

Development and Evaluation of a Serious Game to Support Nursing Staff

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Abstract

The nursing profession faces high stress and demanding workloads, leading to burnout and decreased job satisfaction, which affects both nurses and patient care. This research, based on design science methodology, aims to develop and evaluate a serious game to support nursing staff by offering an engaging method for stress management, skill development, and continuous education. The game, created with input from healthcare professionals, simulates real-world challenges in a controlled, interactive environment. It aims to enhance problem-solving abilities, communication skills, and stress management techniques among nurses. Preliminary evaluations show that the game engages nursing staff and positively impacts their confidence, resilience, and job satisfaction. This research provides a validated tool for professional development in nursing, contributing to improved patient care and reduced turnover rates. The evaluation of the game with the specified target group highlights its potential as an effective complement to traditional training methods, offering a scalable solution to ongoing challenges in the nursing profession.

1 Introduction

Nursing staff are at the forefront of healthcare delivery, providing critical care and support to patients across diverse settings. Despite their indispensable role, nurses frequently encounter numerous challenges that impact their ability to deliver optimal

care. These challenges include high patient loads, long working hours, emotional stress, and the constant need to stay updated with the latest medical practices and technologies [1, 2]. The increasing complexity of healthcare systems and the rising demand for quality patient care further exacerbate these challenges, highlighting the need for effective training and support mechanisms for nursing staff. In recent years, serious games have emerged as a promising tool in the realm of healthcare education and training. Serious games are defined as digital games designed for purposes beyond mere entertainment, such as education, training, and behavior change [3]. These games leverage engaging and interactive elements to create immersive learning environments, making them particularly effective for simulating real-life scenarios and fostering practical skills [4]. For nursing staff, serious games offer a unique platform to practice clinical skills, enhance decision-making abilities, and manage stressful situations in a risk-free environment [5]. The context of this paper is grounded in the contemporary healthcare landscape, where technological advancements and evolving patient care standards necessitate continuous learning and adaptation among nursing professionals. Through a detailed examination of the design, implementation, and evaluation of the serious game, this research seeks to contribute to the growing body of evidence supporting the efficacy of digital learning tools in healthcare education. This paper aims to explore the development and evaluation of a serious game specifically designed to support nursing staff. The importance of this research lies in address-

ing the critical need for innovative training methods that can alleviate the pressures faced by nurses and enhance their professional competencies. By providing a structured and engaging approach to learning, serious games have the potential to bridge the gap between theoretical knowledge and practical application, leading to improved patient outcomes and job satisfaction among nurses. The demands on nursing staff continue to escalate, the development of effective training interventions becomes increasingly crucial. This paper demonstrates how serious games can be a valuable asset in supporting nursing staff, enhancing their skills, and contributing to better healthcare delivery.

2 Theoretical Background

2.1 Game Design

Effective design and implementation are crucial for the success of serious games in nursing education. Garris et al. (2002) outlined key design principles for developing effective serious games [6]. They emphasized the importance of user engagement, clear learning objectives, and the integration of feedback mechanisms. These principles are essential for creating games that are not only educational but also engaging and motivating for users. Henderson et al. (2014) evaluated the usability and educational impact of a serious game designed for nursing education [7]. Their findings underscored the importance of usability in the design of serious games. A user-friendly interface, intuitive navigation, and relevant content are critical for ensuring that the game effectively supports learning objectives and is well-received by users. Fernandes et al. (2019) discussed strategies for integrating serious games into nursing curricula [8]. They identified several challenges, including resistance to change, the need for faculty training, and the importance of aligning game content with curricular goals. Their work provides valuable insights into the practical aspects of implementing serious games in educational settings, highlighting the need for careful planning and collaboration among stakeholders. The goal of game-design elements is to increase the

motivation, learning behaviour and user binding of users through different game dynamics and motives. Table 1 highlights the most important game-design elements with their corresponding game dynamics and motives, heavily leaning on Blohm et al. (2013) [9].

