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**Generative AI's Influence on Design Thinking: Enhancing
Empathy through Extreme Users and Parallel Universes**

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Master Thesis

presented as a partial requirement for obtaining a master's degree in Data-Driven Marketing

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação

Universidade Nova de Lisboa

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by

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Master Thesis Work presented a partial requirement for obtaining the master's degree in
Data-Driven Marketing, with a specialization in Digital Marketing and Analytics

Supervised by

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July 15th, 2024

STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism, any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledged the Rules of Conduct and Code of Honor from the NOVA Information Management School.

Portugal, July 15th, 2024

DEDICATION

To my family

Raimundo, thank you for being my pillar and my strength. I would not have accomplished this without you. You were my energy source and constant support through tough and tougher times. From the beginning, you were there as we took on the challenge of pursuing our master's degrees while working simultaneously. Countless sleepless nights and weekends were spent studying, helping each other, and growing as individuals and as a couple. I am incredibly lucky to have found you and to have you as my fiancé, friend, lover, and classmate. Thank you, thank you, thank you. I love you.

Mario and Alma, you never stopped supporting my "crazy" ideas. "I want to travel the world," I said, and you were there for me. "I want to live in Europe," I declared, and you stood by my side. "I will do a master's degree in Lisbon," I claimed, and you never left me alone. Without your teachings and support, I would not be where or who I am today. Thank you for those long video calls, for listening to my process, and for trying to help with whatever you could. You are my community, not only my family. Thank you, and I love you, always.

Meme, my dear godmother and aunt, you have loved and supported me throughout my life, no matter what phase I was in. You have always wished me nothing but the best and cared about me in every possible way I could imagine. You gave me strength and showed me that women can achieve anything they desire with determination and resilience. You are one of my role models. Thank you for being one of the kindest and most caring people I have ever met. I am grateful to be your niece. I am always going to be there for you!

Iris, you enjoyed your time on earth as no woman has done. You lived your life with no fear of judgment; you traveled the world and pursued a career at times when people would reject you for being an empowered woman. You did not care, and I am lucky for it. I did not see it back when you were with us, but I do see it now. You taught me that a woman could be whatever she wants and that with hard work, all dreams can become goals, and all goals can be achieved. Thank you for being a rebel of your time and being my grandaunt.

Thank you to my sister, nephew, and grandparents, who have been there for me in tough times and supported me with their patience and loyalty. Thank you for being there for me in one way or another.

ACKNOWLEDGMENTS

I had never heard the term "design thinking" until a friend enrolled in a similar master's program mentioned his favorite class was precisely that. "What is design thinking?" I asked. He described it as merging design creativity with innovation's structured, empathetic phases. This conversation lingered in my mind during our walk to the metro station. As I deliberated over my research topic, that moment resurfaced.

What initially captivated me was the concept of integration at the heart of design thinking. It weaves together everything I had learned in my digital analytics program but with a pivotal addition - people. To me, people are the core of every process. AI is rapidly shaping our future, revolutionizing jobs and processes. However, a critical question lingered: How can we effectively integrate human needs and empathy into these AI-dominated areas? This quest for a harmonious blend of human-centric approaches and machine efficiency led me to my research focus: Design Thinking. Here, I saw an opportunity to explore how we can empathize with, understand, and include human perspectives while harnessing the power of AI to enhance these actions.

Right there, with little knowledge about the topic but much enthusiasm, is where I thought of Professor Victorino. I have had another course with him, and I knew he was a reference for design thinking and its studies. I reached out to him, and I was lucky enough to have his acceptance as my advisor and somehow mentor. Professor, I am deeply grateful to you for guiding me through this harsh process and letting me be myself despite my divergence and intensity on multiple occasions along the journey. Thank you for grounding me when necessary and letting me explore my passions at other times. You are the best advisor I could have picked! I hope this thesis reflects our work together because it would not have been possible without you.

Thank you then, Miguel Aguilar, my Mexican mate! You introduced me to Design Thinking without knowing how important it would become. Thank you, Professor Victorino, for teaching me and guiding me from scratch in developing what I can now call a passion.

ABSTRACT

This research explores integrating Generative AI into the inspiration phase of the Design Thinking process to enhance creativity and problem-solving. The argument is that new technologies should not be seen as a threat to human capabilities when working on innovation or finding solutions for decision-making but instead viewed as a cohesive tool with which we can improve the insights generated on the first and most crucial phase of the design thinking process, empathize. This investigation explores how AI was incorporated and analyzed with human-centered methodologies and approaches throughout design thinking procedures like extreme users and parallel universes to better perceive experiments' effectiveness. Master thesis students were challenged to improve their master thesis journey through the mentioned design thinking methodologies. Their understanding and results were compared to those given by a Generative AI model called ChatGPT 4, which was also tested in the same evaluations. A panel of experts qualified the proposed new practices and surprisingly generated divergent outcomes through quantitative and qualitative methods. In the Extreme Users methodology, Human results predominantly won, with 62.5% of the insights originating from people vs. 37.5% from ChatGPT 4. In contrast, in the Parallel Universe experiment, two of the three conclusions that were selected by a panel of experts were constructed by Generative AI. At the same time, only one was created by humans. Combining the two approaches leverages creativity and problem-solving by giving new insights that can be complemented or matched with human perceptions, making the process more empathetic for users and efficient for designers, creators, engineers, or any Design Thinking enthusiast.

KEYWORDS

Design Thinking; Empathize; Generative AI; Innovation; Problem-solving; Creativity

Sustainable Development Goals (SDG):



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LIST OF ABBREVIATIONS AND ACRONYMS

RtD	Research Through Design
HCI	Human-Computer Interaction
Gen AI	Generative AI
DtP	Design Thinking Process
LLMs	Large Language Models

1. INTRODUCTION

As technological upgrades are reshaping all fields, incorporating Generative AI within the Design Thinking approach is seen as an essential improvement. This research seeks to understand how Generative AI can be integrated into the emphasized phase of the design thinking process to strengthen creativity and problem-solving.

Design thinking, a human-centered methodology, excels at comprehending people's needs by being emphatic with its users. This methodology's basic approach is to improve the product design journey, which begins with an idea and ends with producing a physical artifact (Ulrich et al., 2012). This thesis aims to gather data-driven insights to foster more innovative techniques by blending Generative AI with design human-centered practices (Booth et al., 2024), not just any design process but Design Thinking and its methodologies.

Design Thinking is a flexible critical thinking method that overcomes conventional design constraints and is suitable across numerous disciplines (Norman, 2013). Embedded through empathy and a deep awareness of life events, it combines automated options and consumers' necessities (Brown, 2008). The procedure is separated into three phases: inspiration, ideation, and implementation, each very important in fostering innovation. The emphasize phase also called the inspiration phase, targets comprehending people profoundly through hands-on involvement, study, and envelopment knowledge (Brown, 2008; Kelley, 2013; Liedtka & Ogilvie, 2011).

Empathy in design thinking suggests acknowledging direct user requirements and unveiling hidden, unexpressed needs through immersive and observational techniques. This far-reaching utilizer perception is essential for generating responses that align with the customer's environment and ambitions (Brown, 2009; Kelley, 2013). Nevertheless, traditional methods of empathy-building can be time-consuming and may overlook subtle patterns and insights that large datasets can reveal (Susie Crowder et al. (2021))

Generative AI, with its capability to break down vast data sets and detect trends, presents a game-changing capability for the inspiration stage. By manipulating user-driven data, AI can see unrevealed perceptions that might not be instantly clear to human eyes (Dove & Jones, 2020). As Dalsgaard and Dindler anticipated, technology enriches the depth and scope of empathy, facilitating designers' creation of more subtle and complete user personas and scenarios (Dalsgaard & Dindler, 2014).

Some generative AIs can mirror and amplify numerous sides of the designing procedure, from the first phase, ideation, to prototyping and user trial (Houde et al., 2022). In the inspiration phase, Generative AI's ability to analyze extensive information and produce elaborated user personas can significantly improve designers' perception of user needs and behaviors (Vincent Hunt, 2023). This thesis aims to discover if techniques like the "Parallel Universe" and "Extreme Users" can become more innovative by using new technologies during the design

thinking process by exposing substantial insights and innovative alternatives that standard practices may pass over (Brassett, 2016; Sanders et al., 2008).

Finally, the study uses hybrid approaches, combining quantitative surveys and qualitative experiments, to comprehensively understand AI's effectiveness and innovation potential in design thinking (Creswell & Creswell, 2018).

2. LITERATURE REVIEW

2.1. DESIGN THINKING: A HUMAN-CENTERED METHODOLOGY

Design thinking, a human-centered approach, leverages the designer's toolkit to harmonize people's needs, technological possibilities, and business requirements, leading to innovative outcomes (Brown T, 2009.). This approach transcends product design; it is a versatile problem-solving methodology applicable across diverse fields (Norman D, 2013.). The concept of adopter ecosystems extends this process by underlining the importance of understanding not just individual users but the entire chain of actors—individuals, communities, and other networks—that interact with a product or service (Youngblood et al., 2023). Further, design thinking broadens to encompass wider social, economic, and environmental contexts (Youngblood et al., 2023). Design thinking is particularly potent in tackling complex problems due to its holistic and flexible nature, serving as an integrative practice that bridges the humanities, science, and technology by underscoring the significance of focus on human experiences and needs at every level of design, being deeply empathetic and responsive to human conditions (Buchanan, R. 1992).

To be a creative problem-solving approach that is deeply human-centered, this methodology is structured into three distinct phases, each essential for driving innovation and practical solutions (Lockwood et al., 2017). The foundational inspiration phase focuses on profoundly understanding the problem or opportunity. This incorporates communicating openly with people, putting each other in their shoes, understanding their context and considerately grasping their needs and drivers. Such immersion ensures that the solutions developed genuinely reflect user needs and are grounded in real-world contexts (Brown et al., 2012).

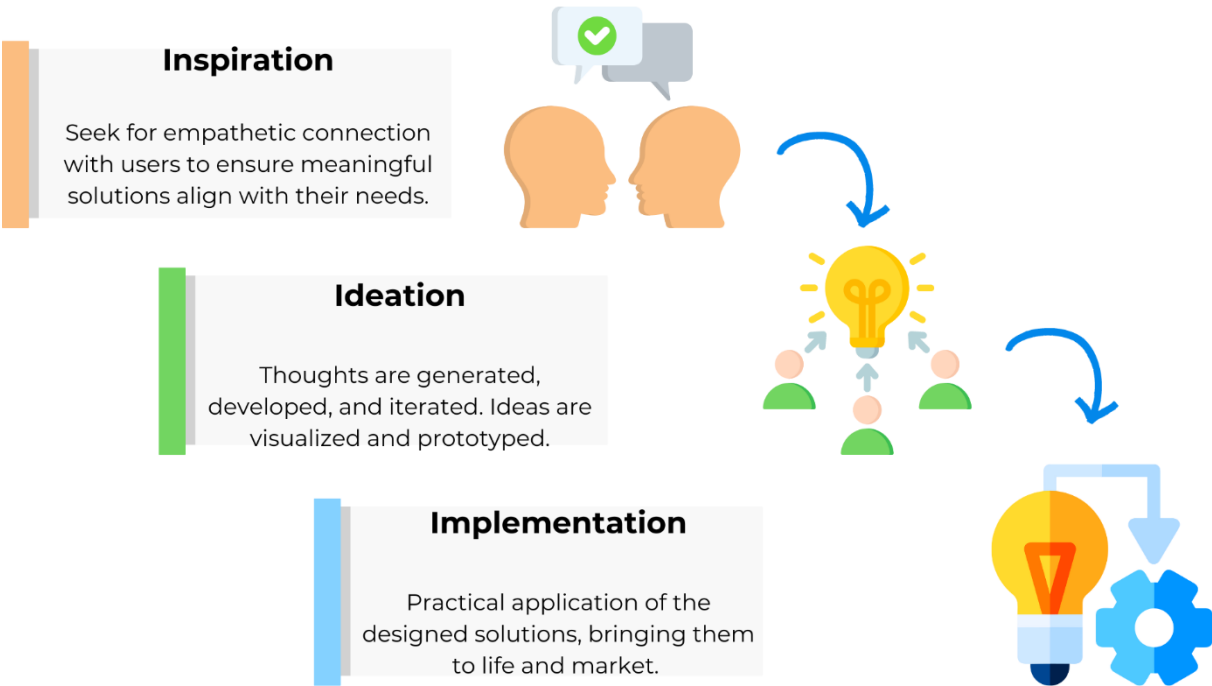


Figure 1 - Design Thinking Phases

The empathize phase will be studied in this thesis since it is the fundamental pillar and first step in comprehending people's profoundly and holistically. Empathize or inspire consider real engagement with users, using methods such as observations, interviews, and immersive experiences to collect qualitative perceptions into their necessities, behaviors, feelings, and experiences (Brown, 2009; Kelley & Kelley, 2013; Liedtka & Ogilvie, 2011). The importance of observation in uncovering the often-unarticulated needs of users suggests that innovative solutions arise from a profound understanding of people's real-world interactions and experiences. Empathy is a conduit for creativity, arguing that seeing the world through another's eyes can spark insights that lead to groundbreaking innovations (Brown, 2009; Kelley et al., 2013).

Empathy extends beyond individual insights to encompass a broader understanding of human behavior and societal trends (Brown, 2009). Observing what people say and what they do not say reveals the latent needs that traditional market research methods might overlook (Dove & Jones, 2020). This approach is enriched by integrating Generative AI technologies, which can analyze vast amounts of data to identify patterns and insights that might elude human observers, thereby enhancing the empathize phase's depth and breadth (Vincent Hunt, 2023). In design thinking it also involves a shift from a problem-solving mindset to one of opportunity identification, where designers are urged to use their insights to envision innovative solutions that genuinely resonate with users (Liedtka & Ogilvie, 2011).

The collaborative nature of this stage is crucial, involving designers, users, and stakeholders in a co-creative process that ensures the final product is both desirable and meaningful to its planned audience (Houde et al., 2022). However, the human-centered methodologies approach is the first groundwork for creating solutions that resonate with users (Norman, D. 2013). Two of them will be crumbled to analyze better the co-creation relationship between designers, researchers, and users and how they do or did better understand the real end consumer's experiences: Parallel Universe and Extreme Users.

