Students' Perceptions of Speculative Design with Generative AI in Creating Futuristic Narratives

An Interdisciplinary Study with Undergraduate Students from Diverse Fields

Marcelo Soares Loutfi
Federal University of the State of Rio de Janeiro
Rio de Janeiro, Brazil
marcelo.loutfi@edu.unirio.br

Marcelo Tibau
Federal University of the State of Rio de Janeiro
Rio de Janeiro, Brazil
marcelo.tibau@uniriotec.br

Paulo J. A. Gimenez
Federal University of the State of Rio de Janeiro
Rio de Janeiro, Brazil
paulo.gimenez@edu.unirio.br

Sean Wolfgand Matsui Siqueira
Federal University of the State of Rio de Janeiro
Rio de Janeiro, Brazil
sean@uniriotec.br

Abstract

Context: This study explores the integration of speculative design (SD) and Generative Artificial Intelligence (GenAI) in educational and interdisciplinary contexts. The goal is to prepare students to face future technological complexities, emphasizing ethical and social considerations.

Problem: The research addresses the need to equip students with critical skills to engage with emerging technologies. Challenges include the usability of GenAI tools, the lack of ethical frameworks for responsible innovation, and the need for creative approaches to envision future scenarios. These challenges have technological, social, and educational dimensions.

Solution: A participatory workshop that integrates SD and GenAI to inspire creativity and ethical reflection, enabling participants to collaboratively explore future technological implications.

Information Systems Theory: The research draws on Actor-Network Theory (ANT) and speculative realism to analyze the dynamic interactions between human and non-human actors in sociotechnical networks.

Method: The research employed a participatory design methodology, conducting a workshop with 17 undergraduate students from diverse fields. A qualitative approach was used to examine data collected through focus groups. The analysis focused on identifying themes related to user experiences and ethical considerations.

Summary of Results: Four main themes emerged: engagement with the process, the applicability of GenAI, personal impact and recommendations, and ethical and social reflections. Participants valued SD as a critical tool for analyzing ethical implications and the social effects of speculative technologies.

Contributions and Impact on IS: The study offers an innovative framework that combines SD and GenAI, promoting ethical and inclusive educational practices and contributing to more responsible sociotechnical systems.

CCS Concepts

• >**Human-centered computing** → **Collaborative and social computing design and evaluation**; • **Computing methodologies** → *Artificial intelligence*; • **Applied computing** → *Education*; • **Social and professional topics** → Ethics in computing.

Keywords

speculative design, Generative AI, Participatory Design, Ethical Innovation, Interdisciplinary Education

1 Introduction

Speculative Design (SD) and generative artificial intelligence (GenAI) have gained prominence as powerful tools to address complex challenges across various fields [20, 21, 32, 33]. SD, as a methodological approach, encourages envisioning potential futures and exploring possible impacts of emerging technologies, promoting creative thinking beyond immediate utility and feasibility [2, 7]. This approach is especially potent when combined with GenAI, which offers new ways to innovate, prototype, and visualize these alternative futures[1].

This paper presents insights from a group discussion exploring SD with GenAI, analyzing the possibilities and limitations of this combined approach. The discussion involved participants from diverse fields, offering perspectives on how these technologies can be applied across domains, including healthcare, law, and tourism. Key themes that emerged during the discussion highlight not only the technical applicability of SD with AI but also emphasize the critical importance of ethics and social responsibility in the development and deployment of these technologies.

As AI systems continue to evolve in sophistication and influence, they bring both opportunities and challenges [16], necessitating a framework that considers ethical implications and societal impact. SD provides a structured space to imagine the long-term consequences of AI-driven solutions, particularly those that could alter social dynamics, personal privacy, and human interaction. By examining these implications, SD with AI fosters discussions around responsible innovation, encouraging stakeholders to consider unintended consequences and prioritize values such as fairness, transparency, and inclusivity [30]. Beyond its practical applications, SD also expands the epistemological and conceptual boundaries of IS research. As highlighted by Hovorka and Mueller [15], it provides a critical detachment from existing theories, allowing researchers

[1] In "Design Against the Machine", Boris Müller highlights that the SD approach can explore GenAI to enable innovation, prototyping, and visualization of alternative futures. Available at: https://borism.medium.com/design-against-the-machine-72648374aec1

to conceive alternative worlds and challenge deeply rooted assumptions, such as the dichotomy between the digital and the real.

This study contributes to the growing body of literature on SD by situating it within the context of GenAI. Through content analysis of the discussion, this paper reveals how professionals from various fields perceive and approach the challenges and opportunities of SD with AI, particularly concerning ethical and societal responsibilities. This introduction sets the stage for a deeper examination of SD as a transformative tool, aiming to bridge technological innovation with ethical foresight.

The remainder of this paper is organized as follows: Section 2 establishes the theoretical foundation by exploring Actor-Network Theory, Speculative Realism, and SD while reviewing related works. Section 3 details the methodology, outlining the participatory design framework and thematic content analysis approach employed to examine workshop data. Sections 4 and 5 highlight the key findings, including themes such as engagement, ethical considerations, and the applicability of GenAI, and discusses their implications for interdisciplinary practice. Finally, Section 6 concludes with a synthesis of the study's contributions, emphasizing the integration of SD and GenAI as a means to foster ethical innovation and socially inclusive solutions in complex sociotechnical contexts.