Game Mechanics	Game Dynamics	Motives
Documentation of behaviour	Exploration	Intellectual curiosity
Scoring systems, badges, trophies	Collection	Achievement
Rankings	Competition	Social recognition
Ranks, levels, reputation points	Acquisition of status	Self-redeem
Group tasks	Collaboration	Social exchange
Time pressure, tasks, quests	Challenge	Cognitive stimulation
Avatars, virtual worlds	Development/organization	Self-determination

Table 1: Game-Design Elements, Blohm et al. [9]

Games with a purpose reflect an approach in which problems that cannot satisfactorily be solved with information systems are transformed with game-design elements. This allows individuals to solve them in a game-like fashion [10]. For example, ARTigo7 is a game which was developed by the Ludwig Maximilian University in Munich [11]. In this game, two players compete in finding more tags for characterizing images from the digital archive of the Institute for Art History than their opponent.

2.2 Game Flow

Game flow, a key concept in game design, refers to the seamless progression and engagement of players. Rooted in Mihaly Csikszentmihalyi's flow theory (1990), it describes a state of complete immersion where individuals feel in control, focused, and intrinsically motivated [12]. Achieving optimal game flow involves balancing challenge and skill to keep players engaged and satisfied. Key elements of flow include clear goals, immediate feedback, balance between challenge and skill, concentration, a sense of control, loss of self-consciousness, and a transformation of time. In games, clear goals ensure players understand objectives, while immediate feedback helps them adjust strategies. The balance between challenge and skill prevents boredom and frustration, and immersion draws players into the game world, keeping their attention focused. Sweetser, Wyeth and Chen (2005) have identified essential components of game flow, such as appropriate challenge

levels, player skill adaptation, control, clear goals, and feedback [13, 14]. Measuring flow often involves self-report questionnaires, like the game flow questionnaire, behavioral observations, and physiological measures [15]. Applying game flow principles to serious games for nursing involves creating engaging, educational experiences. Serious games simulate real-world nursing challenges, providing immersive training that reflects actual scenarios. By incorporating realistic scenarios, immediate feedback, and adaptive difficulty, these games enhance skill development and competence among nursing professionals. Understanding and applying game flow principles can create effective serious games that improve learning and job satisfaction. For nursing staff, such games offer valuable training tools that enhance performance and patient care, addressing specific challenges and improving overall job satisfaction.

2.3 User Interfaces

User Interfaces are the program layers, which the player interacts with an application or game. They consist of a variety of different UI elements, such as buttons, text fields, sliders, views and more. The UI is the crucial intersection between the application and the user and gives a first impression of the application. In this project, the UI is not only used for interaction, but also for conveying knowledge, such as direct feedback, visual statistics and also for animations during the use of the application. In order for this knowledge to be conveyed, the user must interact with the application. To ensure good UI Design, 10 Usability Heuristics are considered [16]:

1. Visibility of system status: The users should always know what is happening in the system, e.g., via feedback within a reasonable amount of time.
2. Match between system and real world: The games language, used phrases and words should match the users' general type.
3. User control and freedom: Users will often choose system functions by mistake and will need an "emergency exit"

4. Consistency and standards: Users should not be concerned with wording.
5. Error prevention: Preventing error messages entirely is preferable over anything error related.
6. Recognition rather than recall: Users should not have to remember important information.
7. Flexibility and efficiency of use: Allow experienced users to use "accelerators" which can speed up UI interactions for them.
8. Aesthetic and minimalistic design: The UI should not contain irrelevant or redundant data.
9. Help users recognize, diagnose, and recover from errors: If an error occurs, it should be easily understandable even for laymen.
10. Help and documentation: If documentation is required, provide it in an easily comprehensive way.

3 Related Work

3.1 Serious Games in Healthcare and Nursing

The use of serious games in healthcare has gained significant attention due to their potential to enhance education and training. Arnab et al. explored the applications, implications, and design strategies of serious games in healthcare [17]. Their work highlights how these games can be utilized to address various educational needs, providing an interactive and engaging platform for learners. This foundational study sets the stage for understanding the broader impacts of serious games in the healthcare sector. Graafland et al. [5] focused on the development and evaluation of a serious game designed to teach nursing students evidence-based medicine. Their research demonstrated that serious games could effectively improve knowledge retention and decision-making skills. The game's interactive nature allowed students to engage with the material in a meaningful way, reinforcing the practical application of theoretical concepts.

