Transforming Interviews into Experiences: The Power of Immersive Role Playing in Requirements Engineering Education

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Abstract Developing the necessary skills in Software Engineering students to conduct effective requirements elicitation interviews is a complex challenge. Immersive role playing has emerged as a promising educational strategy, enabling students to simulate realistic interviews, receive real-time feedback, and improve their performance under pressure. This approach blends traditional role playing with immersive learning environments, providing engaging and authentic experiences that better prepare students for industry demands. This article presents an experience report on the use of an immersive role playing to teach the interview technique for requirements elicitation. Conducted with 86 undergraduate students enrolled in a Requirements Engineering course, the study offers a broader perspective on the effectiveness and challenges of this approach. The findings suggest that immersive activities foster reflection, help identify areas for improvement, and emphasize the importance of emotional regulation in real-world interactions. These insights reinforce that mastering Requirements Engineering requires not only technical proficiency, but also strong interpersonal and emotional skills.

1 Introduction

The growing demand for qualified professionals in Software Engineering, combined with rapid technological evolution, continuously challenges educational institutions to update their instructional approaches. Cavalcante et al. (2023) highlight the importance of complementing theoretical instruction with practical experiences to better prepare students for the job market. This approach is fundamental for developing the skills required in the field of Information Technology (IT), where adapting to new methodologies, tools, and technologies is essential for success.

Teaching Software Engineering presents significant challenges, particularly in offering students practical, hands-on experiences. Often, these experiences are acquired only during professional internships, which may not be equally accessible or beneficial to all students. This gap between the theory taught in the classroom and the practical demands of the job market underscores the need for innovative teaching methods in Software Engineering, aiming to prepare future professionals for real-world challenges. Among the essential competencies for software engineers is the ability to apply Requirements Engineering (RE) techniques, particularly those related to requirements elicitation.

Interviews are among the most widely used and effective techniques for requirements elicitation (Davis et al., 2006), enabling professionals to engage with clients and stakeholders (Bano et al., 2019). The ability to extract accurate and comprehensive requirements from diverse stakeholders is closely tied to the interviewer's experience and interpersonal skills (Fernández et al., 2017). However, fostering interview skills in undergraduate students remains a challenge, as numerous factors can significantly impact the effectiveness of this activity (Hadar et al., 2014). According to Bano et al. (2019), students often struggle with question formulation, omissions, and effective communication when simulating interviews.

A widely adopted strategy for developing interview competencies among undergraduate students involves the simulation of real-life scenarios. Numerous researchers have proposed various methods and tools to enhance the realism of these experiences (Bano et al., 2019; Ferrari et al., 2019; Görer and Aydemir, 2024; Ferrari et al., 2020; Rusu et al., 2011). However, ensuring high levels of student engagement remains a significant challenge, as designing practical activities that effectively motivate learners can be complex (Quaye et al., 2019; Krusche et al., 2020; Ouhbi and Pombo, 2020).

Immersive learning has emerged as a promising approach in educational contexts. Although multiple definitions exist (Dengel, 2022), immersive learning can be implemented through a range of physical and digital media, methods, and technologies (Mystakidis and Lympouridis, 2023), which facilitates its adoption in universities. A particularly notable physical and analog immersive method is role playing, a technique grounded in the learning by doing philosophy (Dewey, 1986; Anzai and Simon, 1979). This method has been effec-

tively applied in RE education (Ferrari et al., 2019; Zowghi and Paryani, 2003; Nakamura et al., 2014), as it fosters motivation and engagement and supports diverse learning processes (Castro, 2023; Montenegro et al., 2017).

Recent findings by Otemaier et al. (2024) further corroborate these benefits, demonstrating that immersive role playing enhances student engagement, promotes authentic learning experiences, and aids in the development of critical skills such as communication, adaptability, and active listening. Their study underscores that immersive environments offer real-time feedback and encourage reflection on mistakes, thereby rendering the learning process more dynamic and closely aligned with industry demands.

Daun et al. (2023) carried out a systematic literature review (SLR) highlighting the importance of involving real or realistic stakeholders in teaching and learning processes. Their findings emphasize that authentic learning experiences can significantly enhance students' RE knowledge while also improving interpersonal collaboration and teamwork skills. In this context, role playing has emerged as a prominent educational strategy, enabling students to assume roles in low-risk, project-based collaborative instruction scenarios.

In a previous study, Daun et al. (2021) identified three primary trends in instructional approaches for teaching RE, including role playing and stakeholder involvement. These strategies have been shown to effectively increase students' motivation and enthusiasm for learning. Furthermore, immersive learning environments have been recognized as valuable resources for enhancing learner engagement and providing more authentic educational experiences.

Immersive learning environments employ technologies such as Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) to deliver highly interactive and engaging educational experiences (Alnagrat et al., 2022; Khlaif et al., 2024; Fernandes et al., 2022). These environments create a sense of presence by simulating real-world scenarios, allowing students to explore, interact, and learn in a more effective and engaging manner (Mystakidis and Lympouridis, 2023). Moreover, they provide a safe and controlled setting for experiencing real-world situations, making them particularly suitable for use in lectures, virtual laboratories, professional training, and simulations.

The study reported by Otemaier et al. (2024) presented an initial investigation using immersive role playing to teach interview techniques for software requirements elicitation, involving 15 students from the RE course in February 2024. The activity was conducted in an immersive environment at the PUCPR Extended Reality Center. The objective was to address the following research questions:

- **RQ1:** How do students perceive the use of an immersive environment for learning software requirements elicitation?
- **RQ2:** How do students perceive their learning when using an immersive environment?
- **RQ3:** What are the challenges of using an immersive environment to teach software requirements elicitation?

Building upon the findings of this initial study, a subsequent and expanded experience was conducted in August 2024, incorporating adjustments based on prior insights and

involving 86 students. This expanded sample size not only enhances the reliability of the findings but also enables a more comprehensive and in-depth analysis of the research questions. Therefore, this article aims to present the new results, providing a broader perspective on the effectiveness and challenges of using immersive environments for teaching software requirements elicitation.

The remainder of this article is organized as follows: Section 2 presents related work; Section 3 describes the planning of the immersive experience; Section 4 outlines the execution of the interview simulation for requirements elicitation; Section 5 presents the results; Section 6 provides an in-depth discussion of the findings; and Section 7 concludes the article.

