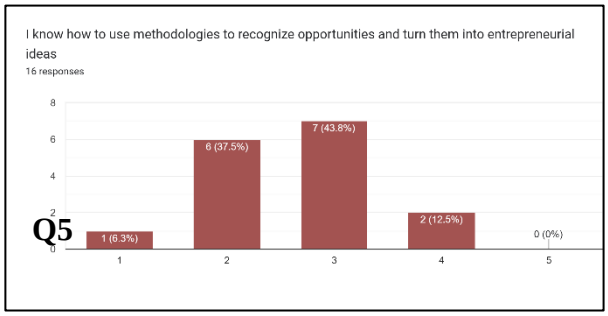
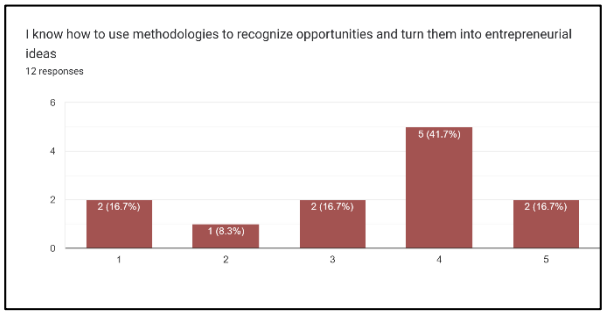
I'm currently thinking, taking actions, or trying in any way to ideate/ create a business

16 responses

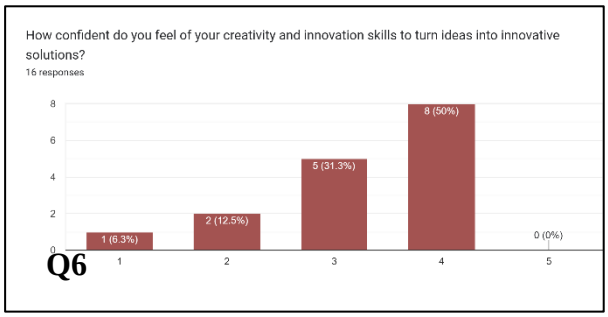


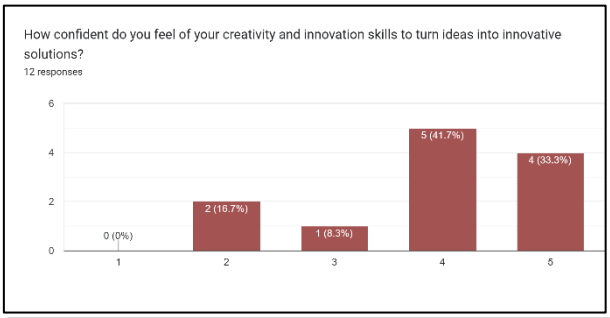
APPENDIX G

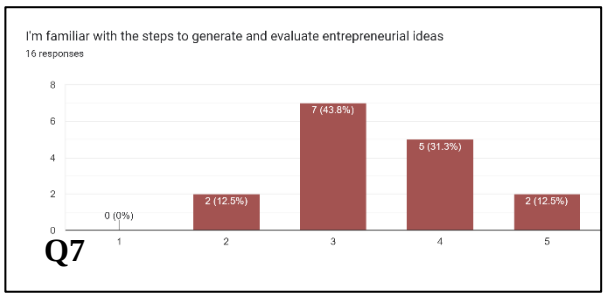
PRE-TRAINING AND POST-TRAINING TEST RESULTS

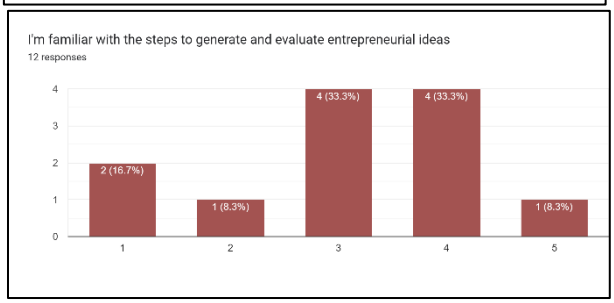
PRE-TRAINING TEST	POST-TRAINING TEST
	
	
	
	
	