A literature review by Pront et al. examined the role of game-based learning in nursing education [18]. The review concluded that serious games offer significant benefits, including enhanced engagement, improved learning outcomes, and increased motivation among nursing students. However, the authors also noted challenges such as the need for high-quality content and the potential for technical issues.

3.2 Addressing Nursing Challenges through Serious Games

Nursing staff face numerous challenges, including stress, burnout, and the need for continual skill development. Smith et al. (2011) investigated the prevalence of stress and burnout among nurses, proposing interactive simulation games as a potential solution [19]. Their study found that such games could help manage stress and improve mental well-being by providing realistic scenarios that allow nurses to practice coping strategies in a controlled environment. McGonigal et al. (2013) explored how serious games can enhance clinical decision-making skills in nursing [20]. By presenting complex patient cases and allowing nurses to make decisions and observe outcomes, these games provide a safe space for practicing critical thinking and problem-solving skills. The feedback mechanisms within the games further reinforce learning by highlighting correct actions and areas for improvement. Kang et al. (2020) conducted a meta-analysis on the impact of virtual reality training on nurses' performance [21]. Their research showed that Virtual Reality (VR) training could significantly improve skill acquisition and performance, making it a valuable tool for nursing education. The immersive nature of VR allows for realistic simulations that closely mimic real-life scenarios, thereby enhancing the learning experience.

3.3 Serious Games for Healthcare Stakeholders

The first records of paper-based serious games go back to the early 1900s, while the first appearance of the term serious game can be traced back to Clark C Abt in 1970. However, the term only received its

current definition in a paper by Ben Sawyer in 2002, who bases it on the idea of connecting a serious purpose to a video game. A serious game can be derived from any given topic, but usually uses a scientific source or field of expertise as foundation, ranging from health over politics to security. However, serious games should not be confused with normal video games or entertainment games. Tarja et al. (2007, p. 6) compared entertainment games with serious games and outlined the requirements for serious games [22]. Although both categories are standalone games, there are significant characteristics that need to be considered differently when creating a serious game. Table 2 shows the differences between entertainment games and serious games.

Category	Serious Game	Entertainment Game
Task vs rich experience	Problem solving in focus	Rich experiences preferred
Focus	Elements of learning	Have fun
Simulations	Need of assumptions	Simplified processes
Communication	Natural communication	Perfect Communication

Table 2: Difference between Serious Games and Entertainment Games, Tarja et al. (2007)

Sandro et al. (2011, p. 4) created a serious games system for sport and health with focus on medical measurements and applications proceedings [23]. They evaluated the effectiveness of the proposed system with 95 participants and conducted test results. The idea of serious games while considering the characteristics was strongly accepted by 65% of the users. Ribaupierre et al. (2014, p. 23 ff.) created a serious games application allowing systematic investigation of simulation fidelity and multi-modal interactions with respect to learning [24]. The interactive nature of the game helped the user become immersed in the game and enhanced eagerness. The fact that serious games have a specific purpose and contain immediate feedback makes them well suited in healthcare. Serious games influence not only the learning effectiveness of individuals but also the psychological behaviour of individuals in terms of health awareness. They can be used for diagnosing and treating attention deficit hyperactivity disorder or post dramatic stress disorder. Games like "SMART Brain Games", which is designed to improve the focus of children with ADHD, or "Full Spectrum Warrior",

which diagnoses and treats PTSD of post war veterans, increases the standard of living. There is a great diversity in the set of applications for serious games in healthcare. Similarly, there is a high number of stakeholders in this market, which includes government, hospitals, clinics, therapists, corporations, and other organizations.

