

What Matters to Patients: Community-Engaged Design for Healthcare-Related Serious Games

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Abstract: Narrative-based serious games are accessible, engaging technologies that connect users' lived experiences to pedagogy. Despite having patient-centered goals, most narrative-based serious games are not designed alongside patients and communities, limiting their likelihood of acceptance, uptake, and impact. Literature reveals that many serious games intended for patients merely evaluate efficacy with end-users after game deployment and with a lack of consistent participatory design. This work aims to describe a patient-centered participatory approach to game development to teach self-advocacy skills to patients newly diagnosed with cancer. First, characters were developed based on panels that included patient advocates, cancer survivors, clinicians, and researchers. Second, storyline development created realistic story arcs, decision-points, and consequences based on qualitative interviews with patients, patient advocates, and cancer survivors. Third, game evaluation metrics (e.g., 1st vs. 3rd person perspective, game fail states that incentivize replaying the game, and provision of implicit or explicit feedback) were developed based on accessibility, usability, and patient preferences. Based on patients' insights, we implemented changes accordingly to maximize the game's efficacy and collected qualitative data on patients' assessment of the game's accessibility, relevance, and impact. During initial game development, patient and advocate feedback built relatable characters with a particular focus on providing sensitive information (e.g., palliative care) and inclusive storylines (e.g., diverse family situations). Following a prototype, patients and advocates suggested refinements to characters and additional storylines, including common and/or distressing experiences related to pain management, family dynamics, financial struggles, and disrespect from healthcare providers. Participants in a randomized trial of the game (N=34) found the scenarios relevant and realistic. Patients reported increased comfort speaking up, seeking support, and interacting with their families and healthcare team after playing the game. Our process demonstrates the essential role patients can inhabit in the development of narrative serious games, particularly in how patient input permeated every aspect of Strong Together's development, from initial design to evaluation. Such integration allows for adjustments to address patient concerns and refine patient-relevant metrics.

Keywords: Serious Games, Self-Advocacy, Healthcare, Cancer, Participatory Design

1. Introduction

Storytelling is a, if not the, primary universal method available to humans looking to explore the affective side of their lives. Especially in cases of hardship, we understand our experiences through stories (Bruner, 1991), may they be our own stories or the stories of others through which our own experiences resonate. Through these lenses, we come to understand ourselves and the world around us: self-image, motivation, ideology, the sciences, et cetera. Why do research papers include introduction sections? They frame the narrative of the paper for an audience to consume it more easily: the utility of storytelling.

Narrative-based serious games take advantage of that utility towards several educational and transformational goals. In a literature review of narrative in serious games, Naul and Liu (2019) highlight narrative as essential in offering highly motivating fantasy that is intertwined with pedagogical content, and they further explore the benefits of empathetic game characters in further immersing the player in the learning environment and altering their considerations when making in-game decisions, especially when players see aspects of their own experience in the characters. The narrative sets base context for the procedural rhetoric of a game, providing an affective layer to what the systems of player choice and game response are communicating (Bogost, 2007).

Narrative-based games are an attractive intervention for patient populations living with chronic conditions. These individuals often have high disease burden, including symptoms and side-effects related to their disease and treatment. This simultaneously makes educational interventions necessary to teach them ways to manage

their illness, but also difficult because they have limitations to their time and energy. Currently, there are over 32 million cancer survivors worldwide, making it one of the most common chronic conditions and one that contributes heavily to disability and healthcare costs (Chan & Nekhlyudov, 2023). For example, some of the most frequent unmet needs of individuals living with cancer include managing their fatigue, pain, and neuropathies. Yet, healthcare providers infrequently discuss these concerns, and engagement in traditional interventions is time-consuming (Schmidt et al., 2022; Lewandowska et al., 2020; Maqbali et al., 2021). Narrative games such as visual novels may address these concerns in an approachable, impactful medium and allow individuals from a variety of backgrounds in game and technological literacy to get the information they need in an engaging, efficacious manner.

While serious games are created with end-users in mind, they rarely include end-users during development, instead involving them during testing after game deployment (Khaled & Vasalou, 2014). We argue that the inclusion of consistent participatory design in the iteration cycle of the game design enhances the quality of the game and provides a pointed approach that directly impacts the users they are created for. Khaled and Vasalou (2014) argue that fluency in both domain content and game design is imperative for the attainability of serious games. This work aims to introduce and exemplify a patient-centered participatory approach to serious game development to teach self-advocacy skills to women newly diagnosed with gynecologic or metastatic breast cancer.