2.1.1. PARALLEL UNIVERSE

The "Parallel Universe" method is an original technique used in the inspiration and ideation phases of design thinking process. It encompasses imagining different scenarios or realities to understand better people's requirements and create novel alternative solutions for them (Dunne et al., 2013). This system encourages designers to think further about conventional constraints and explore broader possibilities. By employing the Parallel Universe method, designers are prompted to consider how a product or service would function in a different societal, technological, or environmental context. This practice helps uncover hidden needs, desires, and potential obstacles that may not be apparent in the current situations. It is particularly useful for speculative design, encouraging radical thinking and the exploration of future possibilities (Dalsgaard, 2014). Parallel Universe emphasizes the integral role of

situational understanding and systemic thinking, advocating for a design practice deeply rooted in empathy and innovation. By engaging with the concept of a "Parallel Universe," designers are encouraged to immerse themselves in diverse perspectives, imagining alternative scenarios that deepen their understanding of user needs and behaviors (Brassett, J. 2016). This imaginative leap is not just about creativity but a methodological step toward uncovering latent needs and fostering a design environment ripe for innovation (Dalsgaard, P. 2014).

Design is a dynamic, iterative process where experimentation and learning from different contexts are dominant (Ulrich et al., 2012). This aligns intensely with the inspiration phase, highlighting the need to accept a broad, inclusive view of user experiences to drive meaningful, empathetic design solutions. By embracing speculative design, which delves into envisioning future scenarios and possibilities, designers can transcend conventional boundaries, thereby deepening their empathy and insight into the human condition (Brown, 2012). As a framework, it fosters a design process that is more wide-ranging and innovative, as it accounts for a wider array of human events and capabilities. Through speculative design, we're encouraged to consider the present realities and the myriad ways in which future technologies, societal shifts, and environmental changes could affect human experiences. This, in turn, propels designers towards more holistic and forward-thinking solutions (Brassett, 2016).

2.1.2. EXTREME USERS

The "Extreme Users" technique centers on connecting with people who have unusual, amplified, or distinct situations with a product or service. These people usually demonstrate extreme challenges, necessities, or aspirations that are hidden when concentrating uniquely on the traditional user. By comprehending these extremes, designers can see new perspectives that guide to more innovative and holistic solutions (Sanders et al., 2008). Engaging with extreme users helps identify unmet needs and opportunities for innovation that would be missed when designing for the average user. This tactic is very important for increasing empathy in the design procedure and guaranteeing that solutions are inclusive and cater to a broad amount of people (Vianna et al., 2011).

Incorporating the viewpoints of extreme users—those who see the world in ways that diverge significantly from the dominance—can profoundly enrich the design practice. These users, who may face unique physical or cognitive challenges, bring to light needs often hidden when designing with only the average user in mind (Vianna et al., 2011). By simulating these extreme user experiences, designers gain invaluable insights that foster a more profound sense of empathy and drive creativity and innovation. This approach is efficient in the empathize phase of design thinking, where understanding the full spectrum of user experiences drives innovation (Sprintbase, 2020). Throughout these angles, the design becomes a more all-encompassing strategy, safeguarding that products, services, or systems serve to a wider scope of necessities and inclinations. Such a method underscores the changing potential of

embracing diversity in user experiences, pushing the boundaries of conventional design to include those at the edges of user demographics (Raviselvam S., 2021). This strategy not only enhances the relevance and accessibility of design outcomes but also amplifies their innovative capacity, making a compelling case for the systematic inclusion of extreme user experiences in mainstream design (Raviselvam & Wood, 2021).

2.2. HUMAN-CENTERED METHODOLOGIES CHALLENGES

In collaboratively designing, people's engagement, including those from "Extreme Users" teams and those within "Parallel Universes," aids as a foundation of innovation. The discrepancy in user involvement, persuaded by user abilities and excitement, accentuates a significant challenge in leveraging the full spectrum of potential that co-design offers (Sanders & Stappers, 2008). This barrier is further complicated by methodological complexities, such as the exploration of other possibility cases and the focus on users with unique needs, which can sometimes lead to solutions that overly specialize, potentially sidelining the broader user base (Brown, 2009; Liedtka & Ogilvie, 2011).

A key factor is the need for a cultural and power-structure change within design groups. Going to a model that puts value in collaborative creativity over unique competence commands a review of settled hierarchies, striving to encourage an atmosphere where ideas can prosper through democratic contribution. This shift is instrumental in addressing the methodological challenges by encouraging diverse perspectives in the design process (Sanders & Stappers, 2008).

Central to navigating these complexities is the creation of in deep empathy towards people, a process that again, considers immersing oneself in their experiences to uncover overlooked needs—requirements that users themselves might not be conscious of (Lamiell, J., Ming, A., Ollapally, P., Turk, J., & Yom, C. (2024)). This level of empathy and understanding demands designers to interpret the underlying motivations and behaviors beyond what is stated, a nuanced task that underscores the importance of observational acuity (Sprintbase, 2024). Recognizing these needs and interpreting non-obvious details are essential skills, reflecting the depth of insight and intuition necessary for meaningful design solutions (Norman, 2013; Brown, 2009).

Moreover, the role of varying thinking in fostering new and innovative approaches cannot be overlooked. By embracing a broad exploration of thoughts, including those that emerge from the complexities of the "Parallel Universe" and "Extreme Users" methodologies, designers are better equipped to create solutions that not only meet the unique needs of diverse user teams but also push the boundaries of creativity and innovation. This strategy secures that designs are tailored to specific user engagement and all-inclusive of the broader community's needs, stabilizing treatments with word wide applicability (Brown, 2009; Liedtka & Ogilvie, 2011).

2.2.1. INTEGRATING GENERATIVE AI AND HUMAN-COMPUTER INTERACTION (HCI)

The "Research through Design" (RtD) approach posits design practice as a scholarly inquiry that generates new knowledge, particularly salient in the fields of interaction design and Human-Computer Interaction (HCI). HCI focuses on designing and using computer technology, especially regarding the interfaces between people (users) and computers (Zimmerman et al., 2007). Within this framework, Generative AI's role is pivotal—not merely as a tool for outcomes but to bridge cognitive gaps between designers' intuitive understanding and insights derived from data analysis. Integrating Generative AI into HCI and the design process enhances empathy by providing a deeper comprehension of user needs, facilitating more intuitive and user-centered designs (Susie Crowder et al., 2021).

Empirical studies underscore Generative AI's transformative potential in uncovering hidden patterns and preferences in user data, facilitating a deeper empathetic connection between designers and users. This connection is vital for creating products that resonate personally and emotionally with users, demonstrating AI's capacity to enhance the empathetic design thinking process within HCI contexts (Vial, 2019). Despite AI's analytical capabilities, the indispensable value of human intuition, especially in interpreting complex emotional and social cues, remains crucial for empathetic design outcomes. Advocating for a balanced approach that leverages AI's data analysis and the nuanced understanding human designers bring to the table ensures that designs are meaningful and impactful (Houde et al., 2022).

Looking forward, the integration of AI into HCI and the design thinking empathize phase is envisioned to evolve, becoming a collaborative partner capable of generating ideas that deeply resonate with human emotions and experiences (Colusso et al., 2019). This evolution predicts a future where the distinctions between technology-driven and human-centered methodologies blur, fostering a collaborative synergy between AI and human designers to prioritize user empathy in design, embodying the essence of HCI's focus on improving the interaction between users and computers (Lee & Hughes, 2021).

2.3. COMPARATIVE ANALYSIS: GENERATIVE AI VS. TRADITIONAL METHODS

Generative AI has been, and it is, an outbreaking technological innovation from the beginning of the 21st century that shockingly changed access to creative design. Imagine Generative AI as a bright, automated, creative companion mechanized run by complicated data processor algorithms. With a soft push, it is like having a system that can proficiently write whatever material is asked for besides crafting images, music, or videos (Saetra, 2023). The most surprising part is that generative AI uses a significant amount of knowledge comparable to how humans assemble information from their memories and experiences besides learning

from books. It carefully analyzes this broad fact set, allowing it to bring about authentic appeasement (Xu et al., 2023).

When asking ChatGPT or Gemini (Generative AI standard tools) that are also Large Language Models (LLMs), to generate something for you, whatever it is, it uses its database to take knowledge and create something different and crisp. However, AI is still in its learning phase; even the newest updates are still biased and could sometimes provide errors or make content that would not align with people's expectations (Caulfield, 2023). Still, it is an excellent engine for enhancing the imagination, welcoming innovative advancements in the arts, design, and technology, among other fields, and transforming how we perceive and shape design (Saetra, 2023).

Although innovation and creativity are perceived as characteristics of people, they are specified by our talent to spawn new, unpredictable, and constructive opinions or artifacts (Kelley, T. 2013), the rise of smart devices, specifically Generative AI, is testing and mutating this interpretation (Xu et al., 2023). In her book "The Creative Mind: Myths and Mechanisms" (2004) Margaret Boden proposes a lucid discernment of creativity. She classifies it into P-creativity (personal creativity) and H-creativity (historical creativity). P-creativity is about creating ideas that are novel to a person, like private experience insight or 'eureka' moments. On the other hand, H-creativity includes concepts new to the entire human species. Large Language Models (LLMs) like ChatGPT4 can develop meaningful outputs in usefulness and appeal, yet their originality is more challenging to gauge. Novelty means producing something previously unseen, which LLMs can achieve through varied prompts. However, in terms of producing something dissimilar from existing examples, LLMs are limited by their training data, often generating outputs similar to past data (Montreal AI Ethics Institute, 2023).

Still and d'Inverno (2019) explore the creative nature of individuals, echoing John Dewey's idea. "Creativity is an intrinsic phase of humanity, interwoven with our intellect and thought processes." They put forward the notion that creativity is not only related to assembling a novel factor or situation but to enveloping extensive reflection and personal history, domains where Generative AI might not achieve to completely resemble people's aptitudes (Still & d'Inverno, 2019). This vision shows that creativity encompasses both the strategy and the result, interweaving encounters with innovation.

Tackling the anthropological aspect, creativity is not a ubiquitous principle but changes within social systems and periods (Du Sautoy, 2019). This mindset is indispensable in recognizing the responsibility of Generative AI to be creative, as it accentuates the promise restrictions of AI in understanding the different cultural environments that influence creative manifestation (Montreal AI Ethics Institute, 2023).

Additionally, while navigating these features, the notions of combinatorics and emergent creativity were unveiled (McCormack & d'Inverno, 2012). Combinatoric creativity is like mixing ingredients in novel forms to develop new formulas, a job where the AIs exhibit potential (Lee, K.-F., 2018). Emergent creativity, nevertheless, relates to creating completely novel ideas or paradigms, close to shaping a new culinary category, a field controlled mainly by personal resourcefulness (McCormack & d'Inverno, 2012).

However, how can AI be integrated into a design process to leverage creativity? The design exceeds the simple fabrication of products; it includes judgment and knowledge, specifically in creative and innovative spaces (Lockwood, T., & Papke, E., 2017). Emerging technologies substantially add to this discipline, not only in the palpable feature of designing, but also enrich the wider expertise pillar and shape future design patterns (Gero, 2002). On Parametric Modeling in Design, for example, computer programs can make design processes more efficient and adaptable. Integrating Generative AI with parametric modeling can revolutionize architectural and design workflows, allowing designers to rapidly prototype and iterate designs with enhanced flexibility (Janssen & Stouffs, 2015).

The incorporation of AI into design represents a fundamental shift in creative methodologies. The role of generative algorithms indicates a transition from conventional design methods to more dynamic, AI-driven practices (Makarius et al., 2020). Additionally, using Generative AI in the creative design process significantly accelerates the development of novel products, illustrating the synergistic potential of technology and human creativity (Malone, 2024).

Integrating Generative AI in design and creative processes signifies a fusion of computational power with human creative prowess (Ronald Beghetto, 2022). AI excels in processing extensive data sets and generating new ideas, providing inspiration and challenge for designers. Nonetheless, a deep understanding of cultural contexts, emotional nuances, and the creation of new meanings remains a distinctly human attribute (Gero, 2002). Thus, while AI emerges as a powerful tool for designers and creatives, augmenting their abilities and opening up unprecedented possibilities (McKinsey, 2024), the essential human element in the creative process continues to be irreplaceable and invaluable (Caulfield, 2023; Saetra, 2023)

2.4. ENHANCING CREATIVITY AND INNOVATION

Gero's work (2000) on computational models in design has been a pillar in shaping the discussion around AI's capacity to improve creativity and innovation in the design process. Gero explores the concept of "design thinking" as an iterative process that benefits from computational interventions. Generative AI, through its ability to replicate difficult design scenarios and generate many potential solutions, can extend the creative reach of human designers. This augmentation is not only about offering solutions that designers could create independently but about pushing the boundaries of creativity by revealing options beyond the scope of human understanding (UX Magazine, 2024).

The value of Generative AI lies in its capacity to help as a source of inspiration and a cause for creative thinking. This suggests that human designers and AI interaction can create a cooperative relationship (Malone, 2024). This relationship fosters an ecosystem where technological creativity complements human creativity, allowing the exploration of unknown design territories and the discovery of solutions to complex problems (Koc, 2024).

In opposite with Gero's focus on computational creativity, Norman (2013) explores the value of human insight and intuition in the design process. Norman's critique of over trust in technology highlights the unique contributions of human designers, particularly their ability to understand the emotional and cultural contexts of design challenges. He claims that traditional design methods, based in deep human insights, are incomparable in their ability to connect with the user's emotional and cultural dimensions.

While Generative AI can improve the efficiency and scope of the design process, it misses the understanding of human values, emotions, and cultural distinctions that are crucial for innovative design; it is a tool that does not know nor understand what empathy means and therefore cannot innovate (Norman, 2013). However, AI cannot fully replicate the depth of generating insights from people's life journeys and compassion, emphasizing the importance of a balanced approach that leverages human intuition and AI's computational power (Calls9 Insights Team, 2023).

Gero's (2000) and Norman's (2013) perspectives highlight a complementary relationship between emerging technologies and traditional design methods. Gero's support for computational creativity to increase human creative processes suggests a forward-thinking approach to design innovation. In contrast, Norman's emphasis on the irreplaceable value of human insight highlights the need for design to remain deeply rooted in human experience and cultural understanding.