3.4 Serious Games for Skill Enhancement

The use of serious games in healthcare, particularly for continuing education and professional development, has gained significant traction in recent years. Several studies have explored the effectiveness of serious games in enhancing the skills and competencies of healthcare professionals. One example is “Sepsis Trainer”, which focuses on the early recognition and management of sepsis in healthcare settings. The game was evaluated by Bergeron et al. (2019), who demonstrated that it significantly increased the participants’ knowledge and responsiveness to sepsis symptoms [25]. This supports the role of serious games in fostering continuous professional development by reinforcing the critical thinking required in high-pressure situations. “Hand Hygiene Heroes” is another serious game aimed at improving infection control practices among healthcare workers. De Vries et al. (2017) found that participants who played the game demonstrated better adherence to hand hygiene protocols compared to those who did not receive game-based training [26]. This illustrates the effectiveness of integrating hygiene-related tasks into serious games, which emphasizes understanding and eliminating hospital-acquired infections. In a study conducted by Sanko et al. (2016), “Virtual Patient Trainer” was found to improve clinical reasoning skills by allowing nursing students to make decisions regarding patient care in a simulated environment [27]. This game uses realistic scenarios to promote learning, highlighting the importance of scenario-based training for fostering critical decision-making skills in a safe, controlled setting.

4 Methods

4.1 Information Systems Research Framework

The underlying framework of the project is the Information Systems Research (ISR) framework provided by Hevner et al. (2004) [28]. Information systems improve the effectiveness and efficiency of the organization. Figure 1 presents the conceptual framework for understanding, executing, and evaluation ISR combining behavioral-science and design-science paradigms. The concept of the design artifact, foundations and methodologies is described below. The design artifact offers a solution to unsolved problems. This can be achieved by applying existing knowledge in new and innovative ways. The foundation is the creative development of models and methods. The results are contributions to the knowledge base in design-science research. Creative development and the use of evaluation methods provide design-science research contributions to the environment also considered as methodologies.

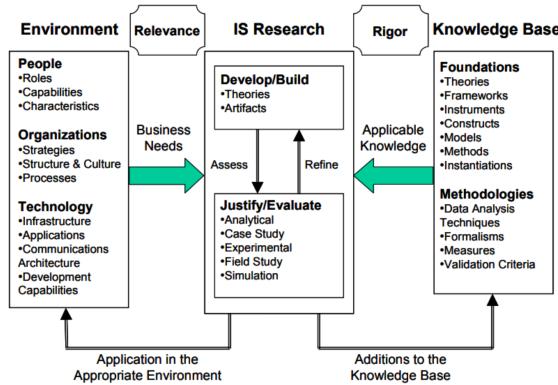


Figure 1: Information Systems Research Framework, Hevner et al. (2004)

4.2 Design Science Research

Design Science, as the other side of ISR, creates and evaluates IT artifacts intended to solve identified organizational problems Hevner et al. (2004,

p. 77) [28]. Design science is a problem-solving process which requires several guidelines to go along with. Design science creates and evaluates artifacts intended to solve identified organizational problems. These artifacts are represented in a structured form that may vary from software, formal logic, and rigorous mathematics to informal natural language descriptions. These guidelines can be summarized heavily leaning on Hevner et al. (2004, p. 83) [28]:

1. Design as an Artifact: Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
2. Problem Relevance: The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
3. Design Evaluation: The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
4. Research Contributions: Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.
5. Research Rigor: Design-science research relies upon the application of rigorous methods in both the construction and the evaluation of the design artifact.
6. Design as a Search Process: The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
7. Communication of Research: Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

All guidelines are useful to follow for the project and make a good checklist. By complying with this list, one can ensure that the application will require the needs of the ISR framework.

4.3 Design Artifact

Now it is important to define the design artifact and convert it into features of the serious game. The related work chapter and the ISR framework build the foundation. Since the topic of the project is to develop and evaluate a serious game to support nursing staff it is now necessary to combine the features of the implementation with the expectation of our solution. The serious game should contain following transformed artifact:

4.3.1 Continuing Education and Professional Development

Ongoing professional development is crucial for nursing staff to remain current with best practices and evidence-based care. The serious game offers a continuing education module covering topics essential to nursing practice, including infection control, medication administration, and patient assessment. These modules feature interactive learning experiences and case studies designed to reinforce key concepts and assess knowledge retention. Through the integration of these artifact, the serious game aims to create a comprehensive support system for nursing staff, enhancing their professional skills, emotional resilience, and overall job satisfaction.