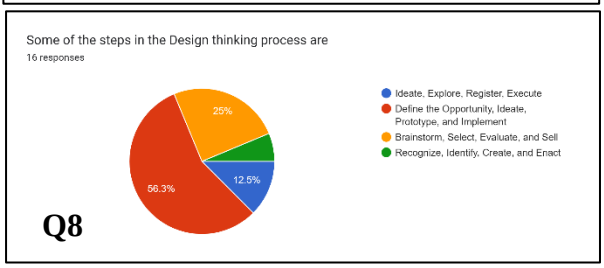
PRE-TRAINING TEST	POST-TRAINING TEST

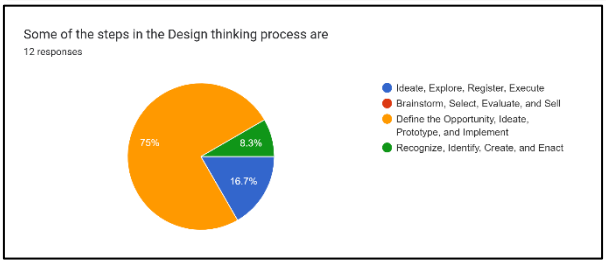


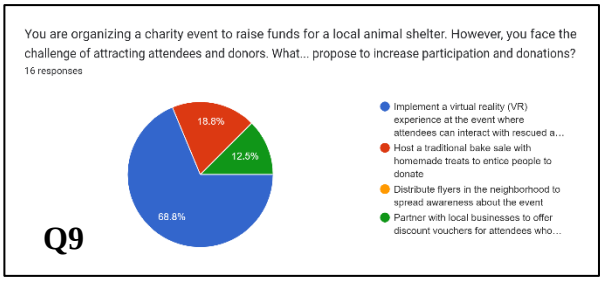


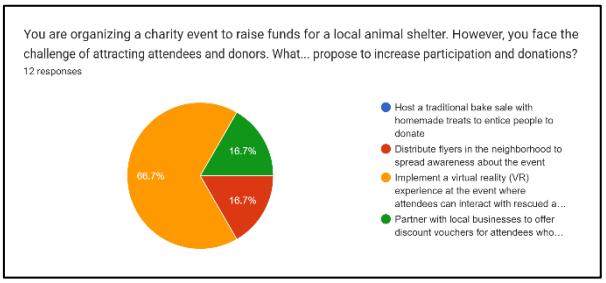


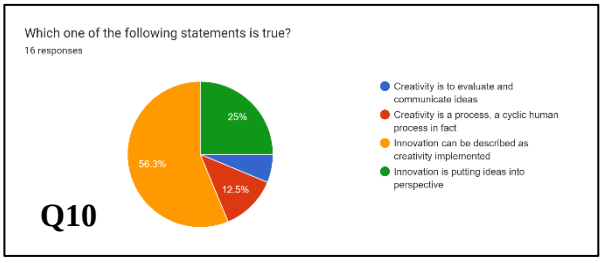


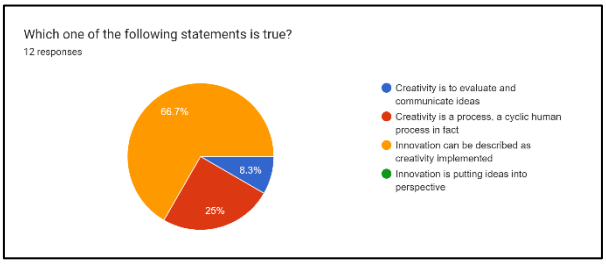












MC NEMAR TEST CODE IN R

Inferential Statistics Thesis

#Student Name: Armando Carias-Henriquez #M.Sc. Degree in Transition, Innovation, and Sustainability Environment (TISE) #UWK - PUEB - UCD - UNL #UWK Student Number: 129813

```
## McNemar Test

# Install necessary packages
install.packages("tidyverse")

## Installing package into '/cloud/lib/x86_64-pc-linux-gnu-library/4.3'
## (as 'lib' is unspecified)
install.packages("exact2x2")

## Installing package into '/cloud/lib/x86_64-pc-linux-gnu-library/4.3'
## (as 'lib' is unspecified)
# Load necessary libraries
library(tidyverse)

## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.4     v readr     2.1.5
## v forcats   1.0.0     v stringr   1.5.1
## v ggplot2   3.4.4     v tibble    3.2.1
## v lubridate 1.9.3     v tidyr     1.3.0
## v purrr     1.0.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become error
library(exact2x2)

## Loading required package: exactci
## Loading required package: ssanv
## Loading required package: testthat
##
## Attaching package: 'testthat'
##
## The following object is masked from 'package:dplyr':
##
##     matches
##
## The following object is masked from 'package:purrr':
##
##     is_null
##
## The following objects are masked from 'package:readr':
##
##     edition_get, local_edition
```



```
##
## The following object is masked from 'package:tidyr':
##
##     matches
# Load the CSV file into a data frame
data <- read.csv("Results.csv")

# Reshape the data from long to wide format
data_wide <- data %>%
  pivot_wider(names_from = Question, values_from = Q2:Q10, names_glue = "{Question}_{.value}")

# View the reshaped data
print(data_wide)

## # A tibble: 12 x 13
##    Student pre_Q2 pos_Q2 pre_Q3 pos_Q3 pre_Q4 pos_Q4 pre_Q8 pos_Q8 pre_Q9 pos_Q9
##    <chr>    <int>  <int>  <int>  <int>  <int>  <int>  <int>  <int>  <int>  <int>
##  1 S1           1      0      1      1      1      1      1      0      1      1
##  2 S2           1      1      1      1      1      1      1      1      1      1
##  3 S3           0      1      1      1      1      1      0      1      1      1
##  4 S4           1      1      1      1      1      1      1      1      1      1
##  5 S5           1      1      1      1      1      1      1      1      1      1
##  6 S6           0      1      1      1      1      1      0      1      0      1
##  7 S7           0      1      1      1      0      0      0      1      1      0
##  8 S8           1      1      1      0      1      1      1      1      1      1
##  9 S9           0      1      1      1      0      1      0      0      0      0
## 10 S10          1      1      1      1      1      0      1      0      1      0
## 11 S11          1      1      0      1      1      1      0      1      1      1
## 12 S12          1      0      1      1      1      1      0      1      0      0
## # i 2 more variables: pre_Q10 <int>, pos_Q10 <int>
# Function to perform McNemar test for a given question
perform_mcnemar_test <- function(pre_col, pos_col) {
  table <- table(data_wide[[pre_col]], data_wide[[pos_col]])
  mcnemar_test <- mcnemar.exact(table)
  return(mcnemar_test)
}

# Perform McNemar test for each question and print the results
questions <- c("Q2", "Q3", "Q4", "Q8", "Q9", "Q10")

for (question in questions) {
  pre_col <- paste0("pre_", question)
  pos_col <- paste0("pos_", question)
  cat("\nMcNemar Test for", question, ":\n")
  print(perform_mcnemar_test(pre_col, pos_col))
}

##
## McNemar Test for Q2 :
##
##  Exact McNemar test (with central confidence intervals)
##
## data:  table
## b = 4, c = 2, p-value = 0.6875
```



```
## alternative hypothesis: true odds ratio is not equal to 1
## 95 percent confidence interval:
##   0.2866338 22.1097024
## sample estimates:
## odds ratio
##          2
##
##
## McNemar Test for Q3 :
##
##  Exact McNemar test (with central confidence intervals)
##
## data:  table
## b = 1, c = 1, p-value = 1
## alternative hypothesis: true odds ratio is not equal to 1
## 95 percent confidence interval:
##   0.01273937 78.49683532
## sample estimates:
## odds ratio
##          1
##
##
## McNemar Test for Q4 :
##
##  Exact McNemar test (with central confidence intervals)
##
## data:  table
## b = 1, c = 1, p-value = 1
## alternative hypothesis: true odds ratio is not equal to 1
## 95 percent confidence interval:
##   0.01273937 78.49683532
## sample estimates:
## odds ratio
##          1
##
##
## McNemar Test for Q8 :
##
##  Exact McNemar test (with central confidence intervals)
##
## data:  table
## b = 5, c = 2, p-value = 0.4531
## alternative hypothesis: true odds ratio is not equal to 1
## 95 percent confidence interval:
##   0.4092861 26.2534768
## sample estimates:
## odds ratio
##        2.5
##
##
## McNemar Test for Q9 :
##
##  Exact McNemar test (with central confidence intervals)
##
```



```
## data:  table
## b = 1, c = 2, p-value = 1
## alternative hypothesis: true odds ratio is not equal to 1
## 95 percent confidence interval:
##  0.00847498 9.60452988
## sample estimates:
## odds ratio
##        0.5
##
##
## McNemar Test for Q10 :
##
##  Exact McNemar test (with central confidence intervals)
##
## data:  table
## b = 4, c = 1, p-value = 0.375
## alternative hypothesis: true odds ratio is not equal to 1
## 95 percent confidence interval:
##    0.3958333 196.9898730
## sample estimates:
## odds ratio
##          4
```

PAIRED t-TEST CODE IN R

#Student Name: Armando Carias-Henriquez #M.Sc. Degree in Transition, Innovation, and Sustainability Environment (TISE) #UWK - PUEB - UCD - UNL #UWK Student Number: 129813

```
## Paired t-test

# Load necessary library
library(tidyverse)

# Import the CSV file
data <- read.csv("Results2.csv")

# Conduct paired t-tests for each question

# Q1
t_test_q1 <- t.test(data$Q1[data$Question == "pos"], data$Q1[data$Question == "pre"], paired = TRUE)
cat("Paired t-test for Q1:\n")

## Paired t-test for Q1:
print(t_test_q1)

##
##  Paired t-test
##
## data:  data$Q1[data$Question == "pos"] and data$Q1[data$Question == "pre"]
## t = 3.0225, df = 11, p-value = 0.0116
## alternative hypothesis: true mean difference is not equal to 0
## 95 percent confidence interval:
##  0.1585519 1.0081148
## sample estimates:
## mean difference
##       0.5833333
```



```
##
## ----------------------
# Q5
t_test_q5 <- t.test(data$Q5[data$Question == "pos"], data$Q5[data$Question == "pre"], paired = TRUE)
cat("Paired t-test for Q5:\n")

## Paired t-test for Q5:
print(t_test_q5)

##
##  Paired t-test
##
## data:  data$Q5[data$Question == "pos"] and data$Q5[data$Question == "pre"]
## t = 2.5606, df = 11, p-value = 0.02649
## alternative hypothesis: true mean difference is not equal to 0
## 95 percent confidence interval:
##  0.1287368 1.7045965
## sample estimates:
## mean difference
##       0.9166667
cat("\n----------------------\n")

##
## ----------------------
# Q6
t_test_q6 <- t.test(data$Q6[data$Question == "pos"], data$Q6[data$Question == "pre"], paired = TRUE)
cat("Paired t-test for Q6:\n")

## Paired t-test for Q6:
print(t_test_q6)

##
##  Paired t-test
##
## data:  data$Q6[data$Question == "pos"] and data$Q6[data$Question == "pre"]
## t = 3.5269, df = 11, p-value = 0.00474
## alternative hypothesis: true mean difference is not equal to 0
## 95 percent confidence interval:
##  0.3446201 1.4887133
## sample estimates:
## mean difference
##       0.9166667
cat("\n----------------------\n")

##
## ----------------------
# Q7
t_test_q7 <- t.test(data$Q7[data$Question == "pos"], data$Q7[data$Question == "pre"], paired = TRUE)
cat("Paired t-test for Q7:\n")

## Paired t-test for Q7:
print(t_test_q7)

##
##  Paired t-test
##
## data:  data$Q7[data$Question == "pos"] and data$Q7[data$Question == "pre"]
## t = -1.3179, df = 11, p-value = 0.2143
## alternative hypothesis: true mean difference is not equal to 0
## 95 percent confidence interval:
##  -1.3350394  0.3350394
## sample estimates:
## mean difference
##            -0.5
cat("\n----------------------\n")

##
## ----------------------
```

APPENDIX H

H.1 FOCUS GROUPS WITH STUDENTS' RESULTS

SUBJECT MATTER: EXPERIENCES OF PARTICIPANTS DURING THE VR TRAINING

CODE: PERSONAL EXPERIENCES/PERCEPTIONS WITH VR TECHNOLOGY		
Focus Group	Themes	Meta Themes
FG 1	-Experience: Positive, fun, exciting, innovative, novel, a learning process, engaging. -VR: interactive, interesting tool, realistic, seamless, motivated to learn more about VR, and develop skills in VR -Troubles: Adaptation time, trouble to perceive information properly	**Overall Experience was Positive and Engaging:** Positive, fun, exciting, innovative, novel, engaging, interesting, great, nice experience, amazing, awesome, exceeded expectations, appreciative, feel as being a part of the process, pleasant, inspiring, glad. **VR as a Tool was Useful, Interactive and Realistic:** Interactive, interesting tool, realistic, seamless, very useful, intuitive to use, easy to learn and to use, feel of being present and focused, feel more natural than other online platforms, motivated to learn more about VR, nice tool for many aspects, helpful, some things are easier to explain, interactivity. **Skill Learning and Development:** Learning process, developed skills, generated solutions, feel more confident for entrepreneurial projects. **Challenges to Adapt and Technical Issues:** Adaptation time, trouble perceiving information properly, needs training, should be simpler for children, tools in VR feel a bit unnatural, time to learn, technical problems, goggles are heavy, hard to use at the beginning.
FG 2	-Experience: Interesting, great, nice experience. - VR: Very useful, intuitive to use for many options, easy to learn and to use, found the tools useful, feel of being present and focused, feel more natural than other online platforms. -Troubles: Needs training, and to be simpler for children, tools in VR feels a bit unnatural, time to learn, technical problems	
FG 3	-Experience: Great, amazing, learning experience, awesome, interesting, exceeded expectations. Appreciative, feel as being a part of the process. -VR: Some things are easier to explain, interactivity. - Skills: I developed my skills", "we worked a lot and generated solutions"	
FG 4	-Experience: Pleasant, inspiring, glad, great experience. -VR: realistic, nice tool for many aspects, helpful, motivated to keep using it, I would recommend it. -Skills: feel more confident for entrepreneurial projects. -Troubles: the googles are heavy, it was hard to use it at the beginning.	