2 Related Work

Several studies have investigated the use of role playing in teaching RE, especially in simulation-based activities. For example, Andersson and Andersson (2010) conducted studies where students interacted with professional software engineers in realistic industrial contexts, demonstrating that role playing can foster professional skills and encourage positive attitudes toward the technique. However, many of these initiatives are limited to face-to-face role playing and do not fully explore immersive technologies (e.g., virtual or augmented reality). Moreover, few systematically assess how communication unfolds under pressure. The present study addresses these gaps by introducing a more immersive environment, in which students interact with avatars that simulate diverse client personalities and receive real-time feedback on their performance.

Building upon the agent-based feedback systems proposed by Nakamura et al. (2014) and extended in Tachikawa and Nakamura (2017), which monitored student behavior in classroom-based role-playing sessions, our work introduces an immersive environment to enhance the authenticity of the experience. Although their findings were positive regarding requirements quality and student performance, their simulations occurred primarily in conventional classroom contexts. These approaches did not fully leverage immersive technologies capable of recreating high-pressure interview scenarios and realistic client interactions. Our study addresses this gap by placing students in a virtual environment where they interact through avatars and deal with unpredictable client behavior. This enhances realism, requiring adaptive interview strategies and spontaneous decision-making. Furthermore, immediate and targeted feedback reinforces learning during the experience, fostering both technical and interpersonal skills in requirements elicitation.

In order to stimulate reflection on errors, Ferrari et al. (2019) proposed a pedagogical strategy combining role playing, peer review, and self-assessment. Their approach reduced frequent mistakes such as vague questioning and insufficient preparation. Bano et al. (2019) also identified typical novice errors, such as unclear or omitted questions, poor rapport with interviewees, and ineffective communication. However, neither study explored the potential of immersive or simulated environments to expose students to real-time

Table 1. Comparison of Related Work on RE Strategies

Study	VR/AR Usage	Feedback Immediate	Real Stakeholders	Simulated Stakeholders	Highlights
Andersson and Andersson (2010)	No	Partial	Yes	No	Realistic simulations in industries
Nakamura et al. (2014), Tachikawa and Nakamura (2017)	No	Yes	No	Yes	Agent system for feedback
Ferrari et al. (2019)	No	Partial	No	Yes	Explores role playing and peer feedback
Görer and Aydemir (2024)	Yes (robot)	Yes	No	Yes	Use of virtual agent and robot tutor
This Study (2025)	Yes (avatar)	Yes	No	Yes	Immersive context + instant feedback

stressors and feedback. In contrast, our approach integrates immersive role playing with dynamic and reactive virtual personas, allowing students to practice real-time communication, adapt quickly to unexpected responses, and reflect on mistakes as they occur. Our work combines immersive technologies, spontaneous user interactions, and feedback loops to prepare students for real-world elicitation scenarios more effectively than traditional methods.

Morávanszky (2023) investigated how RE is taught in Swiss higher education and emphasized the challenges of preparing students to be industry-ready. The study supports the use of active learning methods such as Problem Based Learning (PBL) and role playing to bridge the gap between theory and professional practice. Similarly, Görer and Aydemir (2024) proposed the REIT architecture, which integrates robotic (RoREIT) and virtual voice agents (VoREIT) to enhance interview training. Their results indicate that structured feedback improve students' communication skills and ability to engage with stakeholders.

Building upon these perspectives, our work explores immersive role playing not only as a means to develop technical interview skills, but also as a tool for behavioral reflection and emotional self-regulation. Immersive interactions exposed students to diverse interviewee profiles, which required them to exercise patience and empathy, skills that are often overlooked in traditional RE instruction. For example, during interviews with Maria (a retired user), many students demonstrated impatience, revealing difficulties in maintaining professionalism. These findings support the argument that interpersonal and emotional competencies are as critical as technical skills in RE practice.

Table 1 provides a summary of related work. In this study, we use immersive role playing to foster both technical and soft skill in requirements elicitation interviews. By simulating realistic, emotionally nuanced client interactions, the approach provides an authentic learning environment aligned with real-world challenges faced by software professionals.

3 Planning the Experience

This study was conducted in a 120-hour RE course offered in the second semester of the Software Engineering undergraduate program at PUCPR. The program curriculum is structured around four core competencies that students are expected to develop throughout the four-year degree. The RE course is mandatory and aims to cover the entire RE process over twenty weeks of combined theoretical and practical instruction, employing active learning methodologies. Among the elicitation techniques addressed, the interview aligns with the competency: *"Design computational solutions for diverse scenarios by precisely, critically, and innovatively combining context-appropriate methods and techniques."* The associated Learning Outcome (LO) aims to equip students to identify requirements using the most suitable elicitation method for each problem and context.

Before the immersive experience, students participated in an introductory session on interview techniques. This session covered best practices for formulating questions and conducting interviews, providing the foundational knowledge for the subsequent activity.

The experience was organized in five steps:

1. Scenario Definition: The first planning step was to define a scenario unfamiliar to students, encouraging them to develop their elicitation skills from scratch. The selected context was the development of the Brazilian Federal Government's income tax system, which citizens use annually to declare their income and taxes. This scenario ensured that students would have to investigate both technical and user-oriented aspects.

2. Persona Creation: The second step involved the creation of realistic user personas to provide students with an authentic learning experience. Following the guidelines of Preece et al. (2015), we developed four personas (Figures 1–4), each with a name, photo, educational background, income level, tax profile, personal interests, and challenges related to filing a tax return. These personas aimed to simulate real-world diversity, enhance empathy, improve communication skills, and prepare students for the interpersonal complexity of actual RE practice, as supported by Mims (2003).

3. Interview Script Preparation: In the third step, we

Young Professional: Lucas
23 years old

- **Profession:** Junior Data Analyst
- **Education:** Recently graduated in Computer Science
- **Income:** Primarily from a full-time job as a data analyst, with some occasional freelance work in web development.
- **Tax Situation:** First-time taxpayer, unsure about reporting freelance income and claiming educational deductions.
- **Personal Interests:** Technology, travel, and starting to invest in the stock market with small amounts.
- **Challenges:** Balancing professional life with continuing education in a postgraduate course.

Figure 1. Persona 1 – Young Professional: Lucas

Retired Woman: Maria
68 years old

- **Profession:** Retired, former teacher
- **Education:** Degree in Education
- **Income:** Mainly from her retirement pension, supplemented by income from conservative investments.
- **Tax Situation:** Files taxes annually, with special attention to senior benefits and exempt income.
- **Personal Interests:** Gardening, reading, and volunteering with educational organizations.
- **Challenges:** Managing her finances to maintain a comfortable lifestyle, including health expenses.