5 Implementation

In the following part we are going to discuss the actual implementation and realization of the serious game application. The serious game will be developed with Unity and various 3rd party assets. The game is designed to work on both PC and mobile platforms, providing accessibility across devices. We consider the term Vita Sim for the serious game application from now on.

5.1 Game Overview

The player assumes the role of a nurse and is free to move through the hospital environment. Throughout the game, the player has to complete a total of

13 tasks, each contributing to the successful completion of a single scenario. The hospital setting includes various NPCs such as nurses, doctors, and patients, as well as interactable objects that help the player complete assigned tasks. The serious game follows an open-world approach where the player is able to freely move through the intensive care unit, conference rooms and the lobby of the hospital where nurses welcome new patients. The first six tasks are basic activities, such as getting a new task from the doctor, disinfecting hands, picking up medication, treating a patient, as seen in Figure 2, and reporting back to the doctor. These tasks provide a fundamental knowledge of the surroundings and understanding of the basic controls.



Figure 2: Curing patient in Vita Sim

5.2 Level Design

In the latter part of the scenario, the core serious game element is introduced. During the last seven tasks, the player must read a note that describes three types of viruses commonly found in hospital settings, as seen in Figure 3. Each virus description includes what it is, where it can be found, and how it can be eliminated or avoided.

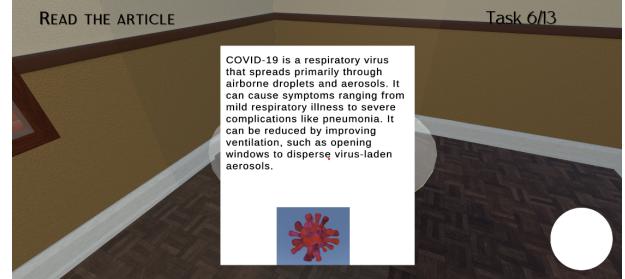


Figure 3: Reading article about viruses in Vita Sim

Once the player reads the note, a mini-game begins involving a virus outbreak. A virus outbreak percentage is shown on the screen, continuously increasing over time. If the percentage reaches 100%, the game ends, and the player must restart. The viruses spawn in their typical locations within the hospital, and the player must perform specific actions to eliminate them:

- **Coronavirus** spawns in the hospital lobby, and the player must open windows to eliminate it, Figure 4.
- **Norovirus** appears on a chair handle, and the player has to pick up a disinfecting wipe and clean the affected area.
- **Influenza** viruses spawn at several locations, and the player must pick up a sanitizer spray can to eliminate them, Figure 5.



Figure 4: Corona virus spawns in lobby in Vita Sim

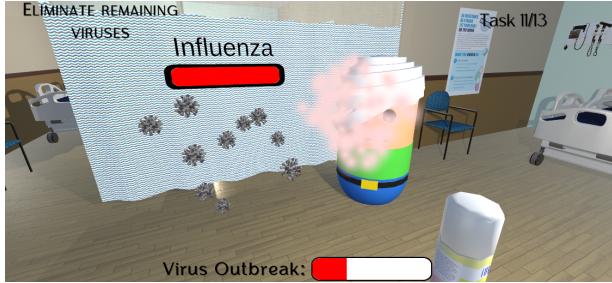


Figure 5: Influenza virus spawns next to patient in Vita Sim

Completing these tasks successfully ends the scenario, and the player is credited for eliminating the virus outbreak. Throughout the game, the total completed tasks are displayed in the top right corner of the UI, while the current task is shown in the top left corner. Interaction with objects is key to progressing through the game.

To facilitate navigation and ensure that players can effectively complete their objectives, Vita Sim integrates a navigation path component as seen in Figure 6. This component draws a path from the player's current position to the target task, providing guidance through the hospital environment. This ensures that players, especially those unfamiliar with complex game environments, can efficiently navigate the space and focus on task completion.