CODE: ASPECTS LIKED		
Focus Group	Themes	Meta Themes
FG 1	Interactivity, innovative, fun. The excitement, fun and curiosity, "like in primary school". Lead and control of the creation process. Possibility to create what you imagine Freedom of movement in the VR environment, even if you're sitting in the real world. VR tools: pen, iPad, post-sticks, access to websites, screen board sharing, 3D writing/drawing Learning enhancement, skills development, short-term concentration increase, fun work, knowledge sharing	**Innovative, Engaging and Joyful:** Interactivity, innovative, fun, fun work. Excitement, and curiosity promoted in the environment. **Creative Empowerment:** Lead and control of the creation process. Being able to control (manipulate) things in 3D. Doing things which cannot be done in the real world. Possibility to create what you imagine. **Virtual Mobility and Collaboration:** Freedom of movement in the VR environment, even if you're sitting in the real world. Being anywhere in the world, and still enable people to work on the same activities, and together in the same room, at the same time than others. **Multi-functional VR Tools:** VR tools: pen, iPad, post-sticks, access to websites, screen board, 3D writing/drawing. VR environments. Applicability to many aspects of our lives. Avatars: raising your hands. **Enhanced Experiential Learning:** Learning enhancement, skills development, short-term concentration increase. Learning by doing, hands-on work, laboratory-like experience. **Realistic Experience:** Realism, the feeling that it's really you doing something and not someone else, it feels natural. **Collaborative Creation and Idea Sharing:** Cooperate and create things with others, showing your ideas using notes, the feeling of freedom of sharing your ideas. Knowledge sharing. Screen board sharing.
FG 2	Learning by doing, hands-on work, laboratory-like experience Being able to control (manipulate) things in 3D, Being anywhere in the world, and still enable people to work on the same activities, and together in the same room, at the same time than others VR tools and environments. Applicability to many aspects of our lives.	
FG 3	Realism, the feeling that it's really you doing something and not someone else, it feels natural VR tools, writing, raising your hands	
FG 4	3D writing which cannot be done in the real world, Cooperate and create things with others, showing your ideas using notes, the feeling of freedom of sharing your ideas.	
CODE: ASPECTS DIS-LIKED		
Focus Group	Themes	Meta Themes
FG 1	Find it hard to integrate information, technical issues, it could be hard to adapt, learn, use, and control for elderly people	**Technical issues:** videos lagging, errors, and system messages. **Not for non-tech savvies:** hard to adapt, learn, use, and control for technologically unskilled or novice individuals. **Learning curve:** Find it hard to move in VR as wished. Find it hard to share information. **It could be uncomfortable:** Eyes tiredness, troubles to watch streamed videos. Goggles are heavy **Reality adjustment discomfort:** It feels weird when you come in and out the VR to the reality, **Avatars lacked realism:** Movements and expressions could be more human-like.
FG 2	Find it hard to move in VR, videos lagging, eyes tiredness when surfing on the web, while being in VR, troubles to watch streamed videos	
FG 3	Glasses were heavy, the feeling when you coming in and out the VR to the reality, avatar movements can be improved,	
FG 4	Technical issues, system messages	

SUBJECT MATTER: PERSPECTIVES OF PARTICIPANTS ON IMPLEMENTING VR TECHNOLOGIES AND ENVIRONMENTS FOR ENTREPRENEURIAL EDUCATION IN UNIVERSITY SETTINGS

CODE: OPINION ON VR FOR EE IN UNIVERSITIES		
Focus Group	Themes	Meta Themes
FG 1	Technology must be implemented Knowledge can be shared more effectively University education can be accessible anywhere. Virtuality may lower university costs Studies are needed on what and how to teach in VR, including interaction methods, information sharing, and its advantages over traditional learning. Be implemented only when needed, in a class, or a meeting. Not essential in universities. Universities can implement VR to enhance entrepreneurship skills learning, like creativity, prototyping, ideation, showcasing. Many universities already offer online classes. VR might provide better ways of distance education, boosting creativity, interaction, and the feeling of a real classroom.	**Potential for Implementation.** VR technology should be implemented for its potential. **Effective Knowledge Sharing.** Knowledge and ideas can be shared in more effective, innovative, and creative ways than traditional means (e.g., paper). **Accessibility and Collaboration.** University education can be accessible anywhere, enabling working and studying with anyone in the world. **Cost Reduction.** Virtuality may lower university costs. **Need for Studies.** Studies are needed on what and how to teach in VR, including interaction methods, information sharing, and its advantages over traditional learning. While VR is not ideal, it's a good solution. **Selective Implementation.** VR should be implemented only when needed, such as in a class or meeting. Mixing/combining VR with normal lessons is more efficient and interesting. It is not essential in universities. In-person education is also important, and standard/traditional lectures should not be fully replaced by VR. **Enhanced Entrepreneurship Education** Universities can implement VR to enhance entrepreneurship skills learning, like creativity. VR increases student engagement, participation, and collaboration, potentially attracting more students to traditional courses. Learning by doing is much greater in VR. It might facilitate more efficient learning for creating new or innovative ideas. VR allows exposure to different "expressions and feelings," enhancing productivity and optimizing research. It supports virtual visits, interactions with processes and machines, group exercises, projects, case studies, negotiations, role-playing (e.g., as a company CEO), brainstorming, problem-solving discussions, prototyping, ideation, and showcasing sessions. **Distance Education Enhancement** Many universities already offer online classes. VR can be a tool among many others used in universities, offering better ways of distance education by making things more realistic and providing the feeling of a real classroom. VR technology offers another approach and practical touch to some subjects, including virtual conferences and business meetings. **Technical Challenges.** Technical limitations are unclear. Controlling a large class in VR and providing support to many students dealing with VR would be a challenge. **Safety and Comfort.** VR lessons are a great idea but need time limits for safety and to avoid exhaustion. Lesson duration can be increased as VR technology becomes more comfortable. VR is a good solution but not for normal lectures; it requires an open-minded approach and time constraints.
FG 2	Working and studying with anyone in the world. Learning by doing is much greater Technical limitations are unclear. Controlling a numerous class in VR, and providing support to many students dealing with VR would be a challenge Advantages over other online platforms by making things more realistic. A tool among many others that can be used in universities, a new tool In person education is important too. Standard/traditional lectures should not be fully in VR, nor replaced. VR can be implemented when needed Technology should be implemented, for its effective and easy way for problem solving VR is not ideal but it's a good solution For entrepreneurial skills: Virtual visits, factories, interaction with processes, machines. More efficient learning and to create new ideas, or innovative ideas.	
FG 3	VR lessons are a great idea but need time limits for safety and to avoid exhaustion. This can be increased as the technology becomes more comfortable. VR techs provide another approach and practical touch to some subjects Can be beneficial to attract more students to trad courses Good solution but not in normal lectures, openminded class, time constraints Mixing VR with normal lessons. More efficient and interesting. Exposure to different "expressions and feelings". Very good for productivity and optimize research. Virtual conferences or business meetings.	
FG 4	Professors can make classes and lectures more interesting, more realistic, less theoretical and in real time introducing VR.	

	Sharing ideas in innovative and creative ways than traditional means (paper). Increased student engagement, participation, and collaboration. Group exercises, projects, case studies, negotiations, role playing (a company CEO), brainstorming, discussions, sessions. Universities should implement it.	
CODE: POTENTIAL IMPACT ON ENTREPRENEURIAL SKILLS AMONG STUDENTS		
Focus Group	Themes	Meta Themes
FG 1	No limitation on entrepreneurial skills. VR tech cannot limit us. It will only help. It might limit in some point that we might get used to it too much looking down on the traditional methods of learning. Enhance entrepreneurial skills, especially hard skills connected to specific domains like industrial operations. It really develops skills and creativity. If we implement this in class and everybody could draw and create something, we can reach some interesting ideas, innovative ideas. Provide more evident and easy ways to develop entrepreneurial ideas and opportunity recognition mindset. More "physical" (tangible/realistic?) ways to create ideas. Idea sharing is easier, translation of ideas into tangible objects that can be "touched"/manipulated and shared with others and checked in real time what's done.	Disagreement on VR Impact Students expressed varying opinions on the impact of VR on entrepreneurial soft skills development. Some students believe VR has no limitations and can only help, while others acknowledge potential limitations and risks associated with VR abuse. Potential Negative Impacts of VR Abuse on Students' Skills -Loss of Traditional Method Benefits Excessive reliance on VR may lead to neglecting traditional learning methods, which offer significant benefits for soft skills development. -Limited Acquisition of Real-Life Skills Overuse of VR can hinder the development of soft skills that require real-life human interaction. Certain behaviors and skills are best learned through face-to-face communication. -Communication Barriers VR may pose challenges in conveying ideas as effectively as real-life interactions, where non-verbal cues play a crucial role. -Creativity and Innovation Focusing too much on VR might limit creativity and innovation, which often stem from real-life experiences and the challenges they present. -Teaching Effectiveness Without proper preparation and training, teaching effectiveness in VR can decrease, leading to increased time and costs. Potential Positive Impacts of VR on Students' Skills -Innovation and Creativity Enhancement VR can foster the creation of innovative and entrepreneurial ideas by providing immersive and engaging environments. -Enhanced Entrepreneurial Mindset and Skills VR offers tangible and realistic ways to develop and create ideas, making it easier for students to share and visualize knowledge in real-time. This can enhance overall entrepreneurial skills and knowledge. -Virtual Education and Business Skills Enhancement VR enables participation in remote classes, courses, and business meetings, simulating real-life environments and enhancing skills among students.
FG 2	The obvious limitation in the soft skills is of course the lack of contact with people. Some behaviors (and so on) "can be only learned" if we talk to each other, in the same room in real-life. VR can limit the acquisition of those soft skills. It can be hard to communicate some ideas when we don't see each other as we do in real life. Creativity and innovation can be limited if the user focuses too much on VR and stops thinking about reality and real-life situations. Creativity occurs when living specific real-life situations, and meeting reality of life Teaching effectiveness can be limited without proper preparation training to students, involving more time and costs.	
FG 3	Huge benefit to the students because the VR headset would enable them to take part in the classes or in courses from home. It would enhance entrepreneurs' skills in students bc it helps to visualize things. Teachers will better share the knowledge, enhancing the whole entrepreneurial skills in students. Development of skills and getting more knowledge.	
FG 4	Business meetings can be conducted remotely enhancing skills among businessmen, since they would communicate similar than in reality.	
CODE: ADVANTAGES OF VR-BASED EDUCATION OVER TRAD EDUCATION		
Focus Group	Themes	Meta Themes