2.5. DECISION-MAKING AND PROBLEM-SOLVING

As discussed in this thesis, AI technologies can process vast amounts of data to uncover insights and patterns not immediately apparent to human designers. This capability is crucial in complex design scenarios where the entire volume of variables and potential outcomes can overwhelm traditional analytical methods (McCormack and d'Inverno, 2012). By leveraging data-driven insights, creators can make more accurate decisions, reducing the reliance on trial and error and naturally direct operations (McCormack & d'Inverno, 2012). Generative AI's ability to reproduce and forecast outcomes can significantly simplify the design process, enhancing efficiency and leading to more innovative solutions. This decision-making approach expands the designer's toolkit and introduces a level of precision and planning that was previously inaccessible (Dove & Jones, 2020).

On the other hand, the importance of human intuition and tacit knowledge in design problem-solving is essential in the design thinking process. The nature of this creative problem-solving method reveals that the natural understanding and insights gained through years of

experience are fundamental to navigating the complexities of creative restrictions. This deep, experiential knowledge allows designers to make judgments sensitive to each project's unique contexts (Cross, 2001).

Cross highlights that while technology can offer valuable data-driven insights, it misses the capacity for empathy, intuition, and the tacit understanding that human designers bring to the table. These human attributes are important for truly creative problem-solving, where understanding the customer's needs and the complexities of human behavior are the key. The integration of AI should not seek to replace these human elements but rather to enhance them, ensuring that the design workflow remains based in human-centered values.

The different views between McCormack and d'Inverno's (2012) support for technology in increasing decision-making and Cross's (2001) defense of human intuition and experience underscores a wide conversation about the optimal integration of technology and human insight in design. This discussion suggests that the future of design stands in a balanced approach that leverages the predictive and analytical capabilities of AI while valuing the irreplaceable intuition and tacit knowledge of experienced designers.

2.6. USER EMPATHY AND UNDERSTANDING

Generative AI's ability to process and analyze big amount of user-generated data can reveal patterns and insights that might remain elusive through conventional analysis. This dive into user data allows designers to enter a more nuanced understanding of user needs, preferences, and behaviors, potentially transforming the empathize phase of the design process (Dove & Jones, 2020). In addition, the data-driven approach emphasizes the irreplaceable value of direct human interaction in developing more empathy toward users. Brown argues that empathy, a basis of design thinking, is cultivated through personal engagement and the direct experience of users' lives, contexts, and emotions. This depth of understanding, according to Brown, shapes the foundation of empathetic design, enabling designers to create solutions that reflect in a deeply personal level with users (Brown, 2009) Again, this perspective highlights the importance of maintaining a balance between leveraging AI's capabilities and supporting genuine human connections to understand and empathize with users effectively (Brown, 2009).

The dialogue between the capabilities of Generative AI and the value of human-centered approaches in understanding and empathizing with users; its use to enhance user understanding suggests a future where AI tools play a fundamental role in improving the empathize phase of design (Dove & Jones, 2020). In contrast, the irreplaceable depth of understanding achieved through direct human interaction reminds us of the essential human aspect of design (Brown, 2009).

2.7. BRIDGING THE GAP

Recent technological advancements reduce the distinctions between Generative AI and traditional, human-centered methods. Researching the growth of AI to enhance the design journey by providing deep perceptions of user behavior, choices, and needs through refined data analysis techniques (Xu & Gao, 2023). AI's capacity to analyze and interpret large datasets can discover trends that may not be immediately visible to human designers. This capability is important in the empathize phase of design, where understanding fine distinctions in user behavior can lead to more empathetic and user-centric design solutions (McKinsey, 2024).

Insights generated by AI can significantly improve the empathetic connection between designers and users. By maximizing AI to examine user data, designers can earn more comprehensive view of the user experience, including aspects that users may not be aware of. This depth of insight allows them to approach their task with increased compassion, creating designs more closely aligned with user requirements and hopes (Canva Newsroom, 2023).

Integrating AI-generated insights with traditional design practices represents a promising pathway toward more empathetic design. It suggests that Generative AI does not substitute the human element in design but boosts it, acting as a tool that can deepen our awareness of people and inform the design process in meaningful ways (Ziv Epstein, 2023). Also, the work of Dalsgaard and Dindler points toward a future where the boundaries between technology and traditional design methods become increasingly blurred. In this evolving landscape, the most successful design approaches will likely be those that effectively integrate Generative AI insights with the depth of understanding that comes from human empathy and intuition (McKinsey, 2024).

Integrating Generative AI with traditional design methodologies catalyzes a profound shift towards enhancing creativity and innovation in design. Generative AI extends the creative potential of designers, facilitating the exploration of solutions that surpass conventional human thinking (Hunt, V., 2024). This technological advancement is not merely an augmentation of the design process but a collaborative venture that merges computational creativity with human ingenuity, significantly broadening the ecosystem of possible design solutions. This blend of AI and human creativity is a pivotal advancement (Xu et al., 2023). This suggests that such integration propels design into uncharted territories, where the combined forces of human and machine intelligence foster groundbreaking innovations (Canva Newsroom, 2024). Despite technological enthusiasm, the essence of human intuition and the nuanced understanding of emotional and cultural contexts retain its pivotal role in design. While AI enhances efficiency and broadens the scope of the design process, it cannot fully grasp the complex web of human emotions and cultural subtleties. This perspective champions a balanced approach where technology augments human capabilities rather than replaces them, ensuring that design remains deeply rooted in human experience and empathy (Norman, 2013).

In contrast, when evaluating decision-making and problem-solving in design, the benefits of Generative AI in processing large quantities of data to uncover new insights are visible. AI's role in enhancing precision and foresight in design decision-making offers a level of analytical depth that traditional methods struggle to achieve (McCormack & d'Inverno, 2012). However, this idea underscores the enduring value of human intuition and experiential knowledge. AI provides valuable data-driven insights, and the depth of understanding that comes from years of design experience and human intuition is irreplaceable, advocating for a design process that integrates the best of both (Beghetto, R., 2022)

The analysis around user empathy and understanding reveals how Generative AI can offer deep insights into user needs and behaviors, potentially transforming the empathize phase of design. How? AI's ability to analyze user data enriches designers' understanding, enhancing the personalization of design solutions (Dove & Jones, 2020). Nevertheless, the value of direct human interaction in cultivating empathy is irreplaceable since genuine empathy stems from engaging with users' lives, suggesting that AI, while helpful, cannot replace the nuanced understanding gained through direct human engagement (Brown, 2009).

The future of design appears to be a collaborative intersection where Generative AI and traditional design methodologies merge, leveraging AI's analytical capabilities while embracing the depth of human creativity and empathy. This integrated approach promises to effectively navigate the complexities of modern design challenges, offering innovative, technologically advanced, and deeply human-centric solutions. The collaborative perspectives the area supports for a symbiotic representation where technology enhances user's creativity, confirming that design is an empathy based and inclusive practice.

3. METHODOLOGY

3.1. RESEARCH MOTIVATION

This research investigates the impact of Generative AI technologies on the inspiration phase in the Design Thinking process, focusing on innovation, creativity, and perceived effectiveness compared to traditional human-centered approaches. Integrating AI into product design presents a paradigm shift from traditional design methodologies, promising enhanced creative outcomes and innovative solutions (Lockwood & Papke, 2017). The motivation to investigate this topic comes from curiosity. In the past year, I heard many people, coworkers, classmates, and employees from different industries complaining or being concerned about how AI would impact their jobs. As a journalist, I was intrigued by people's many assumptions about Generative AI's capability to replace human power force in more than one area. Therefore, I googled it. I found a survey done by the Pew Research Center that demonstrated that Americans are generally increasingly cautious about AI's growing role in their lives. Nowadays, 52% of Americans are more concerned than excited daily, compared with just 10% who say they are more excited than concerned; 36% feel excitement and concern (Faverio et al., 2023).

Back then, I was uncertain about my thesis topic, and I only knew one thing: I wanted to do it about design thinking. As mentioned in the acknowledgment of this thesis, I casually talked with a friend who introduced me to this topic. Since I have understood what it was about, I could not think of a better way to integrate my curiosity regarding people's challenges with AI with a process that includes empathy as one of its central cores. So, why not take it from another perspective? Why not investigate if AI would help people and enhance our abilities instead of replacing them?

3.2. RESEARCH METHODOLOGY

A combined strategies formula is employed to gather comprehensive insights. First, a survey created in the cloud-based software platform Qualtrics was sent to 25 master thesis students. Only sixteen of them responded to the selected criteria of the survey. First, four dimensions were considered when creating the survey: organization, topic affinity, motivation, and stress. These dimensions were selected considering the experiment topic, "My Master Thesis Journey," and what measurements could be considered to evaluate how this process was overcome (Sprintbase, 2024). The poll was relatively short, and it only had one question per dimension to identify which level of the dimensions you would have (see Appendix C). The users were asked the following: Keeping the scenario in mind, to which extent do you agree with the following statements? For example, the scenario would measure the stress level that the student was experiencing with his/her thesis.

After completing the survey, the results were exported from Qualtrics and uploaded into a high-level, interpreted programming language called Python to identify through a code that diagnoses what makes a user "extreme." In this case, the responses to the dimension-related questions in the survey (let us call it 'Q1') were considered the highest 5% and the lowest 5% of responses as extreme. Users who have responses to 'Q1' were recognized as either very high (above the top 5%) or very low (below the bottom 5%). Finally, some statistics were observed about the extreme students and generated a plot to visualize where their responses fall compared to everyone else. Eight users were pinpointed as "extreme" two per dimension, and a questionnaire was designed to interview them to gather insights.

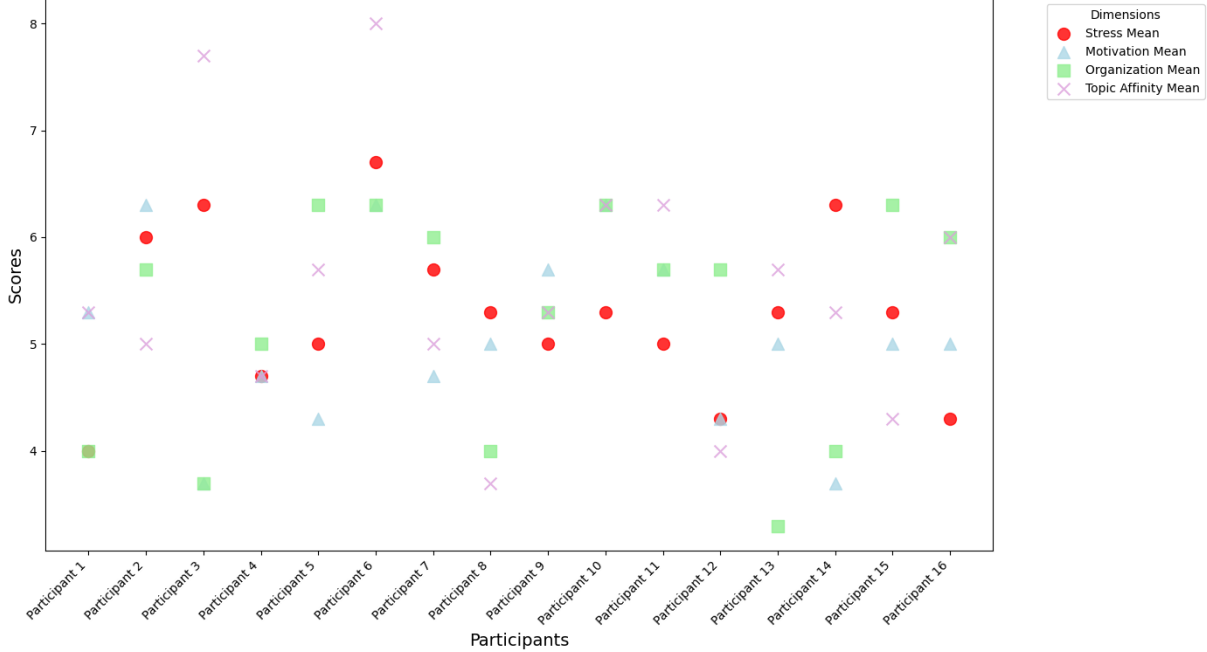


Figure 2 - Comparison of Dimensions of Each Real Human

Metric	Category	Name	Value
Stress Mean Level	Higher Stress Mean	Participant 3	6,3
	Lower Stress Mean	Participant 1	4
Motivation Mean Level	Higher Motivation Mean	Participant 2	6,3
	Lower Motivation Mean	Participant 14	3,7
Organization Mean Level	Higher Organization Mean	Participant 5	6,3
	Lower Organization Mean	Participant 13	3,3
Topic Affinity Mean Level	Higher Topic Affinity Mean	Participant 6	8
	Lower Topic Affinity Mean	Participant 12	4

Table 1 - Extreme Users for each Dimension

The results compiled the students' perceptions in two pages since the same exercise was done using AI, specifically ChatGPT4. So, the insights generated by AI were on page one, while the insights collected from real humans were on page two.

In order to conduct the same experiment with ChatGPT4, eight extreme user personas were created to facilitate interviews and gather insights. The generation of these personas is informed by practical guidance from a GeeksforGeeks article, which details a structured process for creating user personas using ChatGPT. The article outlines a step-by-step approach to creating user personas, emphasizing the customization and detail that can be achieved through careful interaction with AI tools like ChatGPT 4. Key steps include defining the scope of the personas, specifying characteristics and behaviors relevant to the design challenge, and iteratively refining the output. This process ensures that the personas are not just generic archetypes but are tailored to represent specific user needs and contexts. The design process can uncover distinctive insights into user needs by creating different personas, including extreme cases (GeeksforGeeks, 2023).

This methodology is supported by the principles and findings from scholarly articles that underscore the potential of Generative Design and Human-Centered AI. Mountstephens & Teo (2020) highlight the capacity of Generative AI to explore vast design spaces and foster creativity, while principles of generative variability (ar5iv.org, 2022) and Human-Centered AI (Interaction Design Foundation, 2024) emphasize how crucial it is to leverage AI to augment human capabilities and ensure a comprehensive understanding of user experiences.