2 Theoretical Background

This section presents the theoretical foundation for the proposed speculative design framework, grounded in the principles of Actor-Network Theory (ANT) and Speculative Realism. Often referred to as "entanglement theories" [8], these approaches emphasize the intricate relationships between the social and material worlds. They offer a non-anthropocentric perspective that recognizes the agency of non-human actors.

Additionally, the authors discuss studies on integrating GenAI into SD practices, particularly in educational and collaborative contexts.

2.1 Actor-Network Theory (ANT)

Actor-Network Theory (ANT) [19] emerged in the 1980s within the field of science, technology, and society (STS) studies. ANT is a descriptive approach that seeks to understand reality as a network composed of complex interactions between human and non-human actors, referred to as "actants". Unlike traditional perspectives that treat objects and individuals as independent entities, ANT recognizes that all components are interdependent and gain meaning only in relation to one another.

A central concept in ANT is the "black box" [22, pp. 67], which refers to elements that, in everyday life, function seamlessly without the need for inquiry into their internal workings. This "black box" represents a state of stability where an actor's operations and relationships are taken as given. However, to deeply understand the network, it is essential to "open" these black boxes, exploring the connections, negotiations, and interactions that sustain and shape the actor's existence and role within the network. By doing so, it can be uncovered how each element is anchored to others, revealing the articulations and stabilization processes that define sociotechnical networks.

While this process is intricate and time-consuming, it provides critical insights into the dynamics that often remain hidden beneath surface appearances. Under a phenomenological lens, a "black box" can be understood as the "unknown": we are aware of its presence and effects but cannot discern its inner workings without deliberate investigative effort. This perspective emphasizes that perceiving reality partially can often suffice for practical purposes — particularly when designing information or GenAI systems — while maintaining an awareness of the broader network dynamics at play.

The concept of the "double-click" [14] illustrates this notion. For instance, when we double-click on a computer icon, we access something that appears concealed but is, in fact, underpinned by a network of relationships enabling its creation, maintenance, and functionality. This metaphorical "double-click" in ANT symbolizes the necessity of exploring these actors to understand the interplay between human and non-human elements fully.

In the context of technology design, this perspective supports the creation of solutions that address interdependent networks, where technological and societal systems mutually influence each other. By acknowledging these mutual influences, designers — understood here as individuals or teams responsible for developing technological systems — can promote more ethical and inclusive solutions [9].

2.2 Speculative Realism

When attempting to comprehend complex systems —such as sociotechnical networks that integrate people and technologies — it is common to reduce the system to its smallest parts. However, this reductionist approach overlooks the unique dynamics and behaviors that arise from interactions between components and the broader system context.

Immanuel Kant provides a critical lens on this idea of "total understanding". According to Kant, human knowledge is always conditioned by the structures of perception and cognition. We can only access the "phenomenal" world (how reality appears to us), not the "noumenal" world (reality in itself). While this limits knowledge, it still allows for valid and practical comprehension of phenomena, albeit partial [11].

Quentin Meillassoux challenges this view with what he terms "correlationism": the notion that we can only know the relationship between thought and the world, never the world itself [27, 28]. Speculative Realism emerges in response, proposing that we can construct speculative models about reality independent of human perception. This approach rejects the need for direct experience and embraces the possibility of investigating the objective conditions that structure the world, even without full access to the "thing-in-itself". Within this movement, Object-Oriented Ontology (OOO) [12], as articulated by Graham Harman, asserts that all elements of reality—human and non-human possess intrinsic value and agency, regardless of our perception of them.

This line of thought has significant implications. By shifting focus from human-centric interpretations to acknowledging the autonomy of all system components, Speculative Realism promotes a dynamic understanding of systems. It emphasizes that human control is just one of many forces shaping the network [10]. Such an

approach counters positivist perspectives, which often limit analysis to technical aspects, overlooking broader ethical and societal impacts [17].

2.3 Speculative Design

Speculative Design (SD) is an innovative approach that creates futuristic and alternative scenarios to provoke debates about the sociotechnical implications of emerging technologies [7]. Unlike traditional design, which focuses on solving existing problems, SD explores future possibilities and challenges the status quo. It employs speculative narratives and critical objects to encourage reflection on the social and ethical impacts of technology [25]. By incorporating fiction and narratives, SD challenges current perceptions and proposes new perspectives for technological development.

SD is not merely an alternative; it reimagines how to approach problem-solving by prioritizing ethical and behavioral impacts. Most people address issues only when they become apparent — externalizing problems until they demand immediate attention. SD helps anticipate these challenges, enabling designers to preemptively minimize negative implications and encourage responsible innovation.

In this study, the authors use a speculative design framework that integrates principles from ANT and Speculative Realism. This combination enhances SD's potential to understand sociotechnical networks, speculate on futures, and conduct critical analyses of technologies, introducing new dimensions to the design process.

ANT aids in "opening the black boxes" of these networks, uncovering the complex interactions that define each actor's position. While such detailed analysis can be impractical when a quick critical overview of a sociotechnical ecosystem is needed, Speculative Realism provides a complementary approach. It enables the imagination of possible scenarios and relationships—between humans and non-humans without dissecting every detail, extending the scope beyond what is directly observable in the present and envisioning future sociotechnical reconfigurations.