Figure 2. Persona 2 – Retired Woman: Maria

Middle-Aged Businesswoman: Ana
45 years old

- **Profession:** Owner of a clothing boutique
- **Education:** Degree in Fashion Design
- **Income:** Derived from the profit of her boutique, as well as rental income from properties.
- **Tax Situation:** Experienced in tax filing, focused on optimizing business-related deductions and investments.
- **Personal Interests:** Fashion, international business travel, and art.
- **Challenges:** Expanding the business in a competitive market and efficiently managing multiple income sources.

Figure 3. Persona 3 – Middle Age Woman

Self-Employed Man: Rafael
30 years old

- **Profession:** Freelance Software Developer
- **Education:** Bachelor's in Information Systems
- **Income:** Primarily from freelance projects for national and international clients; part of his earnings goes into cryptocurrencies
- **Tax Situation:** Must manage cost deductions and monitor tax variations on investments.
- **Personal Interests:** Technology, electronic music, and eSports.
- Challenges: Stabilizing variable income and planning long-term investments.

Figure 4. Persona 4 – Self-employed Man

designed interview answer scripts containing various situations typically encountered in real-world interviews. These included phone call interruptions, vague or evasive responses (e.g., "yes" or "no"), shifting client needs, and indecisiveness. The objective was to expose students to common elicitation obstacles and train them to manage such difficulties effectively, fostering adaptability and strategic thinking.

4. Participant Selection: The cohort consisted of students regularly enrolled in a mandatory Requirements Engineering course. Participants formed teams based on self-selected affinities, simulating collaborative dynamics similar to those found in professional settings.

5. Execution Stages: The fifth step outlined the stages of the experience process:

- **Learning Stage:** Students studied the income tax system that served as the basis for requirements elicitation.
- **Script Development:** Students collaboratively prepared interview scripts.
- **Interview Conduct:** Students conducted the interviews under professor supervision.
- **Feedback:** Professors provided individualized feedback on interview performance.
- **Perception Assessment:** Students completed a post-activity survey to evaluate their perceptions of the immersive experience.

We conducted two experiences:

- **First experience (February 2024):** This experience involved 15 students, organized into five teams, with each team interacting with two of the four personas. The first implementation served as a pilot study, collaboratively designed and refined by four researchers. Insights from this initial experience lead to improvements in the second iteration, including a reduction in the number of personas and the standardization of interview dynamics.
- **Second experience (August 2024):** This experience involved 86 students, divided into two groups (Group 1 and Group 2). This iteration used only two personas (Figures 1 and 2) to standardize the experience across participants. Reducing the number of personas minimized external variation and allowed for more consistent interaction profiles, enabling a more rigorous comparison of student performance and perceptions. Standardizing the second experience was essential for isolating the effectiveness of the interview technique itself. This control enhanced the validity of the analysis by ensuring that observed outcomes could be attributed more directly to students' elicitation strategies and behavior.

It is important to note that the two implementations involved distinct student cohorts, ensuring that there was no overlap between participants in the two experiences.

Three professors, designated as T1, T2, and T3, supervised the experiences.

4   Executing the Experience

The immersive experience was conducted in three different rooms: Room 1, Room 2, and Room 3. Room 2 and Room 3 were adjacent, separated by a wall, and connected via wired internet. Each room had a distinct role:

- **Room 1** (supervised by Professor T1) served as the waiting area, where students were grouped before participating in the immersive activity.
- **Room 2** (Figure 5) was equipped with a television, desktop computer, webcam, and microphone. This was the

interview room, where students interacted with the digital avatar representing the selected persona. Professor T2 was present in this room, observing each interview and taking notes to provide immediate feedback.

- **Room 3** (Figure 6) was configured with a screen, desktop computer, smartphone on a holder, headset, and microphone. In this room, Professor T3 operated the selected persona via a digital avatar and voice modulation software, simulating realistic client interactions.

The execution process followed these stages:

- **General Instructions:** Professor T2 introduced the exercise, explained its objective, to simulate a realistic user interview scenario, and presented the contextual background of the system to be analyzed. Students were also briefed on the rules for conducting the interview.
- **Interview Script Preparation:** Students had 90 minutes to research the income tax system and collaboratively develop their interview scripts. Professors T1 and T2 supervised this stage, answering questions and ensuring that students remained focused. While not all members interacted directly with the avatar, the activity required collective preparation and joint reflection. Professors assessed group behavior as a whole, based on collaborative performance and post-interview discussions.
- **Interview Execution:** In Room 1, Professor T1 remained with the waiting groups. In Room 2, T2 received each student team individually. Students conducted the interview using a microphone to speak with the digital avatar displayed on the television. T2 observed silently and took notes for feedback. In Room 3, Professor T3 selected the appropriate persona and controlled its corresponding avatar. T3 interacted with the students via microphone while viewing them through a webcam. The professor's voice was altered using voice modulation software to match the chosen persona's profile. Each team conducted sequential interviews with two different personas during the session.
- **Feedback Session:** After each interview, Professor T2 provided immediate and personalized feedback to the teams. The feedback highlighted effective strategies as well as areas needing improvement. Student reactions varied; some passively received the feedback, while others actively engaged, asking clarifying questions to deepen their understanding.
- **Data Collection:** After the activity, each student completed an online questionnaire to report their perceptions regarding the immersive experience.

Each team interacted with two different personas during the experience. Although the interactions occurred sequentially, this structure provided students with exposure to different user profiles and communication styles. After completing both interviews, the professors provided immediate formative feedback to the teams, highlighting strengths and areas for improvement. This feedback encouraged students to compare the communication dynamics and information obtained from each persona, supporting critical reflection on how to improve future interview practices.

Figure 5. Room 2 – Students interviewing the client avatar
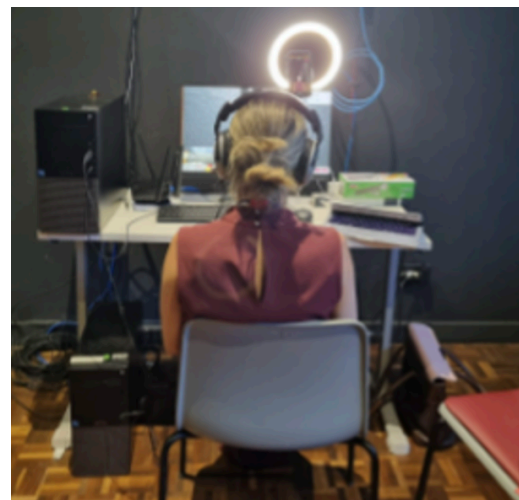

Figure 6. Room 3 – Professor T3 representing the client avatar

5   Results

This section presents the general observations made by Professor T2 regarding student behavior during the interviews, as well as the results from the data collection. The findings are structured according to the three research questions.