For the second methodology approach, an experiment was used for the Parallel Universe methodology. The experiment involved two parallel tracks: one leveraging the Generative AI approach, represented by tools and methodologies related to ChatGPT, and the other following a traditional human-centered design (HCD) process. The target demographic for this study included nine master's thesis students who were gathered in Nova IMS Innovation and Analytics Lab and were challenged to improve their master thesis journey through the methodology Parallel Universes from the Design Thinking process. First, the methodology and the steps that would follow were explained to them. As a primary phase, each one of them had to think in a parallel universe, also called industry, in which they would see similar or comparable challenges to a master thesis journey. Afterward, they were requested to decide between all the universes they had thought about and choose only one as a group. The Universe they chose was the Industry Music.

With the universe defined, the experiment began. Each student started to think separately about which challenges a person in the music industry would face, which could be comparable to a master's thesis journey, and they came up with insights that will be addressed later in this thesis. Later, they were asked to fill out an Empathy Map, thinking they were a music producer or musician. In the last phase of the experiments, they were asked to be aware of the most

relevant takeaways of the session by writing them on a board. The primary objective was to assess the impact of these divergent approaches on the product design process's empathize phase, with a particular focus on innovation, creativity, and perceived effectiveness.



Figure 3 - Parallel Universe Real Personas Insights



Figure 4 - Parallel Universe Real Personas Experiment



Figure 5 - Parallel Universe Real Personas Empathy Map

The same experiment was done with ChatGP4; a prompt was given to the AI (The prompt is shown in Figure 7), asking if it could imagine an analogous situation, a parallel universe, to improve the master thesis journey of thesis students. After being provided with several options and continuing to prompt the chat by questioning whether it could be more creative, the Space Exploration Industry emerged as a parallel Universe.

ChatGPT 4 was then requested to follow the same steps as the nine master's thesis students who participated in the physical experiment. ChatGPT 4 was asked to think of challenges comparable to a master's journey and how they could be solved in the space exploration universe. The results of both experiments were written in two pages in random order for the experts to analyze, again without knowing if they were human-generated or AI-generated.

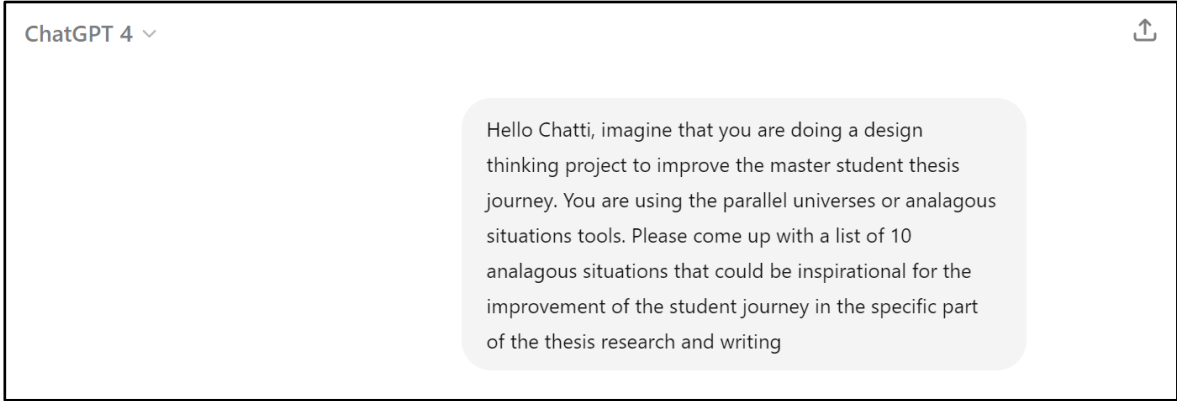


Figure 6 - ChatGPT 4 Prompt One for Parallel Universe Experiment

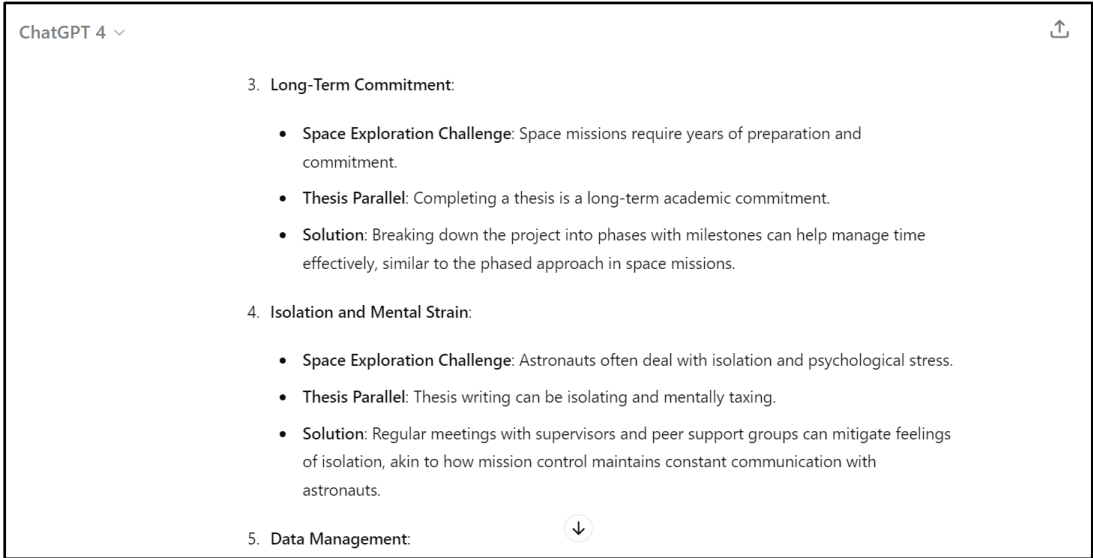


Figure 7 - ChatGPT 4 Experiment's Example Results: Space Exploration

Generative AI can program and augment various dimensions of the design cycle, from ideation to prototype growth and user testing. This automation is achieved through AI's ability to analyze extensive data sets, identify patterns, and generate creativity. The application of ChatGPT to create detailed, nuanced personas can be a powerful tool in uncovering latent user needs and behaviors, potentially leading to more innovative product concepts (Houde et al., 2022).

The symbiotic balance between human creativity and machine intelligence is shown through collaboration between humans and technology in the design process, which enhances creative outcomes. This synergy suggests that the integration of Generative AI technologies, such as ChatGPT, could significantly impact the empathize phase of product design by providing a broader range of perspectives and ideas, thereby facilitating a more comprehensive understanding of user needs (La Rocca, 2012; McKnight, 2017).

Also, the transformative impact of big data and AI on product design emphasizes how AI-driven methodologies can address limitations inherent in traditional design methods, such as subjectivity and limited scope. This suggests that leveraging Generative AI can enable designers to meet increasingly diversified and personalized user requirements by processing and analyzing big data to extract valuable insights into customer preferences and market demands (Quan et al., 2023).

3.3. PARTICIPANT SELECTION

This research included a survey sent to twenty-five participants contacted by mobile phone. After completing the survey, only eight students from the selected sample were identified as extreme users. Therefore, sixteen interviews were done. Eight were done to real extreme user personas, and eight were done to eight AI-generated user personas for the first investigation method: Extreme Users.

Furthermore, the parallel universe experiment included nine thesis students contacted by mobile phone and selected under the criteria of currently doing their master's thesis. They were gathered in a face-to-face session during the two- and half-hour experiment. Additionally, multiple prompts were written to ChatGPT 4 replicating the same experiment done by the master thesis students (to come up with a parallel universe with the question "How to improve my thesis journey2"?). The Generative AI gave the results, and they were assembled as written insights, the same as the ones collected from real students.

3.4. COMBINED METHODOLOGY SUMMARY

In summary, quantitative data from surveys were filtered and analyzed through Python, a definition of an Extreme User was determined, and questionnaires were developed to interview them and gather their perceptions. Additionally, a Parallel Universe qualitative experiment was conducted by gathering master students' perceptions and insights into improving their thesis journey and prompting ChatGPT 4 to create a parallel Universe seeking the same answer.

Mixed methods research blends quantitative and qualitative research to provide a wide-ranging strategy for being aware of the problematic and diverse impacts of Generative AI on design thinking processes. This allows for acquiring a quantifiable effect and the profound environmental perception needed to fully seize technology's role in modern design (Russo et al., 2023). The following is shown in Figure 8.

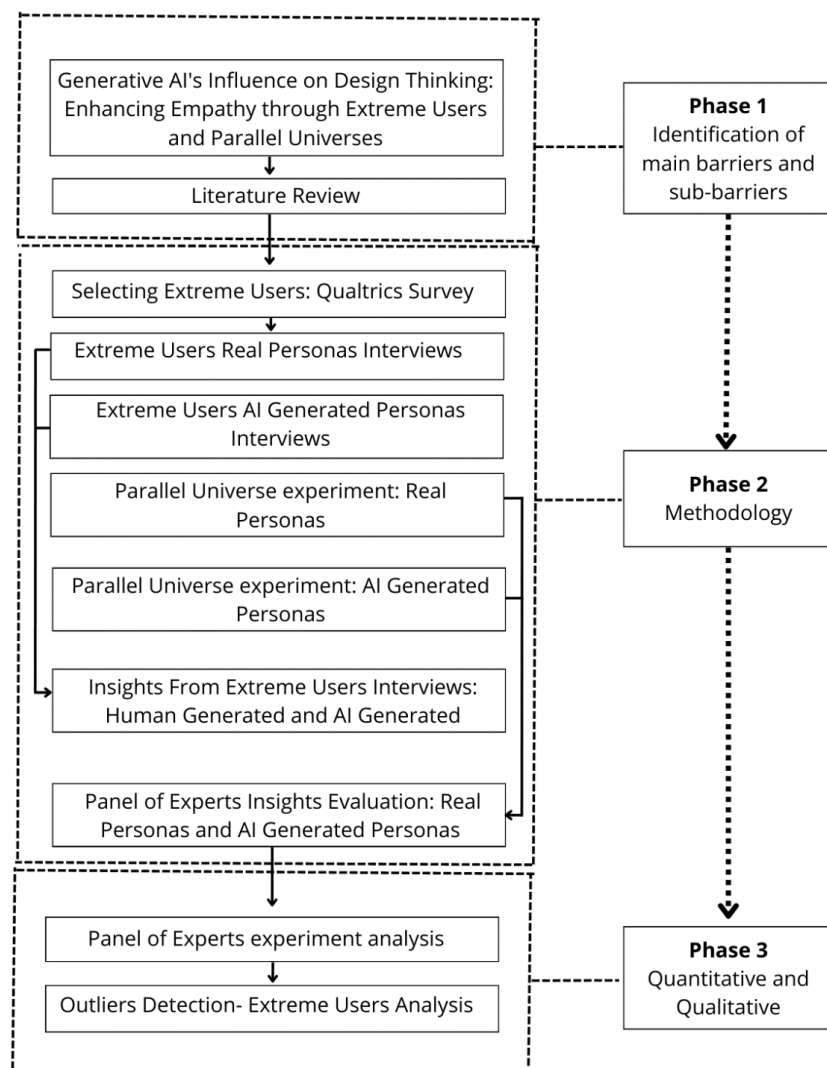


Figure 8 – Research Framework

3.5. INVESTIGATION OUTPUT

The primary focus of the investigation was to identify emerging patterns and differences in how the interviewees and the experiment would provide similar or different outcomes between real people and AI-generated answers. This objective aligns with the exploratory nature of our study, allowing us to gain in-depth insights into the integration of Generative AI into the design thinking process methodologies and give space for future research in this area.

4. EMPIRICAL STUDY

4.1. STUDY DESIGN

4.1.1. RESEARCH OBJECTIVES

The main goal is to investigate the impact of integrating Generative AI into the inspiration phase of the design thinking process to enhance creativity and problem-solving by comparing AI-enhanced procedures with traditional human-centered methods (Vincent Hunt, 2023). However, it also includes the following objectives: Identify the gaps in traditional design thinking methodologies in the empathize phase of the design thinking process; assess the perceived effectiveness of Generative AI integration in the empathize phase, specifically in Extreme Users and Parallel Universe techniques; compare these impacts with traditional human-centered design methodologies.

4.1.2. RESEARCH ASSUMPTIONS

Based on the initial comprehension of the topic and the defined research objectives, the investigation proposes the following assumptions:

Assumptions	Authors Citation
1 Generative AI in the design process will improve decision-making and problem-solving by providing data-driven insights and predicting potential outcomes.	Dove and Jones (2020)
2 Using speculative design methods like "Parallel Universe" will be enhanced by AI, enabling designers to explore future scenarios and possibilities more effectively.	(CERN IdeaSquare Journal of Experimental Innovation, 2024)
3 Integrating Generative AI into the design process will present challenges, such as balancing AI's capabilities with human-centered design principles.	(Xu & Gao, 2023)

Table 2 - Assumptions

4.2. SAMPLING METHOD

4.2.1. EXTREME CASE SAMPLING

For this research, the extreme case sample was the sampling method for the first methodology, Extreme Users. It is a type of purposive sampling that involves selecting cases that are unusual or special in some way. These cases are at the extreme ends of the spectrum about the subject being studied. Extreme case sampling aims to gain insights from individuals with unique perspectives or experiences that can illuminate significant aspects of the phenomenon under investigation (Think Design, 2023).

Extreme cases are chosen because they exhibit traits or behaviors at the far ends of what is being studied. This helps us understand the full range of potential problems, needs, and solutions that may not be evident from studying average cases. By studying the extremes, researchers can understand the boundaries of the phenomenon and identify factors that influence the outcomes (Interaction Design Foundation, 2023).

4.2.2. PURPOSIVE SAMPLING

A purposive sample, also known as judgmental or selective sampling, was collected for the Parallel Universe experiment. This sampling method requires choosing participants based on specific characteristics and the purpose of the study. The researcher uses their judgment to choose particularly informative or relevant cases to the research question (Creswell et al., 2016).

Contributors were selected due to their attributes or knowledge relevant to “How to improve my Master Thesis journey.” So, the study relies on their expertise and understanding of the research topic to select the most appropriate universes or industries. At the same time, the method ensures that the data collected is rich and directly applicable to the research question (Palinkas et al., 2015).

4.3. DATA COLLECTION

4.3.1. INITIAL CONTACT AND INVITATION PROCESS

The sample for the Extreme Users methodology and the Parallel Universe experiment was contacted by mobile phone between March 2024 and May 2024. Mobile phone was chosen since the sample contacted were Master thesis students and the faster way to receive a respond was through this platform. Twenty-five people answered the survey, of them eight people agreed to be interviewed while for Parallel Universes nine people agreed to meet at Nova IMS to do the face-to-face experiment.