By integrating ANT and Speculative Realism, SD becomes a robust approach for exploring and designing possible futures, particularly within complex sociotechnical systems. This integration broadens the understanding of the roles and agencies of technologies, objects, and humans while challenging the designers to transcend conventional relationships and perceptual limitations within system elements.

2.4 Related Works

Our study aligns with existing research exploring the integration of GenAI in SD practices, particularly in educational and collaborative contexts. Similar to the work by [26], both studies investigate how GenAI can enhance the creation and visualization of future scenarios. While [26] focuses on developing a methodological framework that embeds GenAI into speculative and emotional design processes, our research stands out by emphasizing a participant-centered approach through thematic content analysis. Specifically, we identified key themes such as engagement, aesthetic appeal, usability, and ethical considerations, providing a nuanced understanding of how interdisciplinary students perceive and interact with SD and GenAI. This approach captures real-world insights into the practical and ethical challenges faced when using GenAI, positioning our study to contribute a deeper understanding of user experiences. In contrast, [26] emphasizes combining future thinking with design thinking in a structured manner to guide human-AI collaboration. Although both studies underscore the importance of ethical reflection, our research provides more detailed insights into participants' concerns about bias, fairness, and societal impact, enhancing the discourse on responsible and inclusive innovation.

Another relevant study is "Design Thinking com IAs Generativas" by André Diniz, which explores the use of GenAI tools, such as ChatGPT and Midjourney, within the Design Thinking process [6]. The article discusses how these tools can support various stages of design, including idea generation, data analysis, persona creation, prototyping, and testing, highlighting their potential to provide valuable insights, save time, and boost creativity. While Diniz's work focuses on the practical application of GenAI to improve the efficiency and effectiveness of Design Thinking, our research distinguishes itself by examining the use of GenAI in SD contexts. We emphasize the educational and collaborative aspects of SD, analyzing participants' engagement, experiences, and reflections on ethical and societal implications. This focus provides a deeper understanding of how interdisciplinary students interact with and perceive the potential and limitations of GenAI when envisioning future scenarios.

Our research is also closely related to the study by [13], as both explore the use of GenAI within speculative design frameworks. Both works share a focus on applying GenAI to promote creative thinking and address complex scenarios, making them highly relevant to each other. [13] examines how GenAI tools can be utilized in academic research, guiding students and mentors through speculative exercises in scientific initiation. In contrast, our study broadens the scope by focusing on the experiences of interdisciplinary participants and how GenAI influences their engagement, perception, and creativity in designing future scenarios. Additionally, we delve deeper into the ethical and collaborative aspects of using GenAI, offering a unique perspective on its educational impact and potential to foster responsible and inclusive innovation.

3 Methodology

This study employed a Participatory Design approach [31] through a workshop aimed at fostering collaboration among undergraduate students from diverse fields. The objective was to explore SD practices [7] and GenAI as tools to reimagine sociotechnical networks, speculate on future scenarios, and develop more ethical, inclusive, and socially conscious solutions. The methodology included a multiphase data collection process followed by thematic content analysis [3]. Ethical considerations, such as obtaining informed consent and ensuring participant confidentiality, were integral to ensuring a comprehensive and responsible research approach [5].

3.1 Study Design

The study adopted a Participatory Design methodology, incorporating a speculative design framework shown in Figure 1. This framework included GenAI tools and unplugged techniques to encourage students' active participation in designing speculative solutions. By centering on collaboration, the study aimed to value

participants' perspectives, integrating their insights directly into the creation of future scenarios and innovative solutions.

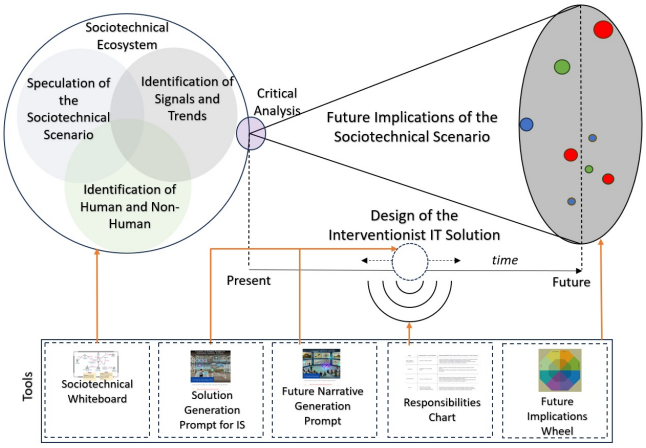

Figure 1: Speculative design framework and Tools

A workshop was conducted over 2 hours and organized as follows: two groups were formed, one with 8 students and the other with 9. Each group chose a theme and then used the sociotechnical board to understand the current sociotechnical context. This understanding was strongly influenced by actor-network theory and speculative realism. Concepts of agency distribution from actor-network theory and recognition of the ontological dignity of non-humans from speculative realism were incorporated into the explanation of how to use the sociotechnical board. Additionally, each group identified signals and emerging trends within that scenario.

Following the initial mapping, the groups used the "future implications wheel" to explore the potential implications of the scenario if the speculated trends were to be confirmed. The construction of the implications wheel is inspired by speculative realism, recognizing the propagation of implications across multiple domains. With the sociotechnical scenario mapped for their specific theme, each group used a prompt generation tool to propose an IT solution aimed at mitigating negative implications and enhancing positive ones. These prompts were applied to ChatGPT, which generated a solution that was then discussed among the group members.