Figure 6: Navigation path in Vita Sim

The emphasis on viruses and their elimination within the game setting ties directly into the educational objective—teaching players about hygiene, infection control, and proper medical practices in a

highly interactive and engaging manner. The tasks encourage active learning and practical application of theoretical concepts, promoting an educational experience that is both informative and immersive.

5.3 Design-Science Research Evaluation

The implementation of Vita Sim aligns well with the core principles of Design-Science Research [28]:

1. **Design as an Artifact:** The game itself serves as an artifact that provides a solution to training challenges faced by nursing staff. By creating an interactive environment, the game addresses the need for effective, practical, and engaging learning tools in healthcare.
2. **Problem Relevance:** Vita Sim is highly relevant to healthcare by focusing on infection control and patient management—critical areas for nursing practice. The tasks are designed to reflect real-world scenarios that nurses encounter, thus addressing practical challenges in healthcare education.
3. **Design Evaluation:** The usability and educational value of the game were evaluated through a user study. The positive feedback on game design and user engagement suggests that the game is well-designed [16]. Future studies with nursing professionals will further validate its educational efficacy.
4. **Research Contributions:** Vita Sim contributes to the body of knowledge by showcasing how serious games can be utilized for continuous professional development in healthcare. It introduces practical gaming scenarios that help bridge the gap between theoretical learning and real-world application.
5. **Research Rigor:** The implementation followed rigorous game design principles, focusing on usability, interactivity, and educational relevance. The game mechanics, such as task completion and mini-games, were developed to ensure an

effective learning experience while maintaining player engagement.

6. Design as a Search Process: The iterative development of Vita Sim involved prototyping, user testing, and refinement, aligning with the iterative search for an effective artifact.
7. Communication of Research: The findings from the user study, along with the detailed discussion of the game's design and implementation, provide valuable insights that can be communicated to both academic and practical audiences. The game serves as a case study in utilizing serious gaming for professional development in nursing.

This evaluation confirms that the design and implementation of Vita Sim are consistent with the principles of Design-Science Research, ensuring that it not only addresses real-world problems but also contributes meaningfully to the broader field of healthcare education.

6 User Study

6.1 Setup

The study was conducted in October of 2024 focusing on a wide target demographic of both people familiar and unfamiliar with video games. The study was divided into the following sections:

1. Introduction to the User Study
2. Playtest session
3. Questionnaire

At first, the participants were introduced to the user study and its goal in this research. They were given a brief introduction to the concept of serious games and healthcare. In order to conduct the study in a proper manner, a finalized study build of "Vita Sim" was distributed to the participants. All participants either played the survey build in presence of a survey conductor or live-streamed their experience using programs like Zoom [29], Skype [30] or Discord

[31]. In addition to observing their live reactions, participants were asked to fill out the survey as described above, questioning them about the game experience as well as the game design. Lastly, the survey and live-reaction were evaluated as described in the section Results.

6.2 Results

6.2.1 Demographic Overview

In the frame of the mentioned study, 20 participants took part in the User Study over the course of a few days with a diverse demographic profile. The majority (70%) were aged between 25-34, while 30% were in the 18-24 age range. Gender distribution showed that 80% of respondents were male, and 20% were female. The educational level varied, with most participants (60%) holding a Bachelor's degree, followed by 30% with a Master's degree, and 10% with a high school diploma. The occupational distribution indicated that 70% were students, while 30% were employed. Notably, all participants reported a high familiarity with technology, with 75% considering themselves "Very familiar" and 25% as "Familiar".