5.1   Student Behavior

The behavior categories presented in this section were not predefined. Instead, they emerged inductively from the professors' observations during the activity. Professor T2 systematically observed the behavior of student teams during the interviews, identifying and classifying recurring actions as either Appropriate Behaviors (AB) or Inappropriate Behaviors (IB). Each behavior was assigned a code (e.g., AB1, IB3) for reference and subsequent analysis. The final typology was refined collaboratively based on shared observations among all professors.

5.1.1   First Experience

The group participating in the first experience was divided into five teams. Regarding appropriate behaviors (AB), as shown in Table 2, teams ST1, ST2, ST3, and ST4 demonstrated common behaviors such as explaining the purpose of

the interview to the client (AB1), asking broad questions followed by specific ones (AB2), maintaining a non-imposing attitude (AB3), and attempting to understand the client's profile (AB4). Team ST2 was the most prepared, as they exhibited key behaviors for requirements elicitation, such as active listening (AB5), seeking a deeper understanding of the business (AB6), and improvising by asking questions outside the script based on the client's responses (AB7). On the other hand, team ST5 displayed an imposing attitude and faced greater difficulties than the others.

Table 2. First experience – Appropriate Behaviors (AB)

Behavior	ST1	ST2	ST3	ST4	ST5
AB1 – Explains the purpose of the interview	x	x	x	x	
AB2 – Starts with broad then specific questions	x	x			
AB3 – Maintains a non-imposing attitude	x	x	x	x	
AB4 – Understands the client's profile		x	x	x	
AB5 – Demonstrates active listening		x			
AB6 – Understands business context		x			
AB7 – Improvises beyond the script		x			

Regarding inappropriate behavior (IB), as shown in Table 3, the most common mistakes included strictly following the script without addressing unexpected situations (IB3), not engaging in listening actively (IB4), failing to ask direct questions (IB5), asking technical rather than business-related questions (IB6), and lacking planning and coordination among team members (IB12). Additionally, ST2 and ST5 recorded the interview without obtaining client consent (IB7), which is considered unacceptable in any professional setting. ST4 and ST5 showed impatience when responding to the client's questions (IB9), struggling to handle the simulations of the client's lack of knowledge. ST5 also failed to explain the purpose of the interview (IB10) and took excessive time to begin, potentially demonstrating a lack of respect for the client's availability (IB11).

Table 3. First Experience – Inappropriate Behaviors (IB)

Behavior	ST1	ST2	ST3	ST4	ST5
IB1 – Not asking for the interviewee's name	X				
IB2 – Not asking questions to understand the interviewee's profile	X				X
IB3 – Following the script and not responding to the unexpected	X		X	X	X
IB4 – Not listening actively	X		X	X	X
IB5 – Not asking direct questions	X		X	X	X
IB6 – Asking technical questions	X		X	X	X
IB7 – Not asking permission to record		X			X
IB8 – Asking irrelevant questions			X	X	X
IB9 – Showing impatience with client questions				X	X
IB10 – Not explaining the purpose of the interview					X
IB11 – Taking too long to start the interview					X
IB12 – Lack of planning and coordination between team members	X		X	X	X

5.1.2 Second Experience

To accommodate a larger number of students, the second experience was divided into two groups: Group 1 (eight teams) and Group 2 (seven teams).

Table 4 presents the professor's observation of the appropriate behaviors exhibited by Group 1. All teams demonstrated a non-imposing attitude (AB3), respecting the client. Teams ST2 and ST3 attempted to understand the client's profile (AB4), while ST7 and ST8 sought a deeper understanding of the business (AB6). A new finding compared to the first experience was that ST6 explicitly asked for permission to record the interview (AB8).

Table 4. Second Experience – Appropriate Behaviors (AB) – Group 1

Behavior	ST1	ST2	ST3	ST4	ST5	ST6	ST7	ST8
AB1 – Explains the purpose of the interview		x	x		x			
AB3 – Maintains a non-imposing attitude	x	x	x	x	x	x	x	x
AB4 – Understands the client's profile		x	x					
AB6 – Understands business context							x	x
AB8 – Requests permission to record						x		

Regarding inappropriate behaviors (IB), Table 5 shows that most teams in Group 1 failed to ask for the interviewee's name (IB1), did not engage in active listening (IB4), and did not request permission to record the interview (IB7). Additionally, ST3 did not ask direct questions (IB5).

Table 5. Second Experience – Inappropriate Behaviors (IB) – Group 1

Behavior	ST1	ST2	ST3	ST4	ST5	ST6	ST7	ST8
IB1 – Fails to ask for interviewee's name	x				x	x		x
IB4 – Lack of active listening	x		x	x	x	x	x	
IB5 – Fails to ask direct questions			x	x				
IB7 – Did not request permission to record	x					x	x	x

Table 6 presents the appropriate behaviors exhibited by Group 2. Teams ST1 and ST2 explained the objectives of the interview (AB1) and attempted to understand the client's profile (AB4). ST5 started with broad questions before asking specific ones (AB2). ST3 maintained a non-imposing attitude (AB3). Only ST6 and ST7 demonstrated active listening (AB5). Additionally, ST2 aimed to understand the business (AB6), and teams ST2, ST6, and ST7 effectively improvised beyond the script when responding to the client's questions (AB7).

Table 6. Second Experience – Appropriate Behaviors (AB) – Group 2

Behavior	ST1	ST2	ST3	ST4	ST5	ST6	ST7
AB1 – Explains the objective of the interview	x	x					
AB2 – Starts broad then specific					x		
AB3 – Maintains a non-imposing attitude			x				
AB4 – Understands the client's profile	x	x					
AB5 – Demonstrates active listening						x	x
AB6 – Understands business context		x					
AB7 – Improvises beyond the script		x				x	x

Regarding the inappropriate behaviors (Table 7), it is observed that most teams did not ask questions to understand the interviewee's profile (IB2) nor explain the purpose of the interview (IB8). Additionally, Team ST3 did not ask for the interviewee's name (IB1). Teams ST1 and ST3 did not formulate direct questions (IB5), which may have hindered the collection of relevant information. Furthermore, Teams ST4 and ST5 showed impatience (IB9) when interviewing a participant with a retired profile, which could have negatively impacted the quality of the interaction.