Subsequently, each group used another prompt generator to create a future narrative from the perspective of one of the actants (human or non-human) within the speculated solution for the indicated time frame. Here, the agency of non-humans is still recognized, aligning with both the principles of actor-network theory and speculative realism. With the futuristic narratives in hand, the students filled in the responsibilities chart, identifying the responsibilities of the actants for each raised implication.

3.2 Participants and Context

The workshop involved 17 undergraduate students from UNIRIO[2], a public university in Brazil, recruited during an academic integration week. Recruitment was conducted through the event's website and email invitations to students. To encourage collaboration and the exchange of diverse perspectives, participants were organized into groups, each with designated representatives responsible for articulating collective responses. Before sharing their perspectives, group members engaged in internal discussions to reflect on their experiences and consolidate their viewpoints. This approach ensured that the responses provided during the workshop were representative of the collective understanding and consensus of each group regarding the activities and themes explored.

The distribution of the focus group participants is detailed in Table 1, which presents the areas of expertise of the individuals who contributed to the discussion. However, Participant (p1), who acted as the evaluator and was responsible for conducting the questions during the focus group, is not included in the table, as they did not participate as an active respondent but rather as the activity mediator.

Table 1: Distribution of Participants by Area

Area	Quantity	Participant
Social Sciences	2	p4, p9
Biological Sciences	4	p8, p10, p11, p12, p13
Environmental Sciences	2	p9, p14
Information Systems	3	p3, p7, p17
Nursing	2	p5, p15
Tourism	2	p6, p16
Law	2	p18, p2

3.3 Data Collection Procedures

To guide the speculative process, participants used a structured speculative design model composed of tools and techniques for visualizing and constructing alternative futures. Using these tools, participants extrapolated future contexts and developed IT solutions to reconfigure the relationships within the predicted sociotechnical ecosystems.

At the end of the workshop, data were collected through focus groups, where participants shared their reflections on the process of extrapolation and design. These discussions were audio-recorded to ensure a detailed capture of qualitative data for subsequent analysis.

The focus group questions were developed using the ARCS model (Attention, Relevance, Confidence, and Satisfaction), a motivational design framework that identifies key factors influencing learner engagement and persistence. The ARCS model emphasizes designing learning experiences that capture learners' attention, establish relevance to their goals, build confidence in their abilities, and ensure satisfaction with the learning process [18, 23]. This approach ensured that the questions comprehensively addressed participants' perceptions of the SD process and its implications.

The questions were organized into thematic axes corresponding to the ARCS components, with two questions for each axis. Additionally, two extra questions were created for an Objectives axis to capture reflections on ethical and societal aspects. This resulted in a robust set of questions designed to provide deep insights into participants' experiences. The questions are described in Table 2.

[2]UNIRIO - Federal University of Rio de Janeiro State. Website: https://www.unirio.br/

Table 2: Focus Group Questions by Thematic Axis

Axis	ID	Question
Attention	1	What captured your attention the most during the workshop and why?
	2	Was there any moment during the workshop that was particularly surprising or unexpected?
Relevance	3	How do you relate the concepts learned in the workshop to your professional or academic activities?
	4	In what ways did the workshop address issues that are important to you in your field of work?
Confidence	5	What skills or knowledge acquired during the workshop do you feel confident applying?
	6	How do you assess your ability to contribute to discussions or projects involving SD?
Satisfaction	7	What did you value the most about the workshop, and what do you think could be improved to increase participant satisfaction?
	8	Would you recommend this workshop to a colleague or friend?
Objectives	9	In what ways did the workshop encourage you to reflect on ethics in the development of information systems?
	10	What were the main lessons learned in the workshop about creating more inclusive and socially responsible systems?

3.4 Data Analysis Procedures

The audio recordings from the focus groups were transcribed[3] and subjected to Thematic Content Analysis [3]. This analytical method facilitated the identification of themes, patterns, and meanings in participants' responses, highlighting their envisioned reconfigurations of sociotechnical networks in the speculated futures [3]. The analysis focused on participants' expectations for possible futures and the implications of the IT solutions they developed for these imagined ecosystems.

3.5 Ethical Considerations

This study was approved by the institutional ethics committee, ensuring compliance with ethical standards of confidentiality and informed consent. Participants were fully briefed on the study's objectives, and their participation was entirely voluntary. All data collection methods adhered to ethical guidelines, and participants' privacy was safeguarded throughout the research process.

4 Results

The transcription of the focus group discussions was meticulously analyzed using an integrated approach to capture participants' perceptions of SD practices with GenAI. Three complementary analyses were conducted:

(1) The first analysis examined participants' motivational responses, structured around the four axes of the ARCS model (Attention, Relevance, Confidence, and Satisfaction). This included a similitude analysis, referred to as thematic discourse network analysis (TDNA) [4], which identified connections between terms and patterns in participants' discourse, shedding light on factors influencing their engagement and motivation throughout the workshop.
(2) Ethical and societal implications: The second analysis explored participants' perceptions of the SD objectives, emphasizing the potential of GenAI to foster ethical, inclusive, and socially responsible technological solutions. This analysis provided insights into how students perceived the alignment of speculative practices with broader societal values and ethics.
(3) Thematic content analysis: Finally, a thematic content analysis, guided by the frameworks of Neuendorf [29] and Anderson [1], was conducted to identify prominent themes that emerged from the discussions. This analysis mapped key issues raised during the focus group, such as challenges in prompt engineering, the integration of non-human agency in speculative scenarios, and reflections on the implications of AI-driven solutions. The identified themes aligned with the study's objectives and enhanced understanding of the broader implications of the participatory SD approach.