FG 1	No limitations of physical space as traditional classroom. No physical limitations of the number of people you can have in the same place. Especially advantageous during pandemics or war times enabling more interactive, engaging and creative remote education. Interactivity nature. Interaction with people and information in new and different ways. More superior, creative ways to interact and share information than other experiences. Better for brainstorming and might help increase memory. No need for or reduced use of materials, lower investment in class materials. Safe experiences, safe manipulation of materials.	Unlimited Classroom Space VR might eliminate physical space constraints, allowing unlimited participants in a virtual environment. Enhanced Remote Education VR might be particularly beneficial during pandemics or conflicts, enabling interactive, engaging, and creative remote learning. It allows students to "visit" places, see inside objects, and interact with environments that are impossible to replicate in a traditional classroom, such as factories or machines. VR facilitates global interactions in a fun and practical way, making remote lectures more engaging. Interactivity and Innovation VR might offer new and superior ways to interact with people and information. It promotes innovative and creative behaviors through 3D prototyping and interaction with 3D objects and prototypes. Engaging Classes VR makes classes more interesting, amusing and engaging than traditional methods, enhancing overall class participation and limiting boredom. Cost-Effective Learning Reduced need for physical materials lowers the investment in class materials, making education more affordable in the long run. Safe Experiential Learning VR provides a safe environment for experiential learning and material manipulation, minimizing risks associated with hands-on activities. Increased Focus and Memory Retention VR might keep users fully engaged and free from external distractions, unlike other virtual meeting platforms or traditional lectures. This enhanced focus can improve memory retention and overall educational outcomes. Practical and Time-Efficient VR-based education is faster than traditional methods, eliminating commuting time and streamlining the learning process. New Frontiers for Creativity and Innovation VR enables the creation of products and experiences that are impossible in traditional education, significantly enhancing creativity and innovation. Overcoming Fears and Skill Development VR can help students overcome fears, such as public speaking, and facilitate the development of various skills in a safe and controlled environment.
FG 2	Ability to keep users fully engaged and free from external distractions (phones, social media), unlike other virtual meeting platforms or during a lecture in university 3d prototyping. Interaction with 3d objects and prototypes, which might improve the innovative and creative behaviors among future students. The possibility of “being” in places, seeing “from inside”, and “touching” objects that cannot be done in a physical-class room, such a factory and machines. Faster than traditional education. No commuting time	
FG 3	We can create a new product, we can create something which is impossible in standard, or traditional education. So, I think it enables us to go beyond. It could really enhance the creativity and innovation for sure Speaking with someone in a different place of the world in a more fun, practical way and as if they were in the same place together. Enhanced focus for education	
FG 4	I think it's more interesting than these old traditional classes we have now. Fun and engaging remote lectures. It might help overcome fear of public speaking in real world.	

SUBJECT MATTER: PERSPECTIVES OF PARTICIPANTS ON IMPLEMENTING VR TECHNOLOGIES AND ENVIRONMENTS FOR ENTREPRENEURIAL EDUCATION IN UNIVERSITY SETTINGS (CONTINUED)

CODE: DIS-ADVANTAGES OF VR-BASED EDUCATION OVER TRAD EDUCATION		
Focus Group	Themes	Meta Themes
FG 1	It couldn't be used for a long time. Risk of eyesight issues or headaches. It could be chaotic if mismanaged, since everyone could be playing or creating something at the same time. Technical issues affecting user' s experience. Learning curve. Needs pre-training on VR tech before class. Implementation needs to be carefully evaluated to ensure it's helpful. Not accessible for everyone. Not feasible to implement for everyone. VR has important pre-requisites for implementation that traditional class does not have. Traditional class is simpler to implement. Associated costs. Adaptation time to VR Complexity of programming needed to create realistic simulations	**Limited Usage and Associated Risks.** VR cannot be used for extended periods due to the risk of eyesight issues, headaches, and physical discomfort. The equipment can be heavy and unsuitable for long lectures, and it may not be suitable for everyone. **Class Management Challenges.** VR can be chaotic if mismanaged, as students might get distracted or engage in unrelated activities. Effective management is crucial to maintain focus and order. **Technical Issues.** Technical problems can significantly impact the user experience, causing difficulties in hearing, cooperating, and overall interaction within the VR environment. **Training Requirements.** There is a learning curve associated with VR technology, necessitating pre-training and adaptation time for students and educators before effective use in the classroom. **Careful Evaluation for Positive Impact.** The implementation of VR must be carefully evaluated to ensure it is beneficial and does not detract from the educational experience. **Accessibility Issues.** VR technology is not feasible for all students, as not everyone will have access to the necessary equipment. It may only be practical for use in university labs or conference rooms, limiting its widespread adoption. **Complex Implementation** VR requires significant prerequisites for implementation, making it more complex than traditional classes. However, the rapid advancement of technology might mitigate these challenges in the future. **Development Complexity** Creating realistic VR simulations involves advanced programming and the development of complex environments, leading to high costs. While AI advancements may reduce these barriers over time, they remain a consideration. **Server Dependency** VR relies on a stable server connection to function properly, which can be a limitation if the server fails or is inaccessible. **Potential Hindrance to Social Skills** Excessive use of VR might limit the development of social skills, as human interaction in VR lacks the natural elements of seeing and perceiving others' emotions. This can be a communication barrier, especially for introverted individuals. **Risk of Boredom** The novelty of VR might wear off, leading to boredom if students are confined to one position or if the VR experience becomes monotonous.
FG 2	It's impossible that every student would have VR technology for their own. Only to use in the university, in an onsite lab or in a conference room wherever you are. 1950s, many thought that it wasn't possible that every person would have a single personal computer of their own. And now we have no single, but often a few or several personal computers per person. It requires creating complex environments in VR. Associated costs of development and implementation. But since the raise of AI, development of complex VR environments will be faster and easier Issues with technical problems and requirement of training.	
FG 3	We must be connected to the server that is maintaining the whole thing. Difficulties to hear each other and to cooperate. People might get distracted in VR. Possible limitations for Social Skills development since human interaction needs "seeing the other" and perceive their emotions	
FG 4	It's heavy and if used for a long time can cause headaches. Not for long lectures, not for everyone. It could be boring when we are in just one position. Lack of natural relations with others. Not the same feeling when you're in person. It could become a communication barrier for introvert people.	
CODE: CHALLENGES OF IMPLEMENTING VR FOR ENTREPRENEURIAL SKILLS DEV AMONG STUDENTS		
Focus Group	Themes	Meta Themes
FG 1	Difficult to implement on the large scale, not friendly for all, costly, and limitation in batteries duration.	**Large-Scale Implementation Difficulties.** Costliness, limited battery duration, and dependency on specific technical requirements, not user-friendly for everyone. **High Costs.** VR technology is expensive, and unaffordable for many students and educational institutions, which limits its accessibility and widespread adoption.
FG 2	Costs. Not all can afford such expensive tools, especially students.	
FG 3	Not everyone can comprehend the VR headset and how to use it properly. Lack of knowledge and understanding about VR tech. People need to be introduced and trained first.	