On the other hand, six specific experts were reached by email during May 2024 to constitute the panel of experts, five of them agreed to meet face to face in the Nova IMS Innovation and Analytics Lab to evaluate the insights generated by the two design thinking methodologies, both AI Generated and Human Generated.

4.3.2. INTERVIEW QUESTIONS

In constructing the questionnaire content for this study, there are guidelines provided by Bradburn, Sudman, and Wansink (2004) to minimize response biases and enhance the clarity of questions, a practice relevant for investigating nuanced perceptions and experiences with Generative AI technologies in emphasizing the design process. These guidelines underscore the importance of careful questionnaire design to ensure data reliability and validity, which is essential in areas where subjective interpretations and diverse experiences are anticipated. Specifically, ensure that questions are relevant, clearly worded in simple language, and logically sequenced to avoid biasing respondents' answers. Response options were designed to be balanced and exhaustive, incorporating neutral options to capture a spectrum of perspectives. Pretesting with a small, representative sample of the target population helped identify and rectify any confusing aspects of the questionnaire, refining the survey tool to meet its objectives better (Bryman, A., 2016).

The questionnaire also focused on the four dimensions mentioned, having a few extra questions empathy specific as:

- Reflecting on your thesis journey, can you share an instance where you felt deeply understood or supported by someone? What difference did it make?
- How could the process of working on a master's thesis be improved to understand better and support students' needs and emotions?
- If you had the power to change one aspect of the thesis journey to make it more empathetic and supportive, what would it be and why?

The complete questionnaire can be found in Appendix A.

4.4. DATA ANALYSIS

A quantitative analysis using Python software was used to identify the extreme users' real personas. In contrast, a qualitative method called Thematic Analysis was used to compile the insights from the interviews with the extreme users.

4.4.1. QUANTITATIVE ANALYSIS: CODING PROCESS

This section leveraged the data manipulation capabilities of the Pandas library to create and transform our dataset. First, the survey results were exported from Qualtrics to identify Extreme Users and then uploaded to Python, where a data frame was created using a

dictionary. This dictionary contained various attributes for different individuals, including their names, topic affinity, stress, organization, motivation levels across human dimensions, gender, and expertise area.

After focusing on Human-related dimensions, the DataFrame was filtered to include only relevant columns. This helps in narrowing down the dataset to the attributes of interest. The data frame was transposed to switch rows and columns, which was essential for creating a heatmap where each column represented an expert and a different dimension. Seaborn and Matplotlib libraries were used to create this heatmap to visualize the code, which provided an intuitive graphical representation of the data. Also, a custom colormap was defined to distinguish different data values visually, enhancing the heatmap's interpretability.

Finally, the heatmap was customized with options such as annotation, color mapping, and axis labels, which improved its clarity and presentation. The Plot was also customized. Titles, axis labels, and tick parameters were set to ensure the heatmap was informative and easy to understand.

4.4.2. QUALITATIVE ANALYSIS: THEMATIC ANALYSIS

A qualitative method called Thematic Analysis was used to analyze the extreme users' questionnaire data. The process focused on modifying the raw data into actionable insights. The analysis process started with familiarizing yourself with the data, synthesizing it into themes, and converting findings into practical outputs like prioritized lists or user personas. Techniques such as tagging, clustering related evidence, and segmenting data helped reveal patterns and insights (Condens, 2023).

Qualitative data provided valuable but inherently uncertain perceptions, and the focus of this interview analysis was to reduce this uncertainty enough to gather informed insights. Over-analysis was avoided since it can be counterproductive; instead, it was aimed at sufficient clarity to guide actionable steps, ensuring the findings were communicated effectively and stored accessibly for future reference.

4.5. ETHICAL CONSIDERATIONS

The research will adhere to ethical guidelines, ensuring informed consent, participant anonymity, and data confidentiality. Ethical authorization will be sought from the university's study ethics board, and all research tasks will be conducted following approved protocols. This commitment aligns with the principles outlined by the American Psychological Association (2017), emphasizing the importance of safeguarding actors' welfare and maintaining the investigation's integrity.

Informed consent, a cornerstone of ethical research, will be diligently obtained, ensuring that participants are fully aware of the research's nature, purpose, and potential impacts, following the guidelines recommended by Sieber (1998). Participants will be briefed on their right to withdraw from the study at any point without any harmful consequences, thus upholding the standard of voluntary participation.

Participant anonymity and data confidentiality will be rigorously maintained to protect sensitive and personal information (Mertler, 2016). This will involve assigning codes to participants' data and securely storing all research materials to prevent unauthorized access, aligning with best research data handling practices (Corti et al., 2020).

By seeking ethical approval from the university's research ethics committee, this thesis confirms that all proposed research pursuits are assessed and approved by an independent body that checks the ethical implications and risks involved in the research (Israel & Hay, 2006). This process underscores the research's commitment to ethical standards and accountability.

5. RESULTS AND DISCUSSION

5.1. OVERVIEW

This chapter aims to clarify the findings of the study on integrating Generative AI into the emphasize phase of the design thinking process to enhance creativity and problem-solving. Given that the data were collected and analyzed using two different methodologies, this chapter will be structured to analyze the insights collected precisely. As mentioned at the beginning, the research was driven by three objectives or research questions and three assumptions built into the literature review's theoretical foundation, which will be included in the following investigation findings.

5.2. RESULTS AND DISCUSSION

5.2.1. PANEL OF EXPERT EVALUATION

A group of professional experts in their field was reunited to analyze the Extreme Users questionnaire insights and the Parallel Universe experiment results. Six experts were contacted by email: the Dean of Nova IMS, a PhD Professor from Nova IMS, the student mentor from Nova IMS, a Design Thinking Expert, a psychologist, and the Alumni President from the same university. Only five of the six experts contacted could physically come to an evaluation session at the Nova IMS Innovation and Analytics Lab at the agreed time. When they arrived the Design Thinking methodologies were explained along with the criteria evaluation, so the experts could start analyzing the insights.

The insight selections were done using a specific criteria definition. By applying these criteria, the experts ensured that the perceptions derived from their design thinking experiments lead to solutions that are not only creative and innovative but also profoundly connected to users' real needs and experiences. This approach enhances the overall effectiveness of the design thinking process and increases the likelihood of developing impactful solutions.

1. **Authenticity:** Genuine insights ponder people's real necessities and adventures. Design thinking evokes sympathy and a significant comprehension of the person, guaranteeing that the approaches are pertinent and purposeful. Design thinking first phase begins with inspiration, building empathy and highlighting on the acknowledgement of what people need and what drive their interests (Interaction Design Foundation (2024)).
2. **Revealing:** Perceptions should discover inherent problems that might not be instantly clear. This is a pillar on design thinking, which carefully examines issues before springing to answers. The practice includes differing reflections to assemble as many insights as possible and then meet to describe the key difficulties. By showing profound facts, collaborative teams can tackle the underlying reasons of challenge instead of just their signals (Interaction Design Foundation (2024)).

3. **Non-Obviousness:** Non-obvious insights motivate invention by testing presumptions and providing novel viewpoints. Design thinking promotes redefining issues to see them from various perspectives, which helps to disclose surprising and innovative strategies. It also entails intuitive thinking to create thoughts rooted in actual resolutions to secure they are creative and functional (Han, E. (2022, January 18)).

Lastly, the most important criterion was ensuring that the insights selected by the panel of experts would **benefit and improve the student’s master thesis journey**.

The following sub-themes seek to exhibit the results relevant from the main ideas collected by the panel of experts in which it is presented the analysis of the results regarding the Parallel Universe and the Extreme Users methodologies, both applied to people and Generative AI. The topic incorporates how Generative AI can be integrated into the empathize phase of the design thinking process to generate more creative and innovative outcomes. This section intends to display and address the findings to add value to the unceasing discussion about the relationship between creativity, empathy, and technology.

5.2.1.1. HUMAN VS AI INSIGHTS: EXTREME USERS

The first method to be evaluated was the extreme user's perceptions. Two pages were given to each expert, one including all the insights from actual master thesis students and the other incorporating all user persona outcomes (leveraged by ChatGPT 4). Both pages were numerically ordered, starting from number 1 to 16. The panel was not told which of the pages belonged to which “participant,” they were asked to answer a quick survey, selecting the three insights individually that would, according to their expert perception, improve a student's master thesis journey. The results of that survey are shown in Figure 9 for humans and Figure 10 for Generative AI through heatmaps.

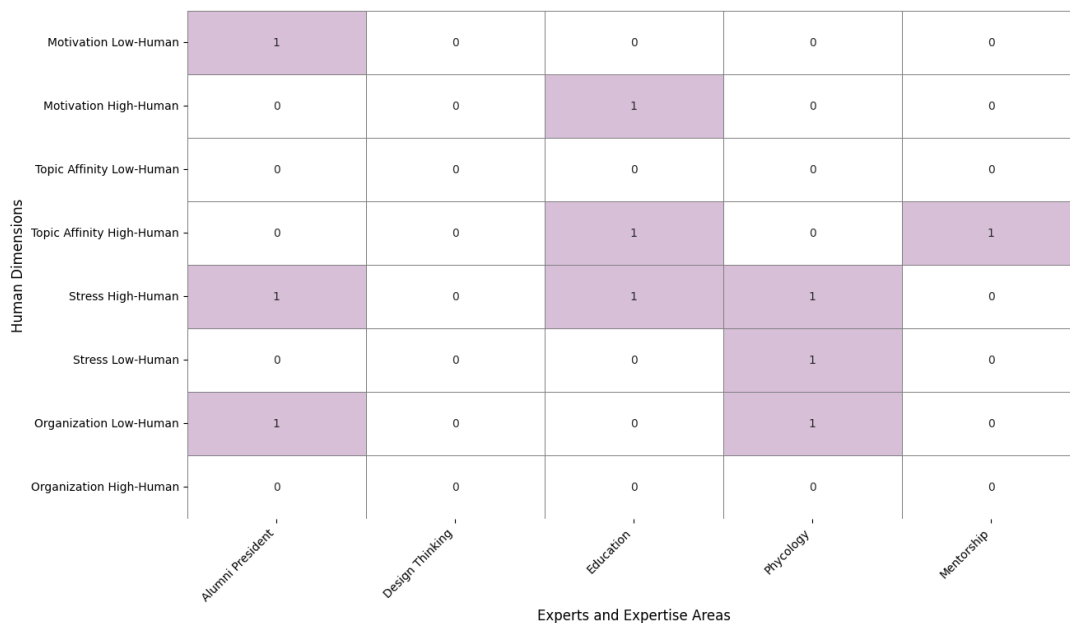


Figure 9 - Human Dimensions Heatmap by Expertise Area

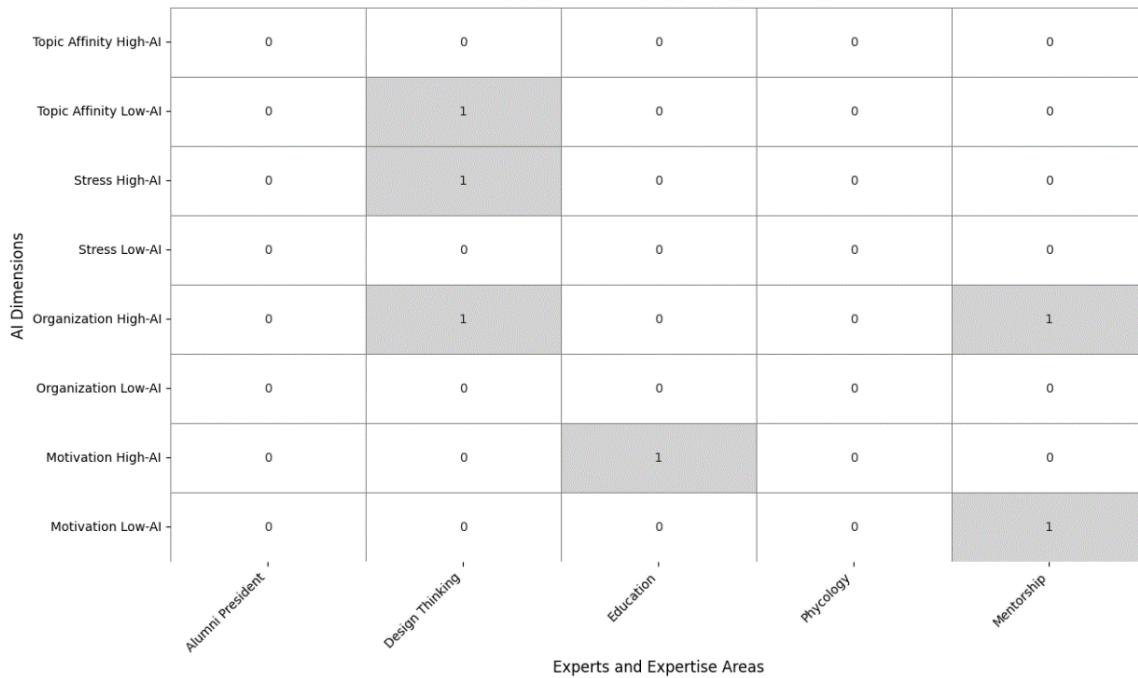


Figure 10 - Generative AI Dimensions Heatmap by Expertise Area

Following the survey, the experts were requested to discuss and select the three key insights to optimize the master thesis procedure. The three conclusions picked were number 5, 13, and 15, corresponding to the following deductions:

- It is crucial for thesis students to have access to real-world data and case studies related to their topics. This not only aids in research but also enriches learning by linking theory with practice. – *Insight done by Generative AI from a high organization-level user persona.*
- Promote a peer support system by encouraging students to connect with others who have recently completed their theses. From the start, having a 'thesis buddy' provides ongoing guidance and support, helping to reduce stress and enhance the overall thesis journey. – *Insight done by a real person from a high-stress level.*
- The role of supervisors should be clearly defined, and the process they should use to support students in their thesis endeavors should be clear. Standardizing this approach ensures that students receive structured guidance and that there is accountability for timely and quality work delivery. – *Insight done by a real person from a low organization level.*

The specialist also concluded that these insights work better when applied together, as shown in Figure 11.