While a detailed discussion of the findings is reserved for the Discussion section, a brief contextualization here underscores how the focus group not only broadened participants' understanding of technological potential but also fostered critical perspectives on imagining and shaping possible futures.

4.1 Analysis Based on the ARCS Model Axes

The similitude analysis of the focus group responses, aimed at revealing connections between words and patterns in discourse, is illustrated in Figure 2.

In addition, participants' responses were analyzed to explore their perceptions of SD practices with GenAI across each axis of the ARCS model. This dual approach provided a deeper and more organized understanding of the data collected. The results of this analysis are summarized in Table 3.

In the **Attention** axis, represented in blue, terms like "interesting" and "speculative design" indicate that the practical activity successfully captured and maintained participants' interest. The concepts introduced and the format of SD were seen as engaging, encouraging reflection on alternative futures. Participant (p3) noted that the "speculative design model" captured their attention, while Participant (p2) mentioned they appreciated the workshop because it "addressed current and relevant topics". These insights demonstrate how the SD practice, combining unplugged and AI-based tools, fostered active engagement.

In the **Relevance axis**, identified in red, terms like "ChatGPT", "solution", "no", and "more" suggest that participants critically evaluated ChatGPT-generated solutions. These terms reflect a perception that, while the prompt generation tool was intriguing, it presented practical applicability limitations. For example, Participant (p5) commented:

[3]The audio transcript from the focus group is available at: https://zenodo.org/records/14146828

Table 3: Student Perceptions by ARCS Model Axis

ARCS Axis	Description of Results	Positive Indicators	Negative or Neutral Indicators
Attention	Participants' interest was captured by the discussion of current topics and the use of GenAI. Visual presentation and clarity of concepts helped sustain attention.	Curiosity and interest in speculative scenarios.	N/A
Relevance	Participants recognized the relevance of SD in their fields, highlighting its potential application to specific problems in their disciplines.	Relevant to fields like Law, Social Sciences, and Nursing.	Critical views on the practical applicability of solutions generated by the tool, indicating limitations.
Confidence	Some participants felt confident applying the tools, while others expressed the need for additional support, especially in AI usage.	Utility in applying ChatGPT.	Need to adapt tools for specific fields, signaling a lack of full confidence in the tools.
Satisfaction	Participants expressed satisfaction with the group dynamics and the workshop content but suggested more time for activities.	Valued the exploratory and creative process.	Limited time for completing activities.

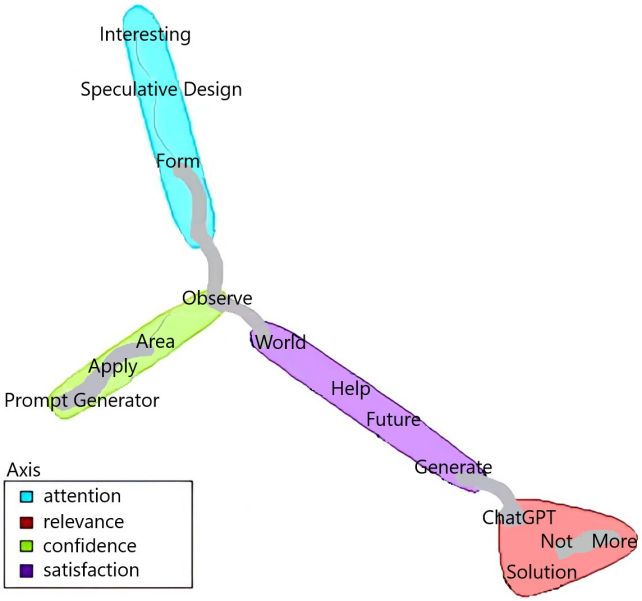

Figure 2: Similitude Analysis Grouped by the ARCS Model Axes

> "...the solution was very dystopian, not practical. It was Black Mirror[4]-ish..."

Similarly, Participant (p6) added:

> "...we found the solution very distant. It wouldn't be practical..."

On the other hand, Participant (p2), who explored the theme of fake news in the context of Law, emphasized the relevance of the practice, stating:

> "I just emailed myself our ChatGPT result because I found it really cool, and I'll include it in my research..."

In the "Confidence" axis, highlighted in green, terms like "prompt generator", "apply", and "area" show that participants saw potential for AI application in specific fields but with reservations about mastering the tool. Participant (p9) mentioned:

> "...I've used AI for a while, but generating prompts is the hardest part for me."

This comment underscores that while ChatGPT holds promise, its effectiveness depends on users' ability to create effective prompts, signaling a need for additional support. Participants expressed confidence in using the prompt generators, recognizing them as facilitators of their tasks.

Finally, in the **Satisfaction** axis, represented in purple, terms like "world", "future", and "help" indicate that participants were satisfied with the workshop's approach to projecting future scenarios. Participant (p6) noted:

> "...ChatGPT brings things in a more playful way..."

Additionally, Participant (p5) reflected on the experience:

> "...I really liked the group discussion part, but I think the time was a bit short to complete all the activities..."