6.2.2 Gaming Behavior and Preferences

A substantial portion of the respondents (40%) played video games daily, while 30% played frequently. The rest were either occasional players (15%) or played rarely (15%). This indicates a generally high engagement with gaming among participants. First-Person Shooters emerged as the most popular genre (20%), followed by Platformers (15%) and Strategy games (10%). A variety of other genres, such as RPGs, adventures and rhythm games, had smaller but still notable followings. PC was the most used platform, with 75% of respondents indicating regular use. Mobile gaming was also common (40%), followed by console gaming (35%). Interestingly, none of the respondents indicated using VR, which might point to limited accessibility or preference for other platforms. Most participants (70%) had been gaming for over 10 years, with a significant

proportion rating themselves as either "Advanced" (40%) or "Expert" (40%) in terms of gaming skill. This experience level likely impacts their preferences and expectations regarding gaming experiences.

6.2.3 Game Experience

The majority of respondents (55%) found the game controls and user interface to be "Very intuitive", while 25% found them "Intuitive". Only 20% were "Neutral", and there were no indications of poor intuitiveness, suggesting overall satisfaction with usability. Visual aspects of the game were positively reviewed, with 55% rating the visual quality as "Very Good" and 25% as "Excellent". This emphasizes the effectiveness of the game's graphical quality in creating engaging experience. 60% of participants found the game objectives "Very clear", and 35% found them "Clear", indicating that the majority of players understood the game objectives well. Only 5% remained "Neutral", which demonstrates the effective game design in communicating objectives.

6.2.4 GEQ post-game module

The Gaming Experience bar chart was designed to capture participants' emotional and experiential responses based on the Gaming Experience Questionnaire (GEQ) post-game module. Participants rated their experience on a scale of 0-4 indicating levels from "Not at all" to "Extremely". Based on the scoring guidelines of [32]:

- **Positive Experience:** Items 1, 5, 7, 8, 12, and 16 represent the positive aspects of the experience. The mean score for Positive Experience was 2.04. These results show relatively high values, indicating that participants generally found the game enjoyable, exciting, and stimulating.
- **Negative Experience:** Items 2, 4, 6, 11, 14, and 15 were used to evaluate negative aspects, such as frustration or annoyance. The mean score for Negative Experience was 0.48. These scores were significantly lower compared to positive experiences, showing that negative reactions were minimal.

- **Tiredness:** Items 10 and 13 gauged physical or mental tiredness. The mean score for Tiredness was 0.53. Moderate scores here indicate that while some level of tiredness was present, it wasn't excessive, pointing towards an engaging yet not overly exhausting gaming session.

- **Returning to Reality:** Items 3, 9, and 17 measured the difficulty of returning to reality after the game. The mean score for Returning to Reality was 0.68. Results indicate moderately low scores, suggesting that while the game was immersive, it was not disorienting or disruptive in transitioning back to real-world activities.

Overall, these responses demonstrate that participants had a largely positive and immersive experience with minimal negative impact or tiredness. The game effectively captured player attention without leading to significant frustration or exhaustion.

6.3 Discussion

The demographic data indicates that the study primarily involved experienced gamers with a high familiarity with technology, the majority of whom were aged 25-34. This demographic context is crucial for interpreting the results, as their advanced skill levels and long history of gaming significantly influenced their expectations and tolerance for complexity in game mechanics. Compared to more casual or less experienced gamers, these participants may require a greater degree of challenge and sophistication in gameplay to find it engaging. This finding is consistent with previous work by Vorderer et al. (2003), who suggested that experienced gamers tend to seek more complex challenges to maintain their interest and engagement [33].

The frequency of gaming and the preference for PC as the main platform suggest that participants are highly engaged with gaming culture and have access to high-performance devices. This insight is consistent with previous research indicating that core gamers often prefer PC gaming due to factors such as flexibility, higher graphic capabilities, and better control customization [34]. The low engagement with

VR suggests potential barriers, such as the high cost of VR hardware or limited game availability. This also indicates that, for this demographic, traditional gaming setups remain more practical and preferable compared to VR.

The positive feedback on game controls, visuals, and clarity of objectives suggests an overall effective user experience. In comparison to existing UX frameworks for gaming, such as the Player Experience Inventory (PXi), the game scored well on usability, which is a key factor in player retention. The moderate tiredness levels reported suggest that the game presents an engaging challenge without overwhelming the player. This balance is crucial for fostering a state of "flow," as described by Csikszentmihalyi, where a player is fully immersed but not frustrated or overly fatigued [12]. The advanced skill level of participants may have also contributed to their tolerance for moderate tiredness, as experienced players are typically accustomed to longer, more demanding sessions.