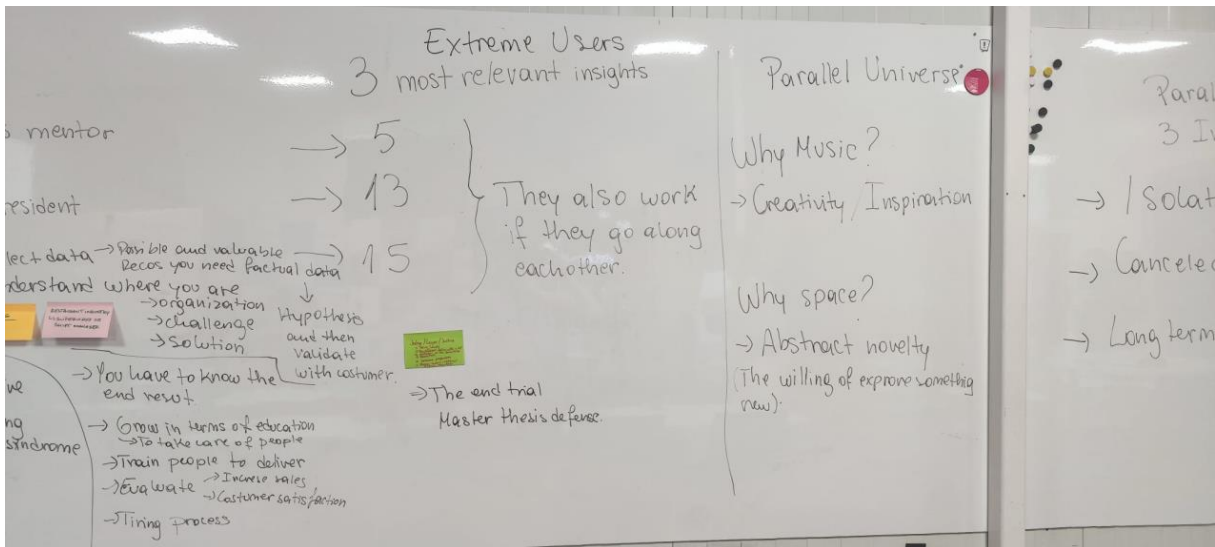


Figure 11 - Panel of Experts Insights from Discussion

5.2.1.2. HUMAN VS AI INSIGHTS: PARALLEL UNIVERSE

The experts had to examine the results of the Parallel Universe experiments in addition to the Extreme Users analysis. A debrief about the methodology was given, and consecutively, they received two papers again; this time, all the insights from the master thesis students and the AI-Generated were mixed without a numerical order. Their specialists were written on the Innovation and Analytics Lab board from Nova IMS, and each had a number corresponding to their respective roles. After they were given three of the same number, they could vote in the pages previously mentioned for the three Parallel Universe challenges and applications that they perceived as more relevant to improve the thesis journey. The evaluation of the insights and the number selection for each expert can be seen in Figure 12 and Figure 13.



Figure 12 - Panel of Experts Parallel Universe Evaluation

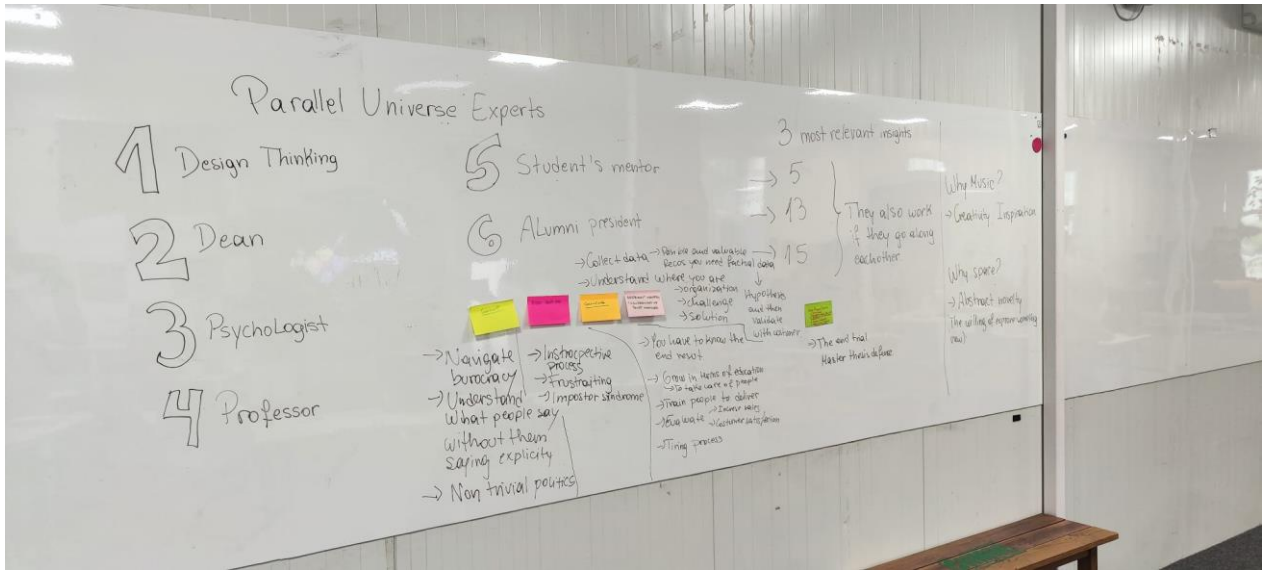


Figure 13 - Panel of Expert Number Recognition

Moreover, the panel was requested to imagine a parallel universe in which they could think of challenges comparable to the master's thesis journey. These industries are shown in Table 5.

Expertise	Parallel Universe	Challenge Comparable to the Thesis Journey
Alumni President	Government	Navigate bureaucracy, understand what people say without them saying explicitly, non-trivial politics.
Professor	Consulting	Grow to educate people, know the end objective/result, train people to deliver, evaluate, and train people (increase sales, customer satisfaction).
Psychologist	Law Firm	Frustration, challenges, isolation, recycling knowledge, final trial.
Design Thinking Expert	Prison	Introspective process, frustrating, impostor syndrome.

Students Mentor	Restaurant Industry	Collect data and possible and valuable recommendations. You need factual data and a hypothesis to validate with consumers. Also, Understand where you are- organization, challenge, solution.
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Table 3 - Panel of Experts Own Parallel Universes

Finally, I invited them to discuss again as a group why either the Thesis students or ChatGPT 4 would have selected the Music Industry and Space exploration as Parallel Universes (without knowing which one chose which). Regarding the music industry, they agreed that it was a source of inspiration and empathy, while space exploration might have been driven by the willingness to see/do the unknown. The insights can be looked at in Figure 14.

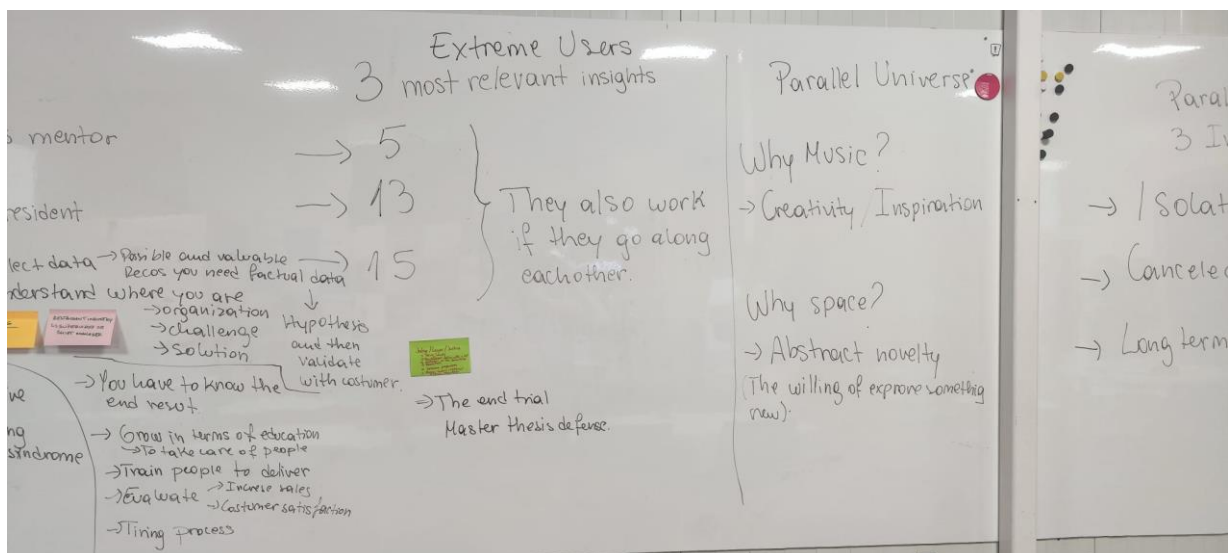


Figure 14 - Parallel Universe Decision Driver

5.2.2. TRADITIONAL METHODS VS AI ENHANCED METHODS

As appreciated in this research, the panel of experts chose two insights generated from the conclusions garnered from real people's interviews and one assembled from the Generative AI questionnaire resolutions. By measuring the percentage of each insight through a simple percentage calculation, the findings show that 62,5% were human-created results while 37,5% were AI-generated. It is important to notice that in this evaluation, the experts aligned that this perception would work better if they were with each other.

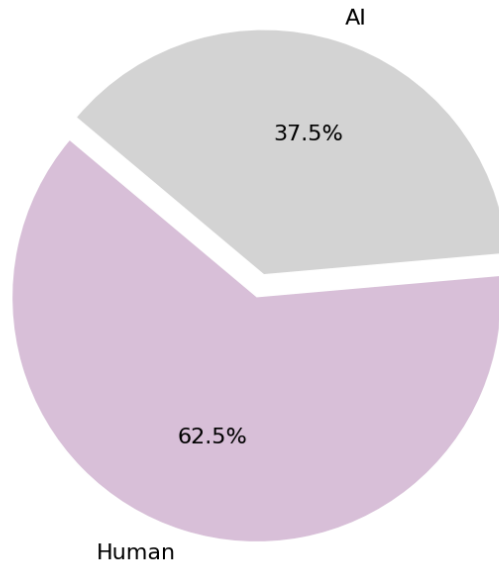


Figure 15 - Extreme Users Distribution of Human vs Generative AI Results

On the other hand, when the specialist on the Parallel Universe experiment analysis chose Revealing with Insights, the results demonstrated that two of the outcomes selected were AI-generated, and one was Human-Generated.

Insight Type	Category	Parallel Universe Solution	Application to Thesis Journey
Human	Challenge: Canceled Shows - Music Industry	Imagine a universe where if you must cancel a sold-out show, you can revisit past performances to integrate successful elements into new plans. You can start over if you need to, using previous successes as a foundation.	Review previous work for a fresh perspective if a hypothesis is rejected. Persist and adapt, using established knowledge as a base to progress your thesis.
AI	Challenge: Isolation - Space Exploration	Imagine a universe where isolation does not affect mental health. Missions could be conducted solo without negative psychological impacts, simplifying logistics and reducing costs.	Individual research could be more focused and productive if isolation were less of an issue. Promoting online collaboration platforms and virtual social interactions among thesis students could help mitigate the effects of real-world isolation.
AI	Challenge: Long-Term Commitment and Motivation - Space Exploration	Imagine a Universe where long-term goals are broken into shorter, manageable tasks with immediate objectives.	Breaking the thesis into chapters or sections with individual deadlines can help students manage their time better and maintain motivation throughout their research project.

Table 4 - Panel of Experts Insights Selection

As a result of both experiments, the conclusions for the initial objectives and assumptions of this research were put together in table 5 and table 6.

	Objectives	Conclusions
1	Identify the gaps in traditional design thinking methodologies in the empathize phase of the design thinking process.	Even though human-centered methodologies foster genuine human connection, they do have room for improvement when analyzing vast amounts of data and providing insights that real people may overlook or miss. This ability is fundamental in the inspiration phase since being aware of subtle nuances in user behavior can lead to more empathetic and user-centric design solutions.
2	Assess the perceived effectiveness of Generative AI integration in the empathize phase, specifically in Extreme Users and Parallel Universe techniques.	Integrating Generative AI in the inspiration phase of the design thinking process, particularly in the Extreme Users and Parallel Universes methods, enhances effectiveness by providing novel insights where human-centered perceptions collide with AI-generated ideas. Both approaches offer unique perspectives, presenting new perceptions that the other side may not have considered.
3	Compare these impacts with traditional human-centered design methodologies.	Despite the value of AI insights, there is a slight preference for human-generated insights due to their perceived relevance and reliability. However, the significant inclusion of AI insights shows growing acceptance and trust in AI. Combining AI-generated insights with human intuition enhances the design thinking process. This synergy allows teams to understand problems better and generate more innovative solutions.

Table 5 - Objectives Conclusions

	Assumptions	Conclusions
1	Generative AI in the design process will improve decision-making and problem-solving by providing data-driven insights and predicting potential outcomes.	This is partially confirmed. While it was confirmed that Generative AI will improve decision making and problem solving by providing novel and hidden insights that humans could not see, it still opens for research to see if it will predict potential outcomes.
2	Using speculative design methods like "Parallel Universe" will be enhanced by AI, enabling designers to explore future scenarios and possibilities more effectively.	This was confirmed. In the Parallel Universe experiment, two of the three insights gathered by the panel of experts were AI-Generated.

3	Integrating Generative AI into the design process will present challenges, such as balancing AI's capabilities with human-centered design principles.	This is also true, while in both experiments it was clear that AI enhanced novel and creative insights, it is still not known in which amount AI should be included in the design thinking process to have a "right" balance between them two.
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Table 6 - Assumptions Conclusions

5.3. DISCUSSION

5.3.1. KEY FINDINGS

The integration of Generative AI into the inspiration phase of the design thinking process was studied with the ambition of upgrading decision-making and problem-solving, boosting hypothetical design methods, and addressing possible obstacles. The findings partially confirm that Generative AI can enhance decision-making by providing novel and hidden insights that human analysts might miss. Yet, Generative AI's capacity to foresee possible results still needs more research. The use of Generative AI in innovation design frameworks, particularly in the "Parallel Universe" method, exhibit to be effective, as AI-generated insights establishes a significant portion of the core perceptions identified by experts. This highlights AI's feasibility to expand the range of speculative design by offering distinct and theoretical scenarios.