This feedback highlights general satisfaction with the workshop, alongside a suggestion for extending the time allocated to allow for deeper exploration.

The term "world" occupies a central position in the similitude network, linking various axes. This suggests that exploring the "world" emerged as a cross-cutting theme connecting attention, relevance, confidence, and satisfaction. Participant (p7) illustrated this point:

> "...it would be very interesting for people to understand speculative design too."

Moreover, Participant (p2) reflected:

> "...speculative design showed me another way to observe how the world changes quickly..."

These findings highlight the exploration of a world marked by uncertainty as a central element of the practice.

4.2 Participants' Perceptions of the Objectives of Speculative Design Practice with GenAI

The practice fostered ethical reflections and highlighted the importance of developing inclusive and socially responsible solutions, as evidenced by participants' accounts.

[4]Black Mirror is a Netflix series that explores the dark and speculative impacts of technology on modern society and the future.

Regarding ethics, Participant (p6) raised issues related to user behavior, citing examples such as individuals addicted to streaming platforms.

Concerning the results generated by GenAI, the same participant observed:

> "...the exercise, if we decide to filter the information generated by ChatGPT, allows us to reflect better on the results..."

These comments provide a critical reflection not only on contemporary issues but also on the outcomes produced by GenAI, emphasizing the need for a more rigorous and ethical analysis of the technological tools employed.

In terms of creating inclusive and responsible solutions, Participant (p4) remarked:

> "This exercise of thinking ahead, thinking about the negative and positive implications..."

The comment highlights that the practice enabled the anticipation of future scenarios and the analysis of their potential consequences, promoting a reflection on the necessity of considering long-term implications when eliciting software requirements.

4.3 Thematic Content Analysis

The analysis of the focus group discussion, complemented by the similitude analysis based on the ARCS model and the perception analysis regarding the objectives, revealed valuable insights into participants' perceptions and interactions with SD and GenAI tools. The responses showcased a rich diversity of experiences, ranging from enthusiastic engagement with creative processes to critical reflections on ethical and practical issues. Table 4 synthesizes the main themes identified by the participants, providing a comprehensive overview of the key points highlighted in the analysis.

These themes will be further explored in the Discussion section, allowing for a more detailed and contextualized analysis.

5 Discussion

In this section, we delve deeper into the themes raised in the previous section, highlighting reflections on participants' perceptions of the practice of SD with GenAI.

5.1 Engagement with the Process

Participants expressed a high level of enthusiasm when interacting with the SD tools, particularly those involving GenAI. They highlighted the innovative nature of the framework and its ability to translate abstract concepts into tangible ideas, fostering an engaging and immersive learning experience. Many participants noted that the use of GenAI brought a playful yet intellectually stimulating element to the workshop, making complex concepts more accessible and encouraging active exploration of alternative futures.

The multidisciplinary nature of the process played a critical role in enriching the experience. Students from diverse fields, including law, nursing, social sciences, environmental sciences, and information systems, brought unique perspectives to the discussions, contributing to a richer and more dynamic exploration of speculative scenarios. This diversity was instrumental in promoting collaborative dialogue, where participants were able to draw on their disciplinary expertise to address speculative challenges from multiple angles. For instance, law students emphasized the regulatory and ethical implications of proposed scenarios, while nursing students focused on the human-centered aspects of technological adoption. Such exchanges highlighted the importance of incorporating diverse viewpoints in SD practices to capture the complexity of real-world systems.

The adaptability of the framework was a standout feature, as noted by several participants. This adaptability not only allowed the framework to accommodate varying levels of familiarity with SD but also positioned it as a versatile tool for addressing complex systems and wicked problems across multiple scales, as noted by Lin [24]. Participants emphasized that the framework could be tailored to different professional contexts, with potential applications ranging from policy-making and healthcare planning to environmental management and technological innovation.

Moreover, the structured yet flexible approach of the framework helped maintain engagement throughout the process. The visual and interactive components of the tools, combined with the GenAI's ability to produce creative prompts and scenarios, kept participants actively involved. The fusion of unplugged and plugged techniques also struck a balance between traditional brainstorming methods and cutting-edge technological support, making the process accessible to all participants regardless of their technical expertise.

The high level of engagement observed in the workshop underscores the importance of designing participatory and multidisciplinary speculative processes. These processes foster individual creativity and build a collective understanding of how to navigate uncertainty and complexity in designing future scenarios. This aligns with the growing recognition in design literature that collaborative and inclusive methods are essential for addressing the social, ethical, and technical challenges of contemporary information systems.

5.2 Applicability of GenAI

GenAI was recognized by participants as an essential tool in the context of SD, valued for its ability to support creative processes and explore future scenarios. Auxiliary prompt generation tools were particularly appreciated for facilitating the design process, especially by participants who reported difficulties in crafting high-quality prompts.

To develop the prompt generation tools used in this study, advanced prompt engineering techniques were deliberately avoided. Instead, a linear workflow was adopted, where outputs from the tools used to visualize and construct alternative futures informed the creation of subsequent prompts. This approach allowed participants not only to use the generated prompts but also to critically evaluate and refine them, transforming prompts into objects of analysis within the speculative process.