The GEQ post-game analysis demonstrated a predominance of positive experiences with minimal negative reactions. This result is consistent with the concept of "positive affect" in gaming, where players derive enjoyment and satisfaction from overcoming challenges and achieving in-game goals, a concept well-explored by Ryan et al. (2006) [35]. The lower scores for negative experiences indicate effective balancing within the game, avoiding common pitfalls such as frustration from overly difficult challenges or unclear objectives, similar to the observations by Sweetser and Wyeth (2005), who emphasized the importance of balancing difficulty to avoid negative user experiences [13]. The low "Returning to Reality" scores suggest that the game maintained a level of immersion that was engaging without being disorienting. Compared to studies on immersive experiences, such as those by Jennett et al. (2008), this indicates effective pacing and narrative integration, allowing players to comfortably transition back to real-world activities after gameplay [36].

Overall, the results illustrate that the game provided an immersive, enjoyable experience well-suited to experienced gamers. The balance between positive engagement and moderate challenge contributed

to a generally favorable response, reinforcing the importance of clear objectives, intuitive controls, and well-designed game mechanics in fostering an engaging user experience.

7 Future Work

Future iterations of the game could explore multiple directions to enhance its effectiveness and reach.

- **Implement More Design Artifacts:** Future development could incorporate additional design artifacts such as "Rapidly Evolving Medical Technologies" and "Emotional Involvement and Burnout". These artifacts could help address two other crucial challenges faced by nursing professionals: staying up-to-date with rapidly changing medical tools and managing the emotional strain associated with the job.
- **Expand Scenarios for Learning:** More scenarios could be developed, focusing on different medical conditions and topics, such as understanding and mitigating the spread of bacteria and germs in hospital environments. These scenarios could broaden the educational content and enhance the game's relevance to different areas of nursing practice.
- **Targeted User Study with Nurses:** A subsequent user study involving only professional nurses would provide more specific insights into the game's impact on its intended target audience. Such a study could help identify how effectively the game supports real-life nursing challenges and highlight specific areas for improvement.
- **Introduce Reward Systems:** Introducing both intrinsic and extrinsic reward systems within the game could motivate nurses to engage more deeply with the content. This could include in-game badges, certificates of completion, or even potential Continuing Education Credits for participating healthcare workers. This approach would leverage gamification to sustain

user interest and incentivize continuous professional development.

- **Investigate VR Accessibility:** Another potential area for research is enhancing VR accessibility or understanding why it remains underutilized by the target demographic. Addressing accessibility and usability challenges in VR could lead to more immersive training experiences that further bridge the gap between theory and practical skills.

Expanding these areas will help in refining the game as an educational tool, making it more comprehensive, impactful, and appealing to its primary audience of healthcare professionals.

8 Conclusion

In conclusion, Vita Sim presents a promising tool for the continuous professional development of nursing staff, offering an interactive, immersive learning experience in a controlled environment. The game effectively combines elements of serious gaming with practical nursing scenarios, bridging the gap between theoretical knowledge and practical application. The positive feedback from the user study demonstrates the game's potential to engage users through intuitive controls, clear objectives, and challenging yet manageable gameplay. While the current version of Vita Sim was evaluated with experienced gamers, future studies will focus specifically on nursing professionals to ensure that the game is aligned with their specific needs and challenges. Future developments aim to broaden the scope of Vita Sim, enhance its educational content, and make it more accessible and effective for a diverse group of healthcare workers.

The future work outlined will address current limitations, including adding new design artifacts, refining learning scenarios, and exploring new motivational techniques through reward systems. Moreover, focusing future user studies specifically on professional nurses will help align the game more closely with the demands and realities of healthcare environments. By doing so, Vita Sim can become a vital resource in the continuous education and support

of nursing staff, ultimately contributing to improved patient care, reduced burnout, and better health outcomes.

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