	VR tech might increase time spent with digital devices increasing health risks.	**Market Readiness.** The market is not fully prepared for VR technology. There is a lack of knowledge and understanding about VR, and many individuals need to be introduced, familiarized, and trained on how to use it effectively. This adjustment period requires time and resources. **Health Risks**. Increased use of VR technology can lead to more time spent with digital devices, which may pose various health risks, including eye strain, headaches, and other physical discomforts. **Potential Job Loss.** The development and implementation of VR in education could potentially lead to job displacement or loss, as some roles may become obsolete. **Environmental Impact.** The environmental impact of VR technology is not yet fully understood. Energy consumption and the environmental footprint associated with the production, usage, and disposal of VR equipment.
FG 4	Getting used to the equipment. It might lead to job loss. Environmental impact is unknown.	
CODE: OTHER RELEVANT INSIGHTS		
Focus Group	Themes	Meta Themes
FG 1	Concern on long term impact/effects of VR in the industry. Expectations that training integrating VR tech in education would be implemented soon. The potential of VR technology for entrepreneurial education is significant if well implemented Feeling of freedom promoted in VR platform	Concern on long term impact/effects of VR in the industry. Expectations that training integrating VR tech in education would be implemented soon. The potential of VR technology for entrepreneurial education is significant if well implemented. It has great potential, but it's rather linked to our new growing population rather than past generations. It can be implemented most effectively with the new generation of students. Feeling of freedom promoted in VR platform VR education is not for all. VR technology is not for all types of learning or content, not everything can be taught using VR, it might lose efficiency. Some experiences might not make sense to be conducted in VR, such demonstration in which the real experience needs to be delivered. Well-known and well working methods should not be replaced, but rather enhanced with the incorporation of new technology. Translating everything to the metaverse is not a good idea. If something can be done in physical classroom, like a standard lecture, it should be conducted without the virtual reality. Real-life trainings should be implemented whenever is possible, and VR training incorporated when necessary Implementing VR technology in education will help to learn about VR. It would be a good idea for universities to offer small courses related to virtual reality. Evidence of entrepreneurial mindset and soft skills activation among students: "some ideas really came to my mind after all of that VR, because now I'm thinking that I'm doing e-commerce and I'm thinking that it's really cool to implement if this technology would be widespread to the typical consumer, to the ordinary consumer, and people just can go to your website and see your product using VR technology and maybe in 3D. So, yeah, so even I see the result of just a test lecture we had today. I see the result even now. Yeah, I see the big potential in that technology"
FG 2	VR education is not for all. VR technology is not for all types of learning or content, not everything can be taught using VR, it might lose efficiency. Some experiences might not make sense to be conducted in VR, such demonstration in which the real experience needs to be delivered. Well-known and well working methods should not be replaced, but rather enhanced with the incorporation of new technology. Translating everything to the metaverse is not a good idea. If something can be done in physical classroom, like a standard lecture, it should be conducted without the virtual reality.	
FG 3	Real-life trainings should be implemented whenever is possible, and VR training incorporated when necessary Implementing VR technology in education will help to learn about VR. It would be a good idea for universities to offer small courses related to virtual reality. Evidence of entrepreneurial mindset and soft skills activation among students: "some ideas really came to my mind after all of that VR, because now I'm thinking that I'm doing e-commerce and I'm thinking that it's really cool to implement if this technology would be widespread to the typical consumer, to the ordinary consumer, and people just can go to your website and see your product using VR technology and maybe in 3D. So, yeah, so even I see the result of just a test lecture we had today. I see the result even now. Yeah, I see the big potential in that technology"	
FG 4	It has great potential, but it's rather linked to our new growing population rather than past generations. It can be implemented most effectively with new generation of students.	

H2. INTERVIEWS WITH EXPERTS' RESULTS

SUBJECT MATTER: ABOUT THE EXPERIENCE OF PARTICIPANTS RELATED TO ENTREPRENEURIAL EDUCATION, AND/OR XR DEVELOPMENT TECHNOLOGY

EXPERT	**Experience with entrepreneurship/business education/XR-technology development for educational purposes**
XR Development	UCD Innovation Academy, Dublin, Ireland. AR/VR environments development expert, co-facilitator and tech support on a VR module for skills development in university context.
XR for Training	PUEB Department of Information Technology (KTI), Poznan, Poland. Teacher assistant with expertise working with virtual reality systems, extended reality systems, for applications in companies
Startups / Business Development	Trinity College, NDRC, Dogpatch Labs, Dublin, Ireland. Startup Ecosystems Development Director, Entrepreneurship Trainer, Business Accelerator Director
Entrepreneurship / Business Education	PUEB. International Competitiveness. Educator. Project Management, International Entrepreneurship, Edutainment, International Business Development, Entrepreneurial Education. Business owner.
IoT Education	PUEB Department of Information Technology (KTI), Poznan, Poland. IoT educator, IoT development expert
Communication, Leadership, & Management	UWK, Department for Knowledge and Communication Management, Course Director. Organizational Management, Organizational Leadership, Learning Challenges for Leaders and Organizations. Experienced in Soft Skills development among students (Emotional Intelligence and Leadership)
EXPERT	**Participation in projects or educative activities related to entrepreneurial and business education, and/or XR technology development for education purposes**
XR Development	VR for exploring art expression, developed VR software for education purpose, tech support for the implementation of a VR module for skills development. VR museum project for indigenous community in Brazil.
XR for Training	XR Systems for training factory workers and electricians, mostly focusing on hard skills. Participated in the implementation of XR technology to enhance education outcomes among factory workers and electricians. Focus on training very dangerous situations in a safe environment..
Startups / Business Development	Masterclasses for prospectives entrepreneurs, educational talks, business pre acceleration programs, entrepreneurship coaching, business founders support.
Entrepreneurship / Business Education	Erasmus projects oriented on creating/ implementing tools which could enhance entrepreneurial education: strategic games, and simulation games focused on business creation and management. Experience- based and practice-based learning. Virtual business model creation. Participated in the creation of strategic games, their framework, and functionalities.
IoT Education	VR displays and sensors development, interaction with smartphones. Provided support to university projects dealing with VR tech development for physics and chemistry lessons in primary schools provided by real teacher. Risky chemistry experiments translated into VR, VR museum, 3D artifacts manipulation.
Communication, Leadership, & Management	Responsible for a Communication and Leadership MBA Course, topics on entrepreneurship, situational learning focused on communication management in organizations. Implementation of a Moodle-based course.

Role of universities in the development of soft skills such as opportunity recognition, creativity, and innovativeness, to promote entrepreneurial mindset among students		
EXPERT	**THEMES**	**META THEMES**
XR Development	-Each university has a different focus depending on their academic offer in the global market. Producing knowledge, training. -Universities have a supporting role for soft skills development providing students with the tools and environments to do that. -Students are the ones who lead their soft-skills development.	**Market-Driven Focus** Universities tailor their roles according to market needs and their unique academic offerings in the global market. **Supporting Skill and Mindset Development** -Universities support students in developing both hard and soft skills. -Provide entrepreneurial knowledge and training -Aim to activate entrepreneurial thinking and enhance the entrepreneurial spirit. -Promote the development of emotional competencies, self-awareness, and leadership skills. **Diverse Methods and Environments for Skill Development** -Provide tools, environments, and diverse learning methods for soft skills development. -Offer problem-based techniques, state-of-the-art research, and virtual-based education.
XR for Training	Universities support students to develop their hard skills and a great variety of soft skills. Universities may provide entrepreneurial knowledge among students to show your capabilities. The role of the university is to research, to gain knowledge, and to study lots of different areas. University is the place to gather multiple stakeholders to work on different applications and to be able to create some new scientific breakthroughs	

Startups / Business Development	Provide understanding of entrepreneurship, entry point for entrepreneurial ecosystems, provide training to students on how to build a company, exposing students to speakers so they can see people that have done it and realize they can do it. Connecting students with successful entrepreneurs. Activating entrepreneurial thinking in students. Development of entrepreneurial mindset as early as possible. Access to supporting clubs.	-Present students with various mechanisms, tools, and technologies for learning. **Encouraging Technological Innovation** -Encourage students to become technology change-makers. -Teach how to use, apply, and understand new technologies and their advantages and disadvantages. -Empower students to lead their own soft-skills development and apply technology to solve real-world problems. **Research and Innovation** Conduct research, gain knowledge, and create scientific breakthroughs. -Foster innovation and advance various fields of study. **Entrepreneurial Ecosystem** -Serve as entry points for entrepreneurial ecosystems, gathering multiple stakeholders. -Expose students to successful entrepreneurs and connect them with speakers and supporting clubs. -Provide a network that fosters entrepreneurial growth and collaboration.
Entrepreneurship / Business Education	There's a longstanding dilemma whether entrepreneurship can be taught or not. There are aspects of the entrepreneurial mindset inherent to the individual's life, but universities can enhance the entrepreneurial spirit, the skills through learning, how to expand a business from a technical perspective. You can be born with some talents/capabilities/skills, but you need to exercise to become a champion. The university can help with this by providing problem-based techniques and other methods to practice the skills or cover the technical aspects of soft skills.	
IoT Education	The traditional role of the university is to present the students with all of these mechanisms, tools, and technologies. The real role of universities is to encourage students to imagine/think/research how to use these technologies, how to apply these technologies to solve real problems. Teach how to use the technology, advantages and disadvantages, where to use and under which conditions.	
Communication, Leadership, & Management	Universities and trainers are responsible to promote the development of soft skills such as emotional competencies/intelligence, self-awareness, to support students to become future leaders and managers, specially with the increasingly competitive work life. Knowing your competencies, skills, character, helps you to succeed in entrepreneurship, and universities have a crucial role in that regard. University should offer students different learning possibilities and be state of the art in different research, including virtual based education because this can be the future.	