Table 7. Second Experience – Inappropriate Behaviors (IB) – Group 2

Behavior	ST1	ST2	ST3	ST4	ST5	ST6	ST7
IB1 – Fails to ask for interviewee's name			x				
IB2 – Doesn't explore interviewee's profile		x	x	x	x		
IB5 – Fails to ask direct questions	x		x				
IB8 – Did not explain the interview purpose			x	x	x		
IB9 – Showed impatience				x	x		

5.2 RQ1 – How do students perceive using an immersive environment to learn software requirements elicitation?

5.2.1 First Experience

The analysis of student feedback revealed a wide range of perceptions regarding the immersive experience. Initially, some participants reported feelings of anxiety or discomfort, expressing comments such as: *"I was afraid of the 3D avatar used to represent the interviewee"* and *"It felt strange; it was something new, and I didn't know what to expect."*. However, these reactions gradually diminished as students engaged more deeply with the activity.

Despite early apprehension, many students emphasized the opportunity to apply theoretical knowledge in practice, reinforcing the value of experiential learning. Representative quotes include: *"The activity was very interesting because we were able to put into practice what we learned in class"* and *"It was an important experience to understand how a real interview works."*. Students described the experience as innovative, engaging, and productive, with some highlighting its novelty: *"I was fascinated since it was a completely new and different experience"* and *"It was a very unique and productive experience. I really enjoyed it."*

These comments suggest that immersive environments can enhance student engagement and promote meaningful learning, especially by enabling the application of theoretical concepts in realistic, industry-like scenarios. Although discomfort was noted at the outset, most students ultimately responded positively, appreciating the relevance and authenticity of the activity.

The immersive experience also contributed to the development of essential competencies, including:

- **Requirements elicitation:** The activity required students to formulate effective and context-aware questions while dynamically adapting to the avatar's responses. This process directly supported the intended learning outcome of identifying requirements using appropriate elicitation techniques for each scenario.
- **Interpersonal communication:** The simulated interviews demanded clarity, empathy, and adaptability in communication, key competencies for engaging with diverse stakeholders in real-world software engineering contexts.
- **Teamwork:** The collaborative preparation and execution of the interviews fostered essential team-based skills, including negotiation, role distribution, and collective decision-making, mirroring dynamics commonly encountered in professional environments.

Overall, students perceived the immersive activity as a valuable and realistic learning experience that fostered both technical and soft skills development. Nevertheless, additional studies are needed to explore the long-term impacts of such approaches and identify strategies to maximize their educational benefits.

5.2.2 Second Experience

The results from the second experience reinforced the findings of the first, with both positive and negative perceptions reported.

In Group 1, some students felt surprised, tense, or uncomfortable, while others expressed enthusiasm and engagement. A key observation was the resistance to interacting with avatars, as many students expected human interviewees. This was reflected in comments such as: *"I was surprised by the interviewees"* and *"It felt strange to converse with an avatar that had no prior knowledge of the subject."* For some, the experience was stressful, as one student noted: *"It was tense to have to sell a software solution when the person didn't understand or know anything about the topic."* These responses illustrate the realism of the experience and highlight the importance of preparation for dealing with diverse stakeholders.

However, perceptions improved following instructor feedback. Comments like *"I was nervous but excited; it was interesting and a new experience"* and *"It was an interesting experience"* indicate growing appreciation for the learning opportunity.

In Group 2, the feedback was predominantly positive. Students reported satisfaction with the activity, describing it as realistic, challenging, and rewarding. Quotes such as *"I enjoyed it because it made me feel like I was in a real interview situation"* and *"It was a unique experience because we had to interview people we didn't know"* reflect this sentiment. Some students acknowledged being out of their comfort zone due to the unfamiliar format but felt motivated to explore further, as one noted: *"I felt out of my comfort zone but interested and motivated to explore further."* Others found the activity fun and stimulating: *"I thought it was fun; it was fascinating to see two completely different interviewees"* and *"I was intrigued by the methodology used, as it created a realistic situation."*

These findings underscore the potential of immersive learning environments to create authentic and context-rich experiences that foster student engagement and deepen learning in RE. By simulating real-world scenarios and introducing unexpected variables, such as unfamiliar interviewees or incomplete information, the activity challenged students to adapt, reflect, and develop professional skills. The diverse responses, ranging from initial discomfort to enthusiasm and curiosity, highlight the value of such pedagogical strategies in promoting not only content acquisition but also the interpersonal and adaptive competencies essential for RE practice.

5.3 RQ2 – How do students perceive their learning using an immersive environment?

5.3.1 First Experience

Students' reflections revealed a strong perception of learning through the immersive activity. As shown in Table 8, participants emphasized the value of practicing interviews with a simulated software product user and recognized the impor-

tance of learning from their mistakes.

Table 8. Students' perceptions on learning – First experience

Std	Perception
S1	*"When conducting an interview, we should not assume that the interviewee already has knowledge of the area."*
S2	*"I learned through practice how to conduct an interview correctly."*
S3	*"I learned that I need to be more objective in some questions and explore certain observations made by the interviewee in greater depth."*
S4	*"I learned that it is important to understand the interviewee and adapt the language used in the interview (more technical or less technical, depending on the case)."*
S5	*"How to prepare questions for a recruitment interview and how to conduct it properly?"*
S6	*"I learned how to conduct the interview correctly."*
S7	*"I learned to pay attention to detail when conducting a requirements elicitation interview."*
S8	*"I was able to learn about income tax and how to ask the interviewee good questions."*
S9	*"To conduct the interview, it was necessary to assess the interviewee's knowledge of the subject and adapt the questions accordingly."*
S10	*"Improved analysis of an interview script."*
S11	*"I learned how to formulate interview questions and that we should delve deeper into topics."*
S12	*"It is ideal to adapt to the client's language... while having a deep understanding of the content."*
S13	*"I learned how to structure questions so that meaningful requirements can be extracted."*
S14	*"Always ask the interviewee about anything I do not know. The professor's feedback was extremely valuable."*
S15	*"The greatest gain was having something real, immediate feedback, and meaningful interaction."*

Students consistently emphasized the importance of adapting language and style based on the interviewee's level of knowledge. For example, S9 observed: *"It was necessary to assess the interviewee's knowledge and adapt the questions accordingly."*. Similarly, S12 noted: *"We should speak in an informal way if necessary, but still master the subject."*

Another key insight was the ability to structure effective questions and explore topics in depth. As S13 stated: *"I learned how to structure questions to extract meaningful requirements and always follow up when something is unclear."*

A significant advantage of the immersive experience was the opportunity to receive immediate and targeted feedback, which students considered essential to their learning. For example, S14 and S15 emphasized: *"The professor's feedback was extremely valuable,"* highlighting its role in reinforcing learning by clarifying mistakes and validating correct practices.