5.3.2. COMPARISON WITH PREVIOUS RESEARCH

This thesis results arrange with prior investigations that have spotlighted the advantages of Generative AI in data examination and pattern identification. Nonetheless, this study incorporates literature by concretely assessing AI's role in the empathize phase of design thinking, a reasonably neglected field. It validates that Generative AI can enhance experimental design strategies and aids current studies on AI's creative capability. Furthermore, the research adds to the continuing conversation on harmonizing AI capabilities with human-centered design guidelines.

5.3.3. IMPLICATIONS

The pragmatic outcomes of this thesis findings propose that collaborative teams can noticeably gain from incorporating Generative AI into their procedures. By making use of AI's abilities in data management and scenario construction, designers, engineers and experts in a wider range of fields can accomplish a more exhaustive comprehension of user needs and analyze a larger spectrum of design alternatives. Still, it is vital to sustain stability between AI

and human contribution to guarantee that the produced designs stay empathetic and user oriented.

5.3.4. LIMITATIONS

The research also revealed a few limitations that should be considered. The dependence on the panel of experts to judge AI-generated understandings or perceptions might include personal inclinations or biases. Moreover, the extent of the investigation was restricted to precise methods within the empathize phase, and additional research is required to conclude the observations considering other techniques within the design thinking process. The forecast abilities of Generative AI in design studies also remain to be fully explored.

5.3.5. FUTURE RESEARCH

Further investigation should put emphasis on exploring the forecasting abilities of Generative AI in the design market, precisely in predicting possible results and effects of design resolutions. More inquiries are necessary to establish the ideal proportion between Generative AI and human-centered feedback. Exploring the ongoing repercussions of AI incorporation on the value and durability of Design resolutions will provide in-depth understanding into its position in the design procedure. Likewise, analysis on efficient discussion and integration of AI-generated insights within design teams will be beneficial in increasing the promise of AI in design thinking.

6. CONCLUSIONS AND FUTURE RESEARCH

Integrating Generative AI into the inspiration phase of design thinking offers a promising avenue for enhancing creativity, empathy, and innovation. By bridging gaps in traditional methodologies and providing novel insights, AI can play a pivotal role in shaping the future of design, fostering a more innovative and effective design process. First, it will improve our ability to empathize with users by revealing deeper insights from extensive information sets. It will also help people to find hidden insights that may be overlooked in traditional human-centered methodologies like Extreme Users and Parallel Universes and will enable the exploration of future scenarios, specifically in the Parallel Universe methodology. Human-centered methodologies and AI Generator chats positively leverage new insights and perspectives that work well together and can effectively be used to navigate into novel perspectives. However, there is a gap that opens doors for future research. Even though Generative AI-enhanced idea generation and creativity, it is still unknown how these two approaches should be balanced and if merging their insights will predict potential outcomes. This disparity highlights a larger conversation about the constraints and difficulties of generative AI in fields that demand profound human empathy and nuanced human comprehension. The lack of a broader sample, research done on other methodologies used on the inspiration phase of the design thinking process and results regarding the harmony between AI and Human cooperation makes a broader space to keep experimenting and testing its results.

The integration of Generative AI into the inspiration phase of Design Thinking is not concluded by simply recognizing its advantages and drawbacks. Instead, it begins a continuous, iterative process that promotes collaboration, experimentation, and a multidisciplinary approach to developing design thinking methodologies. The following research must consider the technology's constant evolution, requiring regular reviews and updates of the process and framework. Furthermore, attention must be paid to how these two completely different, but familiar worlds will be balanced and eventually forecast unimaginable outcomes. While this framework shows promise, it requires enhancements and updates following initial tests and practical applications.

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APPENDIX A

Example of Extreme Users Questionnaire and Answers ChatGPT 4 (AI)

Motivation High Participant two - *"Prompt: Hi Chatty, you are a master's thesis student named Katia Ferreira; you are 33 years old and were doing your master's thesis at Nova IMS about the "Cancellation predictive model to measure operation inefficiency." You chose this topic because you find it very interesting. You were a full-time student and worker. You are very motivated to finish your thesis because you will have better work opportunities in the future and because you want to have the master's degree title, which motivates you for your thesis journey. You get stressed in the deliveries because you have intense work in your job at the same time as the delivery and because you are a step before your delivery plan, but you are okay after all. If you could identify yourself, you would be an extreme user with a high motivation level (from the design thinking process). Now, based on this information, please answer the following questionnaire:*

Warm-Up Questions

1. Tell me about your master thesis topic and why you chose it.

My master's thesis focuses on developing a predictive model for cancellations to measure business operational inefficiency. I chose this topic because I've observed firsthand how cancellations can disrupt operations and lead to inefficiencies. It's a complex challenge that intersects with analytics, which I find intellectually stimulating and highly relevant in today's data-driven business environments.

2. How do you typically organize your day to accommodate work on your thesis?

Balancing my job and thesis work requires strict time management. I typically reserve early mornings for thesis-related research, as I find my concentration is highest then. I work on my job responsibilities during regular business hours and dedicate some evenings to writing and synthesizing my findings. Weekends are crucial for deeper analysis and catching up on any backlog.

Stress

1. Can you describe a particularly stressful period during your thesis work? What triggered it?

A notably stressful period was when I had a major project delivery at work coinciding with a thesis submission deadline. The dual pressure from both critical fronts made it difficult to focus and maintain productivity.

2. How do stress levels affect your productivity and well-being during the thesis process?

High-stress levels usually decrease my productivity by scattering my focus and increasing anxiety. It affects my sleep and overall well-being, making it harder to stay motivated and productive.

3. *Have any tools, strategies, or support systems helped you manage stress effectively?*

Regular exercise, particularly running, has been an effective stress reliever. I also use project management tools like Trello to keep track of my tasks and deadlines, which helps reduce the mental load. Support from my advisor, who understands my work commitments, also plays a crucial role.

Organization

1. *Describe how you organize your research and writing process. What tools or methods do you use?*

I use a combination of digital tools and traditional methods. Digital libraries and journals are indispensable for research, while Google Scholar helps me track citations and relevant papers. I use Microsoft Word integrated with Zotero for reference management to write and organize my thoughts.

2. *Have you encountered any organizational challenges that have impacted your thesis progress? How did you address them?*

One challenge was integrating feedback from different sources coherently into my draft. I addressed this by scheduling regular meetings with my advisor to prioritize feedback and set clear, manageable goals for revisions.

3. *In an ideal world, what support or resources would make the organizational aspect of your thesis easier?*

Access to a more integrated platform that combines reference management, note-taking, and draft revisions could streamline the writing process significantly. Additionally, having a peer review group from the start would provide ongoing feedback and improve the thesis progressively.

Thesis Topic Affinity

1. *How connected do you feel to your thesis topic personally? Has this connection changed over time?*

I feel deeply connected to my topic as I see its relevance and impact in real-world scenarios. This connection has only strengthened as I've delved deeper into the subject matter and discovered its various facets and implications.

2. *How has your affinity towards your topic influenced your motivation and approach to your thesis?*

My strong affinity for the topic fuels my motivation, especially during challenging phases. It drives me to produce a comprehensive and impactful study that could potentially influence industry practices.

3. Can you share a moment when you felt particularly driven or inspired by your topic? What sparked it?

Attending a conference on data analytics, where I saw the practical applications of predictive models in reducing operational inefficiencies, inspired me significantly. It provided a clear vision of the potential impact of my work, reinforcing my commitment to my thesis.

Motivation

1. What motivates you to work on your thesis, even during tough times?

The prospect of enhancing my career opportunities and achieving the personal goal of earning a master's degree keeps me going. Knowing the practical impact of my research in the field also provides a significant boost.

2. Have you experienced significant fluctuations in your motivation levels? What do you think caused these changes?

Yes, fluctuations typically occur due to high workload periods at my job or personal life stresses. Recognizing the sources of these stresses helps me address them and restore motivation.

3. What could universities do to help maintain or boost students' motivation throughout their thesis journey?

Universities could provide more structured support systems, including mental health resources and more interactive engagement with industry professionals to enhance the real-world relevance of research topics.

Empathize Phase Specific

1. Reflecting on your thesis journey, can you share an instance where you felt deeply understood or supported by someone? What difference did it make?

My advisor noticed my stress level and suggested adjusting my thesis timeline slightly, which helped significantly. This empathy allowed me to manage my responsibilities without compromising the quality of my thesis.

2. How could the process of working on a master's thesis be improved to understand better and support students' needs and emotions?

Instituting regular check-ins not just about the thesis progress but also about the student's well-being could be beneficial. Providing clearer guidelines and expectations from the start would also reduce anxiety and confusion.

3. If you had the power to change one aspect of the thesis journey to make it more empathetic and supportive, what would it be and why?

I would enhance accessibility to tailored counseling and support services that address academic and personal challenges. Emotional and psychological support is as critical as academic guidance.

Final Questions

1. Is there anything else you'd like to share about your experience that we haven't covered? Balancing a full-time job and thesis work is a formidable challenge, and it's crucial to recognize and address potential burnout before it affects both professional and academic goals.

2. Do you have any suggestions for how this research could be used to help future master's students?

This research could lead to developing a more supportive framework for working students, incorporating flexible timelines and more robust support systems tailored to their specific challenges.”-

APPENDIX B

Parallel Universe Prompt Experiment - *“Hello Chatty, imagine that you are doing a design thinking project to improve the master student thesis journey. You are using the parallel universes or analogous situations tools. Please come up with a list of 10 analogous situations that could be inspirational for the improvement of the student journey in the specific part of the thesis research and writing*

ChatGPT:

Design thinking often uses analogies to draw inspiration from one domain and apply it creatively to another. For a master's student thesis journey, especially focusing on the research and writing phases, we can look for analogous situations where similar processes of investigation, synthesis, and production occur. Here is a list of ten analogous situations that could inspire improvements in the student thesis journey:

1. Cooking a Gourmet Meal:

Similar to researching and writing a thesis, cooking involves careful selection of ingredients (sources), following or modifying recipes (methodologies), and presenting the final dish (writing and formatting the thesis). The process requires balancing creativity with technical skill, much like academic writing.

Mountaineering:

Climbing a mountain involves careful planning, staged efforts, acclimatization (adjusting to each stage), and overcoming unexpected challenges—parallels that can be drawn to the stages of thesis research and writing.

Software Development:

Software projects often use agile methodologies, which involve iterative development, frequent testing, and constant feedback. Applying similar agile principles to thesis writing might involve iterative drafts, frequent feedback from supervisors, and flexible planning.

Documentary Filmmaking:

Like thesis writing, creating a documentary requires extensive research, scripting, capturing the right footage, and editing to tell a compelling story. Emphasizing storytelling in a thesis can make the research more engaging and impactful.

Gardening:

The process of gardening—from planning the layout, planting, tending, to finally harvesting—mimics the thesis journey. It requires patience, care, and the understanding that results (fruits, vegetables, flowers) take time and effort to cultivate.

Music Composition:

Composing music involves themes and variations, much like developing a thesis statement and supporting it through chapters. Both require creativity within a structured framework, and the final 'performance' can be seen as the thesis defense.

Art Restoration:

Art restorers must understand the original artist's intent, use meticulous techniques to preserve or reveal hidden details, and often solve unexpected problems. Similarly, thesis writing involves uncovering and preserving knowledge, requiring attention to detail and problem-solving skills.

Marathon Training:

Preparing for and running a marathon requires long-term dedication, pacing, and strategy. Thesis research and writing also demand endurance, time management, and strategic planning to reach the finish line.

Building a Ship in a Bottle:

This craft requires careful planning, precision, and intricate detail work, much like the delicate and precise nature of conducting and writing up research.

Archaeological Dig:

An archaeological expedition can serve as a metaphor for the exploratory and sometimes tedious process of gathering data for a thesis. Both require methodical uncovering of information layer by layer and interpreting findings within a broader context.

Using these analogies, you can explore different techniques, processes, and mindsets that might help in enhancing the thesis journey for master's students. Each analogy can be dissected to understand its core principles and how these might be adapted to improve the way students approach, execute, and complete their thesis projects.

Prompt: *Be more creative, please*

ChatGPT

Certainly! Let's think outside the box and draw parallels from more diverse and creatively stimulating domains. Here are ten inventive analogous situations to inspire the process of thesis research and writing:

2. *Space Exploration:*

Venturing into the unknown realms of space mirrors the thesis journey of exploring uncharted academic territories. Both require rigorous preparation, dealing with unforeseen challenges, and synthesizing findings into coherent narratives.

Curating a Museum Exhibit:

Similar to a thesis, curating an exhibit involves researching artifacts, designing an engaging layout, and telling a story through the display. This process demands both a deep understanding of the subject and the ability to present it in an accessible way.

Creating a Fantasy Novel:

Writing a fantasy novel requires world-building, character development, and weaving complex plots—akin to developing a thesis framework, defining concepts, and connecting ideas across chapters.

Choreographing a Dance:

Choreography involves interpreting music or a theme into physical movements. This creative process can be similar to translating research data and theories into a structured thesis narrative.

Developing a Video Game:

The multi-layered process of game development—from storyline creation to gameplay mechanics and user interface design—parallels thesis writing. Both require engaging the audience (or reader) and often involve iterative testing and feedback.

Brewing Craft Beer:

The craft of brewing involves experimentation with different ingredients and techniques to achieve a unique flavor profile, much like mixing research methods and theories to craft a distinctive thesis.

Navigating a Maze:

The strategy and problem-solving required to navigate through a complex maze mirror the analytical and organizational skills needed to guide a thesis project towards its conclusion.

Restoring a Classic Car:

Restoration requires understanding the original design and function, while also incorporating modern enhancements. This can be analogous to respecting the foundational theories in a field of study while integrating contemporary research into a thesis.

Directing a Theater Production:

Directing involves interpreting a script, managing a diverse cast, and synchronizing elements like lighting and sound, which can inspire ways to manage different chapters of a thesis and integrate various research elements cohesively.

Building a Miniature Model Town:

This requires attention to detail, scale, and perspective, similar to the precision needed in crafting a well-structured and meticulously cited thesis.