SUBJECT MATTER: ABOUT THE PERSPECTIVES OF EXPERTS ON VR TRAINING FOR ENTREPRENEURSHIP SOFT SKILLS DEVELOPMENT

Perspective about the potential impact (enhance or limit) the development of entrepreneurial skills among students		
EXPERT	**THEMES**	**META THEMES**
XR Development	Anything you're describing through a pitch could be visually presented in front of others. Bring your audience to what you are visioning. Better visualization of ideas, opportunities, identification of risks. The possibility to experiment/simulate/prototype your idea virtually before you put it into action, reducing potential costs, and risks associated. It generates more opportunities for people. Try and error	**Enhanced Visualization of Ideas** -VR enables better visualization of concepts, opportunities, and risks. -Allows for visual presentations of pitches, bringing ideas to life for the audience. **Opportunities for Prototyping** -Facilitates virtual experimentation, simulation, and prototyping before real-world implementation. -Reduces potential costs and risks, promoting a trial-and-error approach. **Enhanced Soft Skills Development in a Safe Environment** -Provides a safe, controlled environment for overcoming the fear of presenting to large audiences. -Enables situational-based learning and decision-making without financial risks. -Positively impacts entrepreneurial skills by allowing practice in low-risk scenarios. **Enhanced Multicultural Remote Collaboration** -Connects individuals globally, enabling collaborative brainstorming and work sessions.
XR for Training	Great positive impact on students. Overcoming fear to presenting in front of a larger audience. Provide a safe environment from the perspective of a "different world" Potential impact on social connections if abuse.	
Startups / Business Development	Connecting with people from other part of the world, conduct brainstorming sessions and other collaborative sessions in VR environments,	

	including live translation to enhance collaborative work among people coming from different nationalities. Providing a diverse and different view to build more robust products.	-Includes live translation features to enhance collaboration among diverse nationalities. -Offers diverse perspectives to build more robust products. **Innovative Entrepreneurial Education** -Provides immersive and engaging learning techniques, making entrepreneurship education more effective. -Enhances understanding of entrepreneurship through attractive and stimulating audiovisual methods. -Enables activities beyond the limits of imagination, reaching younger students familiar with technology through gamified scenarios. **Potential Negative Impact on Social Connections if Overused** -VR may distance users from real-world interactions, limiting genuine human connection. -Communication is mediated by 3D avatars, restricting expressions and natural behaviors. -Users need training to distinguish between real and digital interactions and to communicate effectively in VR. **Ineffective Education Risks** -Requires users to utilize imagination in practical ways. -Limits the feedback trainers can provide due to lack of real gestures and reactions, especially for presentation skills. -Can be restrictive for trainers who rely on observing real-time student reactions. **Challenges for Older Students** -Difficult for older students who are not familiar with or open to the technology. -May not be suitable for those seeking real-world situations for soft skills development.
Entrepreneurship / Business Education	VR technology can really enhance the entrepreneurial education of students by providing immersive and more engaging learning techniques, more engaging learning processes. VR is not a game changer technology, classic methods allow us to teach the same, but VR can provide a more attractive and stimulating audiovisual way of teaching entrepreneurship making it more effective. Situational-based learning without financial risks. Experiment with situations, decision-taking under difficult situations in reality. Potential positive impact on entrepreneurial skills and abilities, that can be exercised under not risky and controlled situations.	
IoT Education	Communication in VR environments is mediated and limited by 3D avatars and VR tools capabilities, which can restrict or hinder users' ways of expression. Avatars' capabilities to transmit human expressions are limited. Users will need to be trained to keep the difference between real and digital environments interaction, and also specific ways to communicate in 3D environments under limited ways of expressions. There are natural behaviors that cannot be mimicked in the unnatural VR environment, and this can affect soft-skills expressions. In VR people can go beyond imagination, by doing things that are not naturally done, but people need to be trained to use this imagination in a useful manner.	
Communication, Leadership, & Management	It might help to improve the understanding concerning entrepreneurship. Depends on the generation. Possible to reach younger students familiar with the technology by gamifying working situations. More difficult for elder students not familiar/open to the technology and looking for real situations for soft skills development. It may sometimes distance people since you don't see the real person behind the avatar. Also, it can limit the feedback a trainer might provide without real input of student's real gestures/reactions during training, especially for presentation skills. Limiting for trainers which primary source of information is people's real reactions.	

Advantages and disadvantages that VR-based education might have over traditional education (e.g.: in-person instruction, and interaction, physical classrooms, materials, "unplugged", etc.) to enhance entrepreneurial skills, such as opportunity recognition, creativity, and innovation, among students		
EXPERT	**THEMES**	**META THEMES**
XR Development	Advantages: Immersive tech enables a feeling of presence, that you are with other people, from anywhere in the world. The possibility to create something easily in immersive environments. Dis-advantages: long-term psychological impact on users is unclear, especially related to social interactions and collaboration. Adoption time. Not accessible to everyone. Costly. Limited battery duration and usage. Headsets are heavy. Tracking sensors needs improvement.	**Advantages:** **Immersive and Innovative Remote Collaboration** -Enables a sense of presence, allowing collaboration with people from anywhere in the world. -Facilitates remote learning, socialization, and collaboration, making it possible to gather diverse opinions and ideas, such as for market discovery. -Enhances brainstorming and social learning with individuals not in geographical proximity. **Augmented Experience for Soft Skills Development** -Offers an immersive learning experience that enhances student engagement and interest. -Provides visually appealing and creative virtual classrooms, fostering creativity and innovativeness among students.
XR for Training	Advantages: versatility and variety of virtual environments, 3D working tools. Instant displacement between environments.	

	Disadvantages: costs, effort to develop, implement and use; technical limitations/software problems which make it time-consuming and unpredictable. VR is still not ready / developing	-Allows easy creation and manipulation of immersive environments. **Versatile Immersive Learning Methods** -Provides versatile and varied virtual environments with 3D working tools. -Enables instant displacement between virtual environments, such as virtual offices and tours. -Effective for teaching during situations like pandemics. -Reaches younger students familiar with technology through gamified working scenarios. **Disadvantages:** **Undesirable Potential Effects** -Raises health concerns and unclear long-term psychological impacts, especially related to social interactions and collaboration. -May distance users from real-world interactions, leading to mistrust and missing personal contact. -Users may struggle with not seeing the real person behind the avatar. **Complex Implementation** -Requires a long adoption time and significant effort to develop, implement, and use. -Involves complicated technology development and preparation of virtual environments. -Limited content availability can hinder effectiveness. **Costly** -High costs of purchase and upkeep pose significant barriers. -Financial constraints make widespread implementation challenging. **Technology Issues** -Limited battery duration and usage time. -Headsets are often heavy and uncomfortable. -Tracking sensors need improvement, and technical limitations/software problems make usage time-consuming and unpredictable. -VR technology is still developing and not yet fully ready. **Challenges for Older Students** -More difficult for older students who are not familiar with or open to technology. -Older students may prefer real situations for soft skills development. **Potential to Limit Teaching Efficacy** -Limits the feedback trainers can provide due to lack of real gestures and reactions, especially for presentation skills. -Trainers may find it challenging to rely on virtual cues instead of real-time student reactions. -Potential for distraction in the virtual environment. **Accessibility Issues** -Technology accessibility and inequality can create unfair situations in a general social and economic sense. -Not all students may have access to the necessary VR equipment.
Startups / Business Development	Advantages: brainstorming and being able to "be" in the same room working with other people coming from far distance and getting different opinions such as market discovery. Virtual offices, virtual tours. Disadvantages: purchase and upkeep cost, a big barrier.	
Entrepreneurship / Business Education	Advantages: immersive learning experience, enhanced student engagement and interest, visually appealing, easily to change environments, accessibility to remote learning, socialization with people from distant places, collaboration, social learning with people not in geographical proximity. Effective teaching in situations such as pandemics. Disadvantages: high cost, complicated technology development and preparation of environments, limited content availability, health concerns, headsets are uncomfortable, potential for distraction in the virtual environment. Issues with technology accessibility and inequality, might be unfair in a general social and economic sense.	
IoT Education	Advantages: possibility of being "at any place". Controlling the environment (adapt it to your desires), provides new ways of expressions. Disadvantages: the 3D environments have limitations and restrictions to represent reality, not everyone can use it due to physical limitations (sight issues), not everyone can adapt to the environment. Potential to exclude people (discrimination). Unrealistic representations of reality (being under the water while breathing air in reality), or artificial representation of reality	
Communication, Leadership, & Management	Advantages: Virtual classrooms might enhance creativity and innovativeness among students. Also from prior answers: Possible to reach younger students familiar with the technology by gamifying working situations. More difficult for elder students not familiar/open to the technology and looking for real situations for soft skills development. It may distance people since you don't see the real person behind the avatar. Also, it can limit the feedback a trainer might provide without real input of student's real gestures/reactions during training, especially for presentation skills. Limiting for trainers which primary source of information is peoples real reactions. Mistrust: if you don't know/see who's the person behind the avatar. Personal contact missing.	