These insights indicate that immersive environments can foster deeper learning by combining practical experience, reflective feedback, and the development of both technical and communication skills.

5.3.2 Second Experience

In this second experience, a larger group of students participated, yielding more diverse perspectives. Their feedback, summarized in Tables 9 and 10, reveals the development of both technical skills (e.g., planning and conducting interviews) and soft skills (e.g., self-control, adaptability). Many students emphasized preparing for unforeseen challenges, adapting questions to each interviewee's knowledge, and remaining composed amid unexpected responses. These findings highlight the importance of combining solid technical expertise with interpersonal skills for successful requirement gathering.

Table 9. Students' perceptions on learning – Group 1

Std	Perception
S4	*"Being better prepared for more general questions."*
S6	*"I understood how a real interview works and how to interact with different people."*
S8	*"Not all interviewees will share the same perspective or knowledge about software development."*
S9	*"You can be caught by surprise, so patience is essential."*
S12	*"Understanding the user's background and adapting the interview accordingly."*
S14	*"How to handle uncomfortable situations."*
S16	*"There are many types of clients, and we must know how to handle different situations."*
S21	*"I learned how to deal with unexpected situations and how to prepare better in the future."*
S20	*"Being more objective when asking questions."*
S22	*"I believe I need to prepare better for tasks in general."*

Table 10. Students' perceptions on learning – Group 2

Std	Perception
S1	*"Developing questions and context based on the interviewee's responses."*
S2	*"There are different types of interviewees, some knowledgeable, others not."*
S3	*"Analyzing the topic, formulating questions, and understanding how to apply them effectively."*
S4	*"Conversations are not always easy, and not everyone has prior knowledge about the subject."*
S5	*"How to gather requirements effectively and avoid being too rigid with the script."*
S7	*"Adapting to unexpected situations during an interview."*
S8	*"I learned to better assess circumstances before and during the interview."*
S10	*"When the interviewee's identity is unknown, it is crucial to prepare a flexible script."*
S13	*"In real interviews, interruptions can happen... different profiles require different question structures."*

5.4 RQ3 – What are the challenges of using an immersive environment to teach software requirements elicitation?

5.4.1 First Experience

In response to RQ3, which aimed to investigate students' perceptions regarding the main challenges encountered during the immersive requirements elicitation activity, several relevant difficulties emerged. Although most of the students acknowledged the innovative and realistic nature of the immersive experience, they also reported facing significant obstacles that affected both their performance and the overall learning process. These challenges, when analyzed in depth, reveal three central categories of difficulty commonly experienced by participants:

- **Preparing effective questions:** Many students struggled to formulate clear, objective, and contextually appropriate questions. Their limited knowledge of the income tax domain hindered the development of coherent scripts, often resulting in vague or generic inquiries. The need to tailor questions to user profiles revealed a gap in the ability of students to perform targeted and effective elicitation.

- **Understanding and adapting to the interviewee's profile:** Students had difficulty assessing the interviewee's level of knowledge and adjusting their language and approach accordingly. The diversity of personas, which varied in background and communication styles, added complexity to the interaction, especially when responses were ambiguous or tangential. This challenge emphasized the importance of empathy and situational awareness in the elicitation process.

- **Time pressure and real-time adaptation:** The limited duration and unpredictability of the avatars demanded quick thinking and improvisation. Students often felt unprepared to steer the conversation when the interviewee deviated from expected behavior. The experience highlighted the value of emotional regulation and adaptability, skills that are rarely addressed in traditional classroom instruction.

Taken together, these challenges provided moments of significant learning, prompting students to critically reflect on their actions, limitations, and growth throughout the activity. The immersive format intensified the perception of these difficulties, making them more tangible and memorable, and allowing both students and instructors to recognize learning gaps that might otherwise remain unnoticed in traditional theoretical approaches.

To further illustrate the challenges discussed, Table 11 provides a summary of individual student perceptions gathered during the first immersive requirements elicitation experience.

Table 11. Students' perceptions of the challenges – First experience

Std	Perception
S1	*"Maintain eye contact with the interviewee."*
S2	*"Our group asked superficial questions and weren't able to extract all the necessary information."*
S3	*"The creation of the interview script required more knowledge about income tax."*
S4	*"Not knowing the client's understanding level made it difficult to prepare."*
S5	*"The development of questions."*
S6	*No answer*
S7	*"Structuring a simple yet adaptable script was challenging."*
S8	*"Learning about income tax to provide clear and objective interviews."*
S9	*"Our lack of knowledge made it difficult to ask good questions."*
S10	*"Be more curious."*
S11	*"Make the interview feel informal and comfortable."*
S12	*"Observe and adapt to the client's profile."*
S13	*"Researching a subject I wasn't familiar with."*
S14	*"We focused on system questions, not on personal traits like occupation or age."*
S15	*"Time and adapting to a surprise interviewee were the main challenges."*

5.4.2 Second Experience – Group 1

Table 12 presents the challenges reported by students in Group 1. Several participants noted difficulties in conducting the interview (S14), formulating questions (S2), and dealing with unexpected situations (S15, S17, S18). Many highlighted the complexity of interacting with clients who lacked business context (S16), as well as challenges in maintaining communication, particularly with the retired persona (S25), who often digressed and gave unrelated responses.

Table 12. Students' perceptions of the challenges – Group 1

Std	Perception
S1	*"Communicating with a talkative interviewee."*
S2	*"Difficulty in structuring questions."*
S5	*"Client was out of sync with the project."*
S8	*"Patience and surprise from the interviewees."*
S9	*"Having patience with older interviewees."*
S12	*"Exercising patience and dealing with unforeseen events."*
S14	*"Conducting the interview and managing the situation."*
S15	*"Handling unforeseen events."*
S16	*"Interviewees didn't know anything about the project."*
S17	*"Dealing with the unexpected."*
S18	*"Maintaining focus and adapting questions during the interview."*
S25	*"Active listening."*

5.4.3 Second Experience – Group 2

In Group 2 (Table 13), while some students reported no difficulty (S1 and S11), most identified challenges in adapting questions (S2), managing unexpected situations (S4, S5, S8), handling interruptions (S19), and maintaining patience (S16, S17). Students emphasized the need to adjust language and manage conversations with interviewees who had little or no technical background.