Participants noted some limitations in the AI-generated solutions. While some viewed the results as lacking practical applicability, others identified significant potential, finding them relevant to their research and projects. This diversity of perspectives underscores a key tension: whether to adopt advanced prompt engineering

Table 4: Themes Identified from the Analysis

Theme	Description
1. Engagement with the Process	Participants expressed enthusiasm for the speculative design model, highlighting the relevance and timeliness of the topics addressed, as well as an interest in making abstract concepts more concrete.
2. Applicability of GenAI	Participants from various fields recognized the utility of GenAI tools but highlighted challenges in prompt creation and limitations concerning accessibility and practical applicability.
3. Recommendations and Personal Impact	The practice was well-received and recommended by participants, who considered learning about SD essential for a broader and more socially informed understanding of technology within their fields.
4. Ethical and Social Reflections	Discussions about ethical and social implications, such as fairness, inclusion, and the long-term impact of speculative technologies, were central, encouraging a critical analysis of the solutions and the social effects of AI use.

techniques to produce results more aligned with participants' expectations or to retain the current approach, which encourages counterfactual speculative results.

Adopting advanced prompt engineering could align outputs more closely with participants' expectations, enhancing their perceived relevance and applicability. However, this strategy risks narrowing the exploratory scope, potentially limiting the creativity and divergence that are integral to SD. Conversely, the current linear approach emphasizes open-ended exploration, enabling the generation of counterfactual results that challenge conventional thinking and prompt critical reflection. These counterfactuals are transformative, fostering engagement with "wicked problems" and broad implications beyond immediate practicality.

A balanced approach could integrate both strategies. Advanced prompt engineering might be selectively applied during later stages to refine outputs for specific goals while preserving the exploratory and critical nature of earlier stages. This hybrid method could provide the benefits of actionable results alongside the creative freedom to explore unconventional ideas.

The authors argue for preserving the role of counterfactual objects as transformative elements of SD. Initial discomfort with these results can disrupt conventional thought patterns, creating opportunities for innovative insights and deeper critical engagement. Zhu et al. [35] support this view, showing that counterfactual scenarios stimulate perspective shifts and foster creative problem-solving.

This perspective underscores the importance of flexibility in SD methodologies, allowing GenAI tools to adapt to diverse objectives and participant needs.

5.3 Recommendations and Personal Impact

Participants were notably surprised by the tools employed during the process, particularly the prompt generators and the integration of SD with GenAI. Many reported that the experience exceeded their expectations, emphasizing how these tools facilitated the extrapolation of future scenarios and the creation of speculative narratives. These narratives were frequently described as unexpected or innovative, reflecting the tools' ability to challenge conventional thinking and foster meaningful discussions about ethics and society.

The integration of SD with GenAI was widely perceived as transformative, offering participants innovative approaches to address challenges in their fields. For instance, nursing participants highlighted its potential for simulating patient care scenarios to explore creative solutions, while law students noted its capacity to enrich analyses of emerging regulations and legislation, preempting potential challenges of new technologies. In environmental sciences, the framework provided a tool for designing solutions that balance sustainable development with ecological impacts, fostering long-term thinking. These diverse applications demonstrate the adaptability and relevance of the method across disciplines. Supporting this, Ye and Zhang [34] illustrate how SD transcends disciplinary boundaries, offering a critical platform to reimagine the implications of future decisions and technologies.

Following the workshop, many participants expressed an intention to apply SD in their academic and professional projects. The combination of speculative thinking and AI encouraged them to reassess their methodologies, anticipate trends, identify risks, and develop solutions that are ethical, inclusive, and socially responsible. These reflections indicate the method's capacity to inspire critical and forward-thinking approaches.

The enthusiastic reception of prompt generation tools suggests their alignment with the current need for creative problem-solving frameworks, particularly for addressing complex, multidisciplinary challenges. However, the reported surprise at some outcomes highlights untapped potential for speculative methodologies to disrupt traditional approaches and generate novel perspectives.

The participants' desire to incorporate speculative practices into their projects underscores the method's utility and broader adoption potential. However, refining tools like GenAI to suit specific disciplinary needs remains essential. For example, domain-specific prompt libraries or integrating visual outputs for environmental contexts could enhance usability and relevance.

The method's capacity to inspire ethical and socially conscious solutions is a critical advantage. SD not only promotes innovation but also fosters deep reflection on societal implications. This reflective component is vital for cultivating a sense of responsibility among future professionals, ensuring their work aligns with societal values and long-term objectives.

5.4 Ethical and Social Reflections

The SD practice incorporating GenAI, explored within an interdisciplinary focus group, proved to be a powerful tool for fostering ethical reflections and promoting the development of more inclusive and socially responsible systems. The experience not only encouraged critical discussions on the implications of technology but also provided practical insights into creating solutions that integrate diverse perspectives and social values.

By integrating concepts from Actor-Network Theory (ANT) and Speculative Realism, the framework embraced the complexity of sociotechnical relationships and acknowledged the agency of non-human actors. While these theories were not explicitly discussed, their principles were embedded within the design practices, enabling participants to recognize tools like prompt generators and ChatGPT outputs as active agents in the process of constructing speculative futures. This approach broadened participants' understanding of the transformative role of technologies in reshaping sociotechnical relationships and practices, steering them toward a posthumanist perspective on design [9]. In this paradigm, traditionally overlooked actors – such as technologies, ecosystems, and other non-human agents – take on central and meaningful roles in the creative process.