Opinion about combining traditional education and VR-based education to enhance entrepreneurial skills among students

EXPERT	THEMES	META THEMES
XR Development	Integrating VR in traditional education is the common way to go. Use of VR to enhance impact of traditional methods, rather than replacing them.	**Complementary Integration of VR and Traditional Education** -VR should be used to enhance the impact of traditional teaching methods rather than replace them. -Combining both approaches can create a more effective learning environment. **Promoting Participation and Engagement** -VR can promote the participation of shy or less engaged students.
XR for Training	It could be used to enhance the lessons, promote participation of shy students	
Startups / Business Development	It depends on the specific use case. Collaborative brainstorming, also simulation of environments such as a store. The framework of virtual reality	

	needs to be adapted to the needs of the course. The use case needs to be clear to make VR use necessary, such as using multiple whiteboards in a room for multiple real-time brainstorming sessions that can be exposed to a virtual audience, architectural design, something you need to "physically see" in 3d.	-Enhancing lessons with VR can make them more interactive and engaging. **Case-Specific Applications** -The integration of VR depends on the specific use case and the course requirements. -Effective for collaborative brainstorming, simulations of environments (e.g., stores), and scenarios that benefit from 3D visualization. **Short VR Sessions with Traditional Follow-Up** -Short episodes in VR followed by traditional teaching methods can be advantageous. -Provides a safe and effective way of teaching through business simulations and interactive games. **Enhancing Real-World Scenarios** -VR can simulate real-world scenarios, providing practical, hands-on experience. -Enhancing real meetings with digital interactions can create a more dynamic learning experience. **Adapting to Course Needs** -VR frameworks need to be adapted to the specific needs of each course. -Clear use cases are essential for making VR integration necessary and effective. **Supportive Technology** -VR can serve as supportive technology, but its effectiveness in some scenarios remains uncertain. -It's crucial to evaluate how VR can best complement traditional teaching methods. **Diverse Learning Methodologies** -Combining different teaching methodologies caters to various learning styles and preferences. -A mixed approach can address the diverse ways in which students learn and retain information.
Entrepreneurship / Business Education	Integrating VR in traditional courses can be advantageous. Short episodes in virtual reality, followed by other more traditional techniques and method. Safe and effective way of teaching. Business simulations and games to practice skills in universities. It might serve as supportive technology to simulate real-world scenarios but it's unclear how effective this could be.	
IoT Education	Enhancing real meetings with the possibility of doing something in the digital world and vice versa.	
Communication, Leadership, & Management	A combination of different methodologies concerning teaching and education is always good, because learning occurs through different ways. Different types of teaching education, for each person with different focus and learning styles.	

Challenges they foresee in using/implementing VR technology to enhance entrepreneurial skills among students in university settings

EXPERT	THEMES	META THEMES
XR Development	Devices are not cheap. Difficult to implement at a large scale for numerous classes in universities due to limited budget. Purchase, replacement and maintenance costs.	**High Costs and Budget Constraints** -High cost of devices, including purchase, replacement, and maintenance. -Limited budgets making large-scale implementation difficult. **Technical Limitations** -Issues with tracking the full body, screen resolution, goggles, batteries, and software. -While some technical challenges are solvable, they still present significant barriers. **Health and Legal Concerns** -Health issues such as motion sickness and the long-term impact of VR use. -Legal issues related to public use of VR technology, some solvable at a bureaucratic level. **Engagement and User Experience** -Keeping students engaged and interested without causing boredom or fatigue from using headsets. -Ensuring the VR environment is varied and specific to the teaching process. **Demonstrating Effectiveness** -Proving the advantages and effectiveness of VR methods over traditional ones. -Justifying the cost-to-benefit ratio. **Teacher Readiness and Institutional Resistance** -Lack of readiness among teachers to implement and run VR technology in classrooms. -Resistance to change at the institutional level, particularly among "digital immigrants". **Student Acceptance and Satisfaction** -Ensuring students accept and are satisfied with VR incorporation in classrooms. -Meeting students' expectations for VR-enhanced learning. **Expression and Identity in VR**
XR for Training	Technical limitations: tracking the full body, screen resolution, goggles, batteries, software. Technical challenges are solvable Legal issues related to the use of this technology publicly. Costs. Health issues such as motion sickness. Some can be solved at a bureaucratic level, some such as health issues are still a big stopping point.	
Startups / Business Development	Cost, defining a clear use case to make the implementation of VR useful.	
Entrepreneurship / Business Education	Keeping engagement and interest of people in using the technology without being bored/tired of using the headsets. 3D-environments development, development/implementation costs, availability/variety of scenarios specific to teaching process. Demonstrating the advantages and effectiveness of these methods over traditional ones or other business simulations, the cost/effect relationship. Preparation of classes. Easier for young researchers and teachers more acquainted with the technology. Not easy for "digital immigrants". Lack of teacher's readiness for implementing and running the technology in classrooms. Resistance to change at institutional level. Ensuring acceptance and satisfaction of students when incorporating VR in classrooms, and that students' expectations can be fulfilled.	

IoT Education	The VR avatar might serve as a way of expression of yourself, then it might limit or enhance that way of expressions/identity depending on its characteristics and how it's used. Combining VR experiences and real activities in a smooth way is a challenge. Implementing and teaching the technology will take time, which is limiting from a business perspective when needed for situations in which you need to take fast decisions. Creating/finding the "market momentum" to implement successfully VR. Technological implementation needs technical skills and new ways of thinking	-How VR avatars serve as a way of expression and identity, which can be limited or enhanced depending on their characteristics and usage. **Integration with Traditional Methods** -Smoothly combining VR experiences with real-world activities. -Balancing VR and traditional methods to create an effective learning experience. **Time Constraints and Implementation Complexity** -The time required to implement and teach VR technology. -Technical skills and new ways of thinking needed for effective technological implementation. **Market Momentum and Adoption** -Finding the right "market momentum" to successfully implement VR. -Interest of trainers limited by system malfunctions, complexity, and lack of realism in avatars and environments. **Trust and Collaboration** -Building trust among students to work with people they don't know in VR settings. -Creating a positive atmosphere for effective group interactions and learning experiences.
Communication, Leadership, & Management	Interest of trainers to implement VR in class is limited by systems malfunctioning faced during the deployment of the technology, the complexity of using it, especially for those not familiar with VR, and the lack of realism of avatars and environments. Lack of trust among students to work with people they don't know. Creating a positive atmosphere to promote effective group interactions and learning experience. Implementation Costs.	

SUBJECT MATTER: ABOUT THE PERSPECTIVES OF EXPERTS ON IMPLEMENTING VR TECHNOLOGIES AND ENVIRONMENTS FOR ENTREPRENEURIAL EDUCATION IN UNIVERSITY SETTINGS

Opinion on universities incorporating VR technologies and experiences to enhance the learning of entrepreneurial skills		
EXPERT	**THEMES**	**META THEMES**
XR Development	Students report really good experience with that, but we cannot be so sure about the real effect upon it. Comparative studies need to be conducted to clarify the real benefits over entrepreneurial soft skills development. Many of the educators seem to be interested and curious about exploring different ways to interact and engage with students. The demand is there. Universities should incorporate XR and other kind of technology as they can. University's role is to bring what is happening in the world, generate opportunities and initiatives, providing resources and material for students to explore and try on.	**Positive Student Feedback but Need for Evidence** -Students report positive experiences with VR. -Need for comparative studies to clarify real benefits on entrepreneurial soft skills development. **Educator Interest and Curiosity** -Educators are interested and curious about exploring different ways to interact and engage with students. -There is a demand for innovative teaching methods. **Role of Universities in Technology Integration** -Universities should incorporate XR and other technologies as they can. -Universities have a role in bringing current trends and technologies to students, generating opportunities, and providing resources and materials for exploration. **Targeted Implementation** -VR should be implemented for specific purposes, such as research and remote classes, rather than replacing all traditional activities. -VR is beneficial for certain learning styles and can make content more accessible to neurodivergent students and those with learning difficulties. -VR can offer a safer environment for conducting studies. **Preparation and Investment** -Universities need to be prepared and knowledgeable about how VR works. -Investment in VR and other technologies is necessary. **Conditional Implementation** -VR should be implemented if certain pre-conditions are fulfilled. -Use VR in short sessions or specific virtual classrooms to avoid overexposure to digital devices and information overload.
XR for Training	It could be implemented for research, especially about VR; remote classes in VR. It should be implemented as a tool/training, and not to translate all organizational activities to the virtual world.	
Startups / Business Development	It could be for certain type of learning styles, it might make the content more accessible to some people, like neurodivergent people. It could be an interesting way of learning and helping people with learning difficulties. Conduct studies in a safer environment.	
Entrepreneurship / Business Education		
IoT Education	Universities need to be prepared, and how VR works. They should invest in VR and other technologies.	