These analogies stretch across different fields and highlight various aspects of creativity, planning, and execution that could be adapted to enhance the thesis writing experience, making it more engaging, efficient, and fulfilling.

Prompt: *Thanks. Let us pick space exploration. Please come up with challenges to conducting successful space exploration and how you would relate this to the master thesis journey and solve these challenges in the space exploration context. Please provide 9 ideas.*

ChatGPT

Great choice! Space exploration offers a rich analogy for the master's thesis journey. Both are about venturing into the unknown, tackling challenges, and synthesizing complex information into actionable insights. Let us explore the challenges in space exploration and draw parallels to the thesis journey, providing solutions that can be applied in both contexts:

A. Funding and Resource Allocation:

Space Exploration Challenge: Securing adequate funding and resources is crucial for successful missions.

Thesis Parallel: Students often struggle with accessing necessary resources (books, software, data).

Solution: Just as space missions might seek multiple funding sources or partnerships, students can explore grants, university resources, inter-library loans, and digital platforms for resource access.

B. Technical Challenges and Problem Solving:

Space Exploration Challenge: Space missions often encounter unforeseen technical issues.

Thesis Parallel: Students face challenges with data collection, software, or experimental setups.

Solution: Implementing a 'simulation phase' or pilot study can help anticipate and solve technical issues before full-scale research begins, much like test launches in space missions.

Long-Term Commitment:

Space Exploration Challenge: Space missions require years of preparation and commitment.

Thesis Parallel: Completing a thesis is a long-term academic commitment.

Solution: Breaking down the project into phases with milestones can help manage time effectively, similar to the phased approach in space missions.

Isolation and Mental Strain:

Space Exploration Challenge: Astronauts often deal with isolation and psychological stress.

Thesis Parallel: Thesis writing can be isolating and mentally taxing.

Solution: Regular meetings with supervisors and peer support groups can mitigate feelings of isolation, akin to how mission control maintains constant communication with astronauts.

Data Management:

Space Exploration Challenge: Managing vast amounts of data from space missions is critical.

Thesis Parallel: Students must efficiently organize and analyze large datasets or extensive bibliographies.

Solution: Using sophisticated data management tools and techniques, like those in space missions, can help students organize their research more effectively.

Adapting to New Discoveries:

Space Exploration Challenge: Missions must be flexible to adapt to new information and findings.

Thesis Parallel: Research can lead to unexpected results requiring changes in direction.

Solution: Building flexibility into the research plan, similar to modular space mission designs, allows adaptation to new insights without derailing the entire project.

Communication of Complex Ideas:

Space Exploration Challenge: Communicating complex space missions to the public or stakeholders is essential.

Thesis Parallel: Students need to effectively communicate their research findings.

Solution: Learning from public science communication strategies used by space agencies can help students articulate complex ideas clearly and engagingly.

Technological Proficiency:

Space Exploration Challenge: Continuously updating technological skills is necessary for the evolving nature of space missions.

Thesis Parallel: Mastering new software or methodologies is often required in thesis work.

Solution: Regular workshops and training sessions, similar to astronaut training programs, can enhance students' proficiency with new technologies.

C. Risk Management:

Space Exploration Challenge: Every space mission involves significant risk assessment and management.

Thesis Parallel: Research projects involve risks, from ethical concerns to experimental failures. Solution: Implementing a thorough risk assessment process similar to that used in space missions can help identify potential issues early and develop strategies to mitigate them. By adopting these solutions inspired by space exploration, master's students can navigate the complexities of their thesis journey more effectively, ensuring a successful and impactful project completion.

Prompt: *Excellent! now, please do an empathy map thinking you are an astronaut and must conduct a space exploration journey successfully. I will attach a picture of an empty empathy map here so you can develop the challenge.*

ChatGPT

Using the empathy map as a framework, let us delve into the mindset of an astronaut embarking on a space exploration journey. This exercise will help understand the astronaut's perspective across four dimensions: what they say, think, do, and feel. This empathetic insight is crucial for improving astronaut support systems, training, and mission design.

Empathy Map for an Astronaut on a Space Exploration Journey

Says

Public Statements: "We are well-prepared for this mission and look forward to contributing to our understanding of the universe."

To Team Members: "Let's double-check all systems and protocols to ensure everything is in perfect order."

During Communications Back to Earth: "All systems are operational, and the crew is in good spirits."

Thinks

About Mission Objectives: "What specific data do we need to collect to maximize the mission's scientific impact?"

Concerns: "Are all safety protocols in place to handle unexpected situations?"

Long-term Impact: "How will this mission contribute to future space exploration and Earth's benefit?"

Does

Pre-Mission: Engages in rigorous training simulations, studies the spacecraft systems thoroughly, participates in team briefings.

During Mission: Conducts experiments, manages spacecraft systems, communicates with mission control, documents findings.

Post-Mission: Debriefs with team, participates in scientific analysis, shares experiences in public speaking engagements.

Feels

Excitement: Thrilled about the opportunity to contribute to space exploration and experience the unique environment of space.

Anxiety: Concerns about the unknowns and potential risks associated with space travel.

Pride: Proud to be part of an elite team representing humanity's quest for knowledge.

Isolation: Feels isolated being far from family and the familiar comforts of Earth, yet also feels a deep connection to the broader mission.

This empathy map helps in designing support structures and training programs that address the emotional and practical needs of astronauts, enhancing the overall mission success and well-being of the crew. This approach can also be adapted to other high-stakes, isolated, or team-based scenarios to improve performance and outcomes.

Prompt: *Now, please generate insights from these challenges I gave you, what was challenging, and what were the good ideas generated by this session that could solve those challenges in the space exploration mission, and then, how this can be compared and used in a master thesis journey.*

ChatGPT

From the empathy map exercise, focusing on an astronaut's experience during a space exploration mission, we can derive several key insights and challenges along with potential solutions. These can be paralleled to the master's thesis journey, providing actionable ideas that enhance both scenarios.

Challenges and Insights from Space Exploration

1. Mental Well-being and Isolation

Challenge: Astronauts experience isolation and psychological stress.

Insight/Solution: Regular communication with mission control and support teams helps mitigate feelings of loneliness and stress. Psychological support and structured social interactions can enhance mental well-being.

Application to Thesis Journey: Students often feel isolated during their research. Regular meetings with supervisors and participation in study groups or seminars can provide similar support, decreasing feelings of isolation and increasing motivation and engagement.

2. Rigorous Preparation

Challenge: Extensive and rigorous training is crucial for mission success.

Insight/Solution: Simulated training sessions prepare astronauts for various scenarios they might encounter.

Application to Thesis Journey: Implementing a phase of 'simulated' thesis presentations or peer-review sessions can help students prepare for their final defense and identify areas needing improvement, enhancing their readiness and confidence.

3. Handling Unexpected Situations

Challenge: Astronauts must be adaptable to unforeseen challenges and malfunctions.

Insight/Solution: Continuous training in problem-solving and emergency procedures ensures astronauts can respond effectively to any situation.

Application to Thesis Journey: Teaching students problem-solving techniques and adaptive research methods can prepare them for unexpected challenges in their research, such as changes in project scope or methodology.

4. Communication of Complex Ideas

Challenge: Effective communication to a varied audience is essential.

Insight/Solution: Astronauts use clear and structured communication strategies to convey complex information simply.

Application to Thesis Journey: Students can benefit from training in public speaking and academic writing to improve their ability to communicate complex ideas clearly in their thesis and other academic discussions.

5. Long-Term Commitment and Motivation

Challenge: Space missions require sustained commitment and motivation.

Insight/Solution: Long-term goals are broken into shorter, manageable tasks with immediate objectives.

Application to Thesis Journey: Breaking down the thesis into chapters or sections with individual deadlines can help students manage their time better and maintain motivation throughout their research project.

Conclusion: The empathy mapping exercise for space exploration yields significant parallels that can be effectively applied to managing a master's thesis journey. Both realms require preparation, support, adaptability, and effective communication. By adopting strategies from space exploration, such as structured training and support, master's students can enhance their thesis experience, potentially leading to higher quality work and a more enjoyable research process.

Prompt: *Can you please do the same but with the parallel universe exercise, please*

ChatGPT

Using the "parallel universes" exercise from design thinking, we'll look at ways to creatively solve challenges encountered in space exploration and apply these solutions to a master's

thesis journey. This method imagines alternative scenarios or "universes" where constraints differ or do not exist, which can lead to innovative solutions.

Space Exploration Challenges and Parallel Universe Solutions

1. Challenge: Resource Limitations

Parallel Universe: Imagine a scenario where funding and resources for space missions are unlimited.

Solution: In this universe, every technological and scientific advancement could be immediately implemented into space missions, leading to rapid innovation and enhanced safety measures.

Application to Thesis Journey: If resource limitations were removed (e.g., unlimited access to research materials, data, and expert consultations), students could conduct more comprehensive research, leading to potentially groundbreaking findings and innovations in their fields.

2. Challenge: Physical and Mental Strain

Parallel Universe: Consider a universe where human limitations do not exist, and astronauts are impervious to the physical and psychological strains of space travel.

Solution: Missions could be longer, more ambitious, and more frequent, significantly accelerating space exploration.

Application to Thesis Journey: If physical and mental fatigue were non-factors, students could engage in more intense research phases without burnout. Implementing strategies to minimize stress and manage workload effectively, such as mindfulness training and enhanced project management tools, can help mimic this scenario.

3. Challenge: Communication Barriers

Parallel Universe: Imagine instant and flawless communication between space and Earth, regardless of distance.

Solution: This would enable real-time collaboration with experts globally, enhancing problem-solving capabilities and decision-making processes.

Application to Thesis Journey: Utilizing cutting-edge communication tools to facilitate instant feedback from advisors and peers could improve the quality and speed of thesis development, much like the envisioned communication advances in space exploration.

4. Challenge: Risk of Failure

Parallel Universe: A universe where failure has no consequences.

Solution: Astronauts and mission planners could take bold risks, potentially leading to significant breakthroughs and discoveries.

Application to Thesis Journey: Encouraging a culture where risks in research are seen as learning opportunities rather than setbacks can foster innovation and creativity among students.

5. Challenge: Technological Limitations

Parallel Universe: Technology evolves at an exponential rate, far outpacing its current trajectory.

Solution: Spacecraft equipped with AI capable of autonomous repairs, navigation, and data analysis would revolutionize missions.

Application to Thesis Journey: Embracing rapidly advancing technological tools, such as AI for data analysis and virtual reality for simulations, could enhance research methodologies and outcomes in thesis projects.

6. Challenge: Isolation

Parallel Universe: Imagine a universe where isolation does not affect mental health.

Solution: Missions could be conducted solo without any negative psychological impacts, simplifying logistics and reducing costs.

Application to Thesis Journey: If isolation were less of an issue, individual research could be more focused and productive. Promoting online collaboration platforms and virtual social interactions among thesis students could help mitigate real-world isolation effects.

Conclusion

The "parallel universes" exercise offers a creative framework to think about overcoming typical constraints and challenges. By imagining scenarios where limitations are absent, we can uncover innovative solutions that, while may not be fully realistic, inspire us to approach problems in new ways. Applying these imaginative solutions to a master's thesis journey encourages a more expansive and resourceful approach to academic challenges, potentially enhancing both the process and the outcomes of scholarly research."

APPENDIX C

Survey for Master thesis students, Q1 example:

Keeping the scenario in mind, to which extent do you agree with the following statements?

	1. Strongly Disagree	2	3	4	5	6	7	8	9. Strongly Agree
I don't feel stress at all about my thesis.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel stress whenever I think about my thesis.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel stress whenever I have a deadline to deliver some pages of my thesis.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

ANNEXES



Figure 16 - Panel of Experts and Researcher



Figure 17 - Parallel Universe Experiment: Master Thesis Students and Researcher

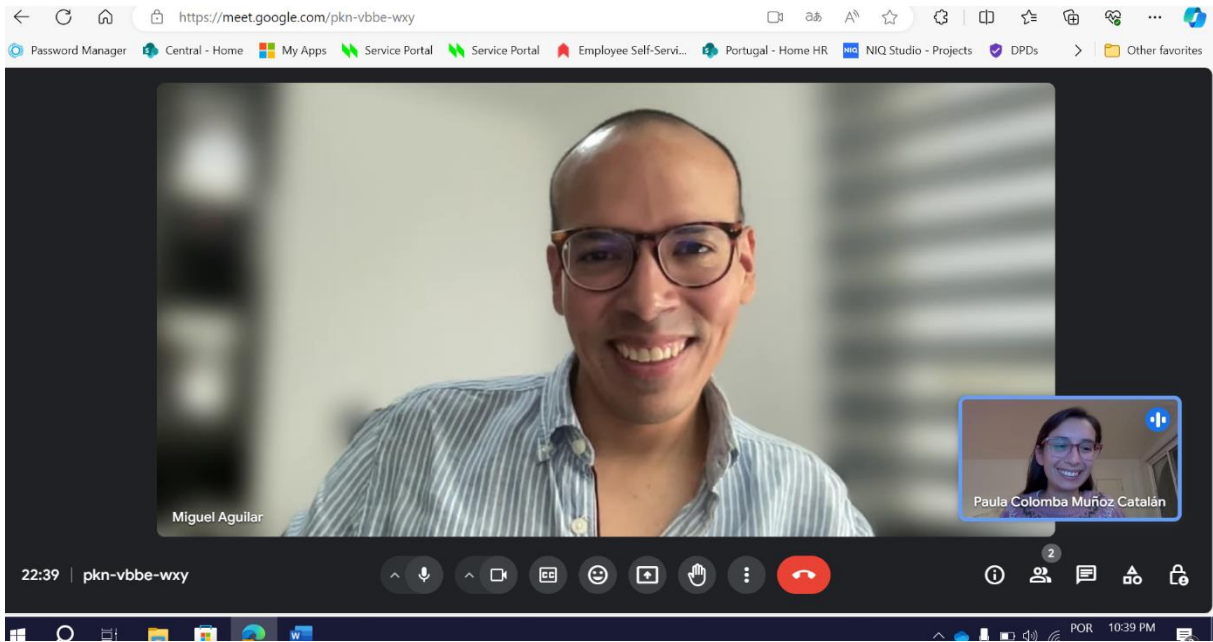


Figure 18 - Extreme User Interview Participant 14



Figure 19 - Extreme User Interview Participant 2



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