Table 13. Students' perceptions of the challenges – Group 2

Std	Perception
S1	*"No difficulty."*
S2	*"Adapting questions to each interviewee and response."*
S4	*"Talking to someone unfamiliar with the subject."*
S5	*"Handling unexpected answers from the interviewee."*
S8	*"Dealing with people with no technical background."*
S11	*"The interview was smooth."*
S16	*"Slow responses and difficulty managing the script."*
S17	*"Having patience with the interviewee."*
S19	*"Interruptions and misunderstandings during the interview."*

The selection of personas with contrasting profiles, such as Maria, a retired user with no prior experience filing her income tax, and Lucas, a young professional with extensive experience managing his own tax returns, proved effective in generating challenges for the students, eliciting diverse responses and behaviors. Therefore, for this experience, the inclusion of personas with opposing characteristics is considered relevant.

These findings illustrate that immersive activities not only simulate technical aspects of requirements elicitation but also expose students to interpersonal and emotional challenges commonly encountered in professional contexts. Difficulties related to question formulation, real-time adaptation, and emotional self-regulation were repeatedly mentioned, reinforcing the value of immersive experiences for comprehensive skill development.

6 Discussion

The results presented in Section 5 indicate that immersive role playing can significantly enhance student engagement, learning outcomes, and the development of both technical and soft skills in RE. However, several challenges persist, particularly regarding the consistency of communication and the ability to manage unexpected situations during elicitation interviews. This section offers a deeper analysis of our findings, situating them in the context of existing literature and highlighting the implications for teaching RE through immersive methodologies. We also discuss recurring challenges, the role of feedback, and the importance of designing realistic scenarios that closely mirror professional settings.

6.1 First Experience – Professors' Observations

Professor T2's observations during the first experience proved valuable in providing feedback on the students' learning process. Even though the intervention lasted only 180 minutes, it allowed for close scrutiny of student behaviors, including both successes and mistakes, typical of beginners in requirements elicitation.

The proposed approach yielded higher student engagement, revealing that using role playing to teach elicitation fosters motivation and interest. Conducting the activity in an environment distinct from a traditional classroom, featuring immersive and playful technologies, brought students closer to the types of experiences they may encounter in industry, thus raising their motivation to complete the tasks. These results align with Ouhbi and Pombo (2020), who highlights that role-playing is an effective strategy for teaching elicitation techniques over short periods and increasing student engagement.

Observing students' mistakes was essential for the teaching-learning process. Based on these errors, professors could provide more precise and individualized feedback, encouraging students to reflect on what went wrong, evaluate alternative approaches, and identify which technical and soft skills need improvement (Ferrari et al., 2019; Nakamura et al., 2014; Tachikawa and Nakamura, 2017).
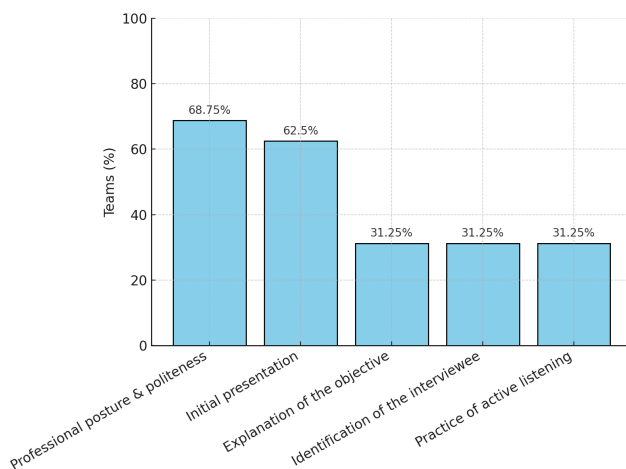
Regarding inappropriate student behaviors, we classified them according to Bano et al. (2019) into seven categories: (1) errors in question formulation, (2) question omission, (3) issues with question ordering, (4) communication skills, (5) interviewer behavior, (6) client interaction, and (7) planning/teamwork. A notable observation was that approximately 60% of the teams did not practice active listening, a critical gap given how vital it is for effective interviewer–client communication. Strengthening active listening skills is thus an area that warrants further attention, particularly to help students handle unexpected situations and improve their overall elicitation performance.

6.2 Second Experience – Professors' Observations

In the second experience, two professors observed the teams and provided real-time feedback, examining both positive behaviors and areas needing improvement. These findings are consistent with the literature discussed in Section 2 (Bano et al., 2019; Ferrari et al., 2019, 2020; Daun et al., 2021, 2023; Otemaier et al., 2024), underscoring the role of immersive role playing in developing the competencies required for RE. Nonetheless, the results also reveal persistent challenges in student behavior and communication.

Figure 7 illustrates the percentage of teams displaying key interview behaviors. The highest rates were observed for "Professional posture and politeness" (68.75%) and "Initial Presentation" (62.5%). On the other hand, lower percentages were found for "Explanation of the objective" (31.25%), "Identification of the interviewee" (31.25%), and "Practice of active listening" (31.25%), suggesting that many teams struggled to clearly define the interview's goals, gather essential

background information, and engage actively in the dialogue.

Figure 7. The percentage of teams displaying key interview behaviors

Another frequent issue was difficulty in formulating appropriate questions to understand the interviewee's profile. This resonates with the "question omission" theme identified by Bano et al. (2019) and Ferrari et al. (2019), highlighting the need to systematically teach strategies for exploring the client's context. Additionally, concerns about politeness and empathy emerged, as some students exhibited impatience or insensitivity toward the interviewee's pace, a finding aligned with Sakuma et al. (2023), who propose that immersive environments can bolster interpersonal skills by exposing learners to unexpected avatar responses.

Over-reliance on the scripted interview was another challenge. Some teams did not adapt to unforeseen situations or deviated too rigidly from the plan. While role reversal and improvisation have been suggested as effective ways to enhance student confidence (Ferrari et al., 2020), not all participants demonstrated these adaptive behaviors.

Lastly, some teams displayed a lack of politeness and professionalism, such as immediately shifting to technical questions upon discovering the interviewee had an IT background. This can compromise the trust built during elicitation, corroborating findings by Hadar et al. (2014). Overall, the second experience reaffirmed the utility of immersive role-playing as a learning tool but also highlighted the ongoing need for structured, iterative training that hones communication, adaptability, and emotional self-regulation skills.

6.3 First Experience – Students' Perceptions

Overall, students expressed positive views of the immersive environment, noting that its realism motivated them to better grasp interview techniques. The immersive approach also helped them identify and reflect on mistakes in practice, emphasizing the value of learning by doing in an environment different from standard classrooms.