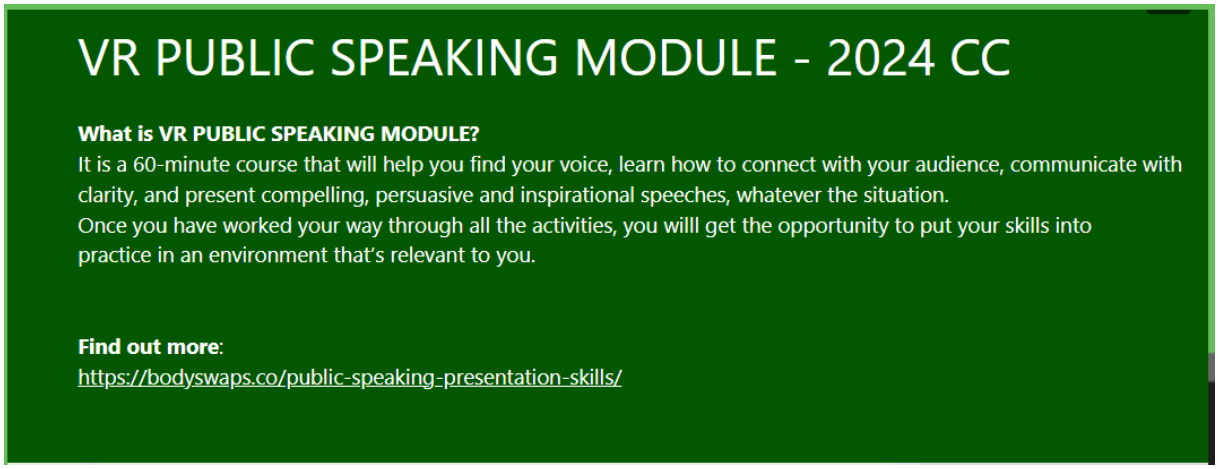
Communication, Leadership, & Management	Universities should implement VR if pre-conditions are fulfilled. Short or some sessions in a virtual classroom to avoid overexposure to digital devices, and overflow of information. Each department should decide whether they want to implement VR and how. Universities should seek to be state-of-the art	-Each department should decide on VR implementation based on their specific needs and goals. **State-of-the-Art Pursuit** -Universities should strive to be state-of-the-art in adopting new technologies and methodologies to enhance learning experiences.
Prerequisites for incorporating VR technologies at universities to support the education of entrepreneurial skills among students		
EXPERT	**THEMES**	**META THEMES**
XR Development	An open-minded and supportive environment for students, staff members or colleagues to embrace the technologies A culture that embraces change, and that understands that technology is still developing and under iteration. Effort, financial support. Definition of the use case to ensure that including VR is helpful (not vain use). Must satisfy real educational needs.	**Open-Minded and Supportive Environment** -Foster a culture that embraces change and understands the evolving nature of technology. -Encourage an environment where students, staff, and colleagues are open to adopting new technologies. **Clear Educational Use Cases** -Define specific educational needs and use cases where VR can be genuinely beneficial. -Avoid implementing VR for its own sake; ensure it addresses real pain points, such as supporting students with special learning needs. **Financial and Technical Resources** -Secure financial support to cover the costs of VR implementation. -Ensure availability of necessary hardware, such as a significant number of headsets from the same provider. -Provide adequate technical infrastructure, including a strong Wi-Fi connection and compatible computers/laptops. **Specialized Facilities and Applications** -Develop dedicated facilities for safe and comfortable VR experiences. -Create a standalone VR application exclusive to the university, supported by a team of developers. **Training and Expertise** -Train staff members to effectively implement and use VR technology. -Employ expert trainers and professionals knowledgeable in VR and its educational applications. -Encourage creativity and imagination to explore new and appropriate ways of using VR. **Technical Support and Readiness** -Ensure robust technical support to address any issues promptly. -Verify that staff and students are ready and willing to adopt VR technology in their educational activities. **Cost-Benefit Analysis** -Conduct thorough cost-benefit analyses to ensure that the investment in VR technology is justified. -Guarantee that VR tools and environments work perfectly and are user-friendly. **Governmental and Institutional Support** -Seek governmental support and funding to aid in the implementation of VR technology. -Align VR integration with professors' teaching topics and ensure it complements the curriculum. **Health and Safety Considerations** -Assure the health and safety of students and professors when using VR. -Address potential health concerns and ensure safe usage practices. **Demand and Need** -Ensure there is a clear demand and need from the student body for VR-based learning. -Assess and confirm that VR will have a positive effect on entrepreneurial skills and educational outcomes.
XR for Training	An important number of headsets from the same provider to use in the same environment. A standalone application for the exclusive use of the university, a team of developers, dedicated facilities for safe, and comfortable VR experiences. A strong Wi-Fi connection, adequate computers/laptops	
Startups / Business Development	Clear pain points in which VR can solve educational needs, such for example helping people with special learning needs.	
Entrepreneurship / Business Education	Ensuring financial and technical capacity. Acceptance and readiness among staff to use this type of technology. Training for staff to know how to effectively implement and use VR. Technical support. A clear demand/need from the student side.	
IoT Education	To have the technology, and trained people. Expert trainers to teach how to use VR, and trained professionals knowing how to use VR and its consequences. People with imagination to discover new appropriate ways of implementation and usage.	
Communication, Leadership, & Management	Positive effect to increase the knowledge concerning entrepreneurship or educational skills or soft skills needs to be guaranteed. Budget to cover implementation costs. Environments and tools must work perfectly and be user friendly. Costs/Benefits relationship. Governmental support (budget). Health and safety assurance for students and professors. VR needs to fit in professors teaching topic.	

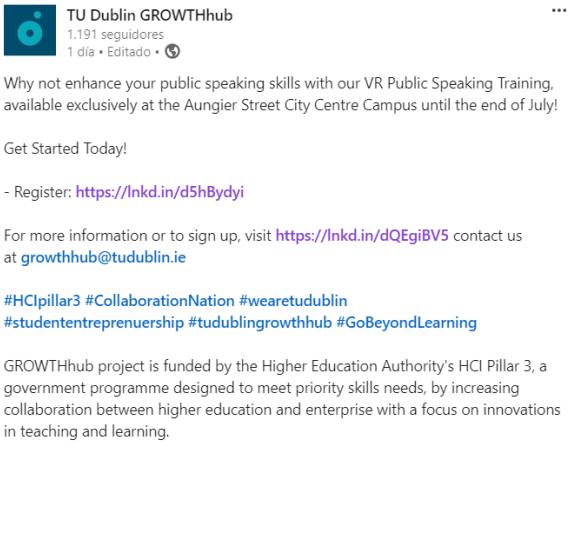
Other Important Remarks		
EXPERT	**THEMES**	**META THEMES**
XR Development	XR are tools to learn things from an extended, immersive and different perspective AI will help to the fast advancement of XR technology to build faster 3D models and environments, even throughout voice command. Although you can make the models/avatars more realistic it is still unclear if this increases interaction and collaboration and how this is perceived. Interaction within virtual space, what would be a safe space? Limitations to actions, mobility, social norms in virtual environments are yet to be defined. You need time to really develop soft skills and that's exactly what we don't have in VR.	**Extended and Immersive Learning** -XR tools offer an extended, immersive, and unique perspective for learning. -They provide new ways to experience and understand complex concepts. **Advancement with AI** -AI will accelerate the development of XR technology. -Future advancements may include faster creation of 3D models and environments, potentially even through voice commands. **Realism vs. Perceived Interaction** -There is uncertainty about whether more realistic models and avatars enhance interaction and collaboration. -The perception of realism's impact on virtual interactions needs further exploration. **Defining Safe Virtual Spaces** -Safe and effective interaction within virtual spaces requires clear definitions of acceptable actions, mobility limitations, and social norms. -Ensuring a safe virtual environment is crucial for user comfort and engagement. **Time for Skill Development** -Developing soft skills takes time, which may be a limitation in VR settings. -The time constraint in VR environments can affect the depth of soft skills development. **Awareness of VR Limitations** -Understanding the limitations of VR is essential for better management and realistic expectations. -Awareness of these limitations can guide more effective implementation strategies. **Cost Reduction through Globalization** -The more globalized and widespread VR technology becomes, the lower the costs might be. -The challenge is to demonstrate the usefulness and necessity of VR to justify its widespread adoption. **Technical Challenges** -Exposure to VR provides an interesting experience, but technical issues are common. -Addressing and overcoming these technical challenges is necessary for smoother implementation.
XR for Training	Awareness about VR limitations is crucial for a better management of potential implementation	
Business Development		
Entrepreneurship / Business Education	The more globalized and widespread VR technology is the less the costs might be. But the question is how to make it useful and necessary to the point it's widespread used.	
IoT Education		
Communication, Leadership, & Management	Exposure to VR. Interesting experience. Reports technical issues.	

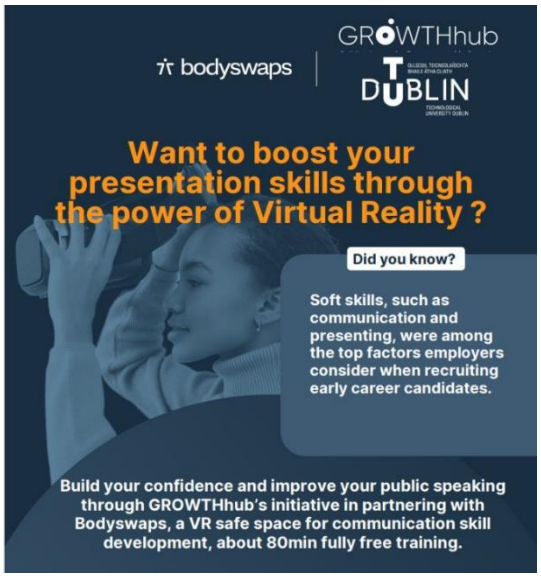
APPENDIX G

EXAMPLES OF OTHER VR MODULES FOR SOFT SKILLS DEVELOPMENT

TU DUBLIN







UCD INNOVATION ACADEMY

"In a major collaboration with enterprise, we're working with Cappfinity, a global strengths assessment organisation, to co-develop a self-led virtual reality programme that develops transversal skills. The programme takes the learner through a series of real-life workplace experiences in virtual reality informed by our decade of experience delivering experiential, immersive education. Through our learning partnerships model, we seek to demonstrate how higher education institutions and enterprise can work together for our mutual benefit"

Source: https://www.innovationacademy.ie/

Pwc pilot study. The Effectiveness of Virtual Reality Soft Skills Training in the Enterprise (pwc, 2020)