One of the most striking aspects of the practice was its ability to provoke ethical reflections in information system development. Participants noted that the AI-generated solutions often evoked dystopian scenarios, described as "Black Mirror-ish". These speculations about potentially undesirable futures sparked intense debates about the feasibility and morality of such technological proposals.

Moreover, the discussions connected futuristic scenarios to existing issues, such as the risk of hacking in domestic robots and other situations that expose technological and social vulnerabilities. These exercises raised awareness of how technical decisions can negatively impact society and underscored the importance of anticipating and mitigating potential ethical consequences.

The practice also highlighted the value of extrapolating futures by considering both negative and positive implications. One participant remarked that the process encouraged them to "think ahead", evaluating how a technology could influence the sociotechnical ecosystem, with ethics positioned as a central axis in this assessment.

Discussions about avoiding "social bubbles" and addiction to platforms illustrated how SD can aid in conceiving systems that promote equity and diversity. Participants reported that the extrapolation activity made them consider how technological systems could be designed to minimize exclusions and maximize social inclusion, addressing the needs of marginalized or underrepresented groups effectively.

6 Conclusion

This study explored the intersection of SD and GenAI, employing a participatory framework to engage participants from diverse disciplines in envisioning and critiquing future sociotechnical systems. The findings demonstrate that integrating SD with GenAI fosters creativity, critical thinking, and ethical reflection, offering valuable insights for designing more inclusive and socially responsible systems.

The workshop highlighted the ability of SD practices to address "wicked problems" by encouraging participants to think beyond immediate, practical solutions. GenAI tools, such as ChatGPT and prompt generators, proved effective in facilitating the creation of speculative narratives and future scenarios. This combination of human and AI-driven design processes enabled participants to engage with complex sociotechnical ecosystems in innovative ways, fostering interdisciplinary collaboration and critical analysis.

Key contributions of the study include:

- Practical insights: Participants gained a deeper understanding of how SD and GenAI can be used to anticipate trends, identify risks, and propose ethical solutions.
- Ethical reflections: The practice provoked critical discussions on societal implications, emphasizing the need to consider fairness, inclusivity, and long-term consequences in the development of technological information systems.
- Methodological advancements: The study introduced a flexible framework that combines traditional SD techniques with GenAI, which can be adapted to various disciplinary contexts.

One of the main threats to the validity of this study was selection bias, as participation was voluntary and may have attracted students already interested in speculative design or AI. To mitigate this, we diversified the participant pool by including students from various disciplines. Social desirability bias was also considered and minimized through anonymous data collection and by emphasizing that there were no "right" or "wrong" answers. Additionally, to reduce the impact of prior knowledge, we introduced key concepts of speculative design and generative AI at the beginning of the workshop, ensuring that all participants, regardless of their background, had a foundational understanding to engage meaningfully in the activities. Finally, subjectivity in qualitative analysis was addressed through data triangulation and collaborative review among researchers.

The limited sample size and focus on undergraduate students from a single university may limit the generalizability of the findings. Future research should expand the participant pool to include professionals from diverse industries and geographical contexts.

There is a risk that participants' reflections during the focus group discussions were influenced by social desirability bias, leading them to emphasize positive aspects of the workshop. To address this, anonymized data collection and diverse question framing were employed to encourage honest feedback.

The qualitative nature of the analysis introduces subjectivity in interpreting participants' responses. To mitigate this, the study employed several strategies to ensure credibility and consistency in theme identification. First, multiple researchers were involved in the coding process, engaging in collaborative discussions to reach consensus on the interpretation of key themes. This collaborative approach facilitated the triangulation of perspectives, reducing individual biases.

Second, the analysis followed established guidelines for thematic content analysis, such as those proposed by Braun and Clarke [3], to provide a structured and systematic approach to data interpretation. Clear documentation of the coding process, including decision logs and coding frameworks, was maintained to ensure transparency and replicability.

Lastly, member checking was employed by sharing preliminary findings with a subset of participants to confirm the accuracy and relevance of the interpretations. This feedback loop helped validate the identified themes and ensured that the analysis authentically represented participants' perspectives.

Building on the findings of this study, future research could:

(1) Refine GenAI tools: Develop domain-specific prompt libraries and incorporate visual outputs tailored to different fields, such as healthcare and environmental sciences.
(2) Hybrid methodologies: Explore the integration of advanced prompt engineering techniques with speculative design frameworks to balance creativity with practical applicability.
(3) Broader applications: Extend the framework to professional and policy-making contexts, examining its impact on real-world decision-making.
(4) Longitudinal studies: Investigate the long-term effects of SD workshops on participants' academic and professional practices.
(5) AI-driven ethical simulations: Develop GenAI systems capable of simulating ethical dilemmas and societal impacts, providing participants with richer tools for critical exploration.

SD combined with GenAI offers a transformative approach for navigating the complexities of sociotechnical systems. By challenging conventional thought patterns and promoting critical engagement with counterfactual scenarios, this method empowers individuals to envision and co-create futures that are not only innovative but also ethical and inclusive. As these methodologies evolve, they hold the potential to bridge the gap between technological innovation and societal values, contributing to the development of sustainable and impactful solutions.

This study contributes to GranDSI-BR's Challenge 4 by emphasizing the integration of social and technical interdependencies in technology development, critically addressing their cultural and societal impacts. It also aligns with Challenge 2 by fostering educational practices through SD, empowering students to explore open, collaborative, and transparent future scenarios tied to practical and emerging issues in Brazil.

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