Real-time feedback proved crucial. Immediately following each team's interview, instructors highlighted both effective strategies and shortcomings, aiming to promote reflective thinking and deeper learning. Students reported that learning from mistakes was particularly meaningful, often describing the biggest lessons as stemming from errors.

However, a point of concern was the limited time allotted for preparation and for learning about the interviewees' backgrounds. Students suggested that 180 minutes was insufficient and advocated for a longer timeframe, such as 240 minutes total, to research the topic, conduct the interview, receive feedback, and engage in structured reflection.

6.4 Second Experience – Students' Perceptions

The expanded experience supported the role of immersive environments as a teaching tool in RE, addressing documented gaps in prior research (Bano et al., 2019; Ferrari et al., 2019, 2020). Incorporating immersive technologies was shown to elevate realism and student engagement, resonating with the arguments of Daun et al. (2021, 2023) about the need for authentic stakeholder participation in RE education. Immediate feedback and diverse client behaviors also aided in preparing students for real-world unpredictability (Ferrari et al., 2019).

Nevertheless, communication and behavioral challenges remained, echoing Hadar et al. (2014). Participants often struggled with patience and active listening when facing interviewees possessing varying domain knowledge, an observation that aligns with Sakuma et al. (2023), who emphasize the need for empathy and real-time adaptation in interviews.

Additionally, the significance of planning and crafting suitable questions, emphasized in our findings, converges with the recurring novice errors noted by Bano et al. (2019). By exposing students to clients without an IT background, we created realistic uncertainties advocated by Ouhbi and Pombo (2020), which can foster deeper engagement and skill internalization. However, the limited time for scenario repetition and interview review hinders full consolidation of best practices, aligning with Ferrari et al. (2020), who propose iterative learning cycles.

Lastly, students' reflections on mistakes further corroborate the power of immediate, targeted feedback (Tachikawa and Nakamura, 2017). While most participants praised this approach, some indicated a desire for more preparation time, suggesting the need to extend both the activity duration and prior instructional content. Overall, our findings demonstrate how immersive environments address identified gaps in the literature and underscore the importance of an iterative method that integrates theory, practice, error reflection, and scenario re-execution to maximize RE learning potential.

6.5 Lessons Learned

The implementation of the immersive role-playing activity revealed several important lessons, summarized as follows:

- **Promote Diversity to Enhance Observation:** The use of personas with distinct profiles broadens the opportunities to assess the diversity of student behaviors. Applying the same personas to all participants enables more consistent comparisons between responses and strategies adopted.

- **Ensure a Minimum of Two Personas per Student:** Considering that each interview requires time to be conducted, and that it is important for students to interview at least two distinct profiles, it is recommended to have at least two personas to make the activity feasible in larger classes.

- **Standardize Personas to Facilitate Comparability:** In the first experience, each team interacted with two out of four personas selected at random, introducing variability in the interview dynamics. In the second experience, all teams interacted with the same two personas, standardizing the interaction context. Although the study did not aim to directly measure the effect of this standardization on the occurrence of student mistakes, professors observed fewer extreme behavioral deviations and more uniform challenges across teams. This suggests that standardizing personas can reduce contextual noise and facilitate a more controlled comparison of student strategies and performance. Future studies may explore whether this consistency contributes to a reduction in error frequency.

- **Distribute Instructor Roles for Effective Facilitation:** The activity requires the coordination of three instructors with distinct responsibilities: one to simulate the persona via avatar; another to supervise students awaiting or concluding their turn, maintaining engagement and preparation; and a third to observe interviews and deliver immediate feedback. This distribution of responsibilities proved essential for effective management of the immersive environment, ensuring the maintenance of educational quality.

- **Incorporate Immediate Feedback to Reinforce Learning:** Immediate feedback is essential for students to understand their strengths and areas needing improvement, both regarding their behavior during the interview and their technical knowledge, thereby promoting the consolidation of learning.

6.6   Threats to Validity

Although the reported results are promising, some factors may threaten the validity of our findings:

- **Sample size and selection:** Each iteration was limited to participants from a single institution. The findings may therefore not generalize to other institutions or cultural settings.

- **Variability in participants' background:** Students entered the course with different levels of programming and business knowledge. These varying skill sets likely influenced both their performance and their perceptions of the immersive experience.

- **Self-reported perceptions:** Qualitative data on learning experiences and challenges relied mainly on self-reports, which can be subject to social desirability bias or incomplete recollection. Although all participants signed an informed consent form before engaging in the activity, their responses may reflect subjective interpretations or a tendency to present socially desirable answers, rather than fully accurate self-assessments.

- **Team-based interaction and evaluation:** Another potential limitation concerns the fact that not all students directly interacted with the avatar during the interviews. Each team was free to define its internal strategy, and in some cases, only one or two members conducted the conversation. Consequently, individual behaviors were not assessed in isolation; instead, feedback and evaluation focused on the collective performance of the team. While this approach reflects real-world collaborative dynamics, it may have limited the opportunities to observe individual skill development.

7   Conclusion

This article presented the use of immersive role playing to teach requirements elicitation interview technique in a Software Engineering undergraduate course, involving 86 participants.

The results indicate that immersive learning environments can significantly enhance students' engagement, encourage reflection on professional behavior, and support the development of both technical and interpersonal skills. The activity allowed students to simulate realistic interviews, deal with unpredictable responses, and receive immediate feedback, fostering essential competencies such as adaptability, empathy, active listening, and question formulation.

Analysis of the three research questions showed that students perceived the immersive environment as an innovative and realistic learning strategy, despite initial discomfort or anxiety. They recognized the activity's value in helping them connect theoretical knowledge to practical application and in highlighting areas for personal and technical improvement. Moreover, the activity made it possible to observe behaviors that often go unnoticed in traditional classroom settings, such as poor communication strategies, lack of preparation, and emotional reactions under pressure.

The challenges reported by students, related to communication, planning, limited domain knowledge, emotional regulation, and the immersive setup itself, are also representative of real-world difficulties faced by software professionals. These findings suggest that immersive role-playing not only improves content learning but also prepares students for the unpredictable and interpersonal nature of RE in practice.

As future work, we intend to refine the pedagogical design of the activity by incorporating more structured feedback mechanisms, diversifying personas, and exploring long-term impacts on students' professional behavior. We also aim to investigate whether the immersive experience influences students' performance in subsequent interviews, particularly in capstone projects and internships.

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