We propose the following major contributions:

- We introduce, exemplify, and advocate for a patient-centered participatory approach to serious game development.
- The design and evaluation of Strong Together, an efficacious serious game intervention aimed at promoting self-advocacy skills among patients newly diagnosed with cancer.

2. Related Works

Participatory design is a user-centered approach that involves end-users in the design and development process of software applications (Chen et al., 2020). In healthcare, participatory design has gained significant attention due to its potential to improve the usability, effectiveness, and acceptance of software tools among healthcare professionals and patients (Donetto et al., 2015). The complexity of healthcare environments, coupled with the diverse needs of stakeholders such as clinicians, patients, and administrators, underscores the importance of incorporating participatory design principles to promote collaboration, empathy, and co-creation, leading to solutions that better align with users' real-world needs and workflows.

For decades, system and software designers have employed participatory design methodologies within healthcare applications. Examples of participatory design include involving clinicians in the design of electronic medical record (EMR) applications (De Croon, Klerkx and Duval, 2014), telemedicine applications (Clemensen et al., 2017), clinical information system design (Pollack et al., 2016), medical artificial intelligence (AI) (Rodrigues et al., 2022), and surgical tools and procedures (Jamjoom and others, 2022). Recently, healthcare-related patient-centric systems, applications, and educational platforms began to employ participatory design frameworks such as the "Think-Aloud Protocol" (Fanfarelli, 2021) and co-design workshops (Alvarez et al., 2019) to allow users to verbalize their thought processes while interacting with prototypes, thus providing insights into potential usability issues and fostering a sense of ownership and engagement.

A large body of research indicates numerous benefits of employing participatory design in healthcare software development. These include increased user satisfaction (Harper & Mustafee, 2023), reduced errors and inefficiencies (Tian et al., 2021), improved patient outcomes (Dykes et al., 2014), enhanced adoption rates (Rushton & Corrigan, 2021), and better alignment with clinical workflows. Additionally, participatory design fosters an equitable, collaborative culture that values end-user perspectives and promotes continuous improvement.

When it comes to game development, participatory design is usually limited to playtesting (Pietriková & Sobota, 2022), the part of game development lifecycle where representatives of the target audience (i.e., potential users) play various prototypes of the game to help identify technical issues, potential problems with game mechanics, or disconnects in storylines. It is exceedingly rare to find examples of games (either digital or analog) where future users participated directly in the creation process.

Serious games (SG), unlike their entertainment counterparts, often require a design approach that is more focused on co-design. SGs, defined as games designed for purposes other than mere entertainment, have gained traction in healthcare for their potential to engage users, promote behavior change, and enhance learning outcomes. SGs have diverse applications in healthcare, ranging from patient education (Damaševičius, Maskeliūnas & Blažauskas, 2023; Arif et al., 2024) and rehabilitation (Mitsopoulos et al., 2023) to medical training (Lin et al., 2023) and therapeutic interventions (Ahmed et al., 2023). For instance, virtual reality (VR) games are used in physical therapy for motor skill rehabilitation, while interactive simulations are employed for surgical training and procedural skill acquisition. Gamified mobile apps are also utilized for health promotion, disease management, and medication adherence among patients.

A growing body of research demonstrates the effectiveness of SGs in achieving various healthcare objectives. These games have been shown to improve patient engagement and motivation (You et al., 2023), enhance learning retention and skill acquisition (Chittaro, 2023), facilitate behavior change (e.g., smoking cessation (Aigner et al., 2023), weight management (Pervanidou et al., 2023)), and contribute to better clinical outcomes (e.g., reduced pain (Suleiman-Martos et al., 2022), improved adherence to treatment regimens (Maurin et al., 2020)).

The design and development of SGs in healthcare require careful consideration of user needs, objectives, and evidence-based strategies. Gamification elements such as rewards, challenges, feedback mechanisms, social interactions, and empathy play a crucial role in maintaining user engagement and fostering learning and behavior change but must be designed within the cultural assumptions and values held by those individuals. That is why participatory design approaches, such as co-design workshops, iterative prototyping, and usability testing, are integral to creating effective serious games.

3. Designing Strong Together

A panel of patient advocates (n = 2), clinicians (n = 2), and nurse researchers (n = 2) worked alongside SimCoach Games' team of designers (n = 3), artists (n = 1), and writers (n = 2) to create the characters within the Strong Together game in iterative steps. Each of the three characters was designed with sufficient backstory and depth to demonstrate familiar yet accentuated aspects of women with cancer. For example, one character is an over-committed retiree with strong social support, a second is a younger single mother with minimal family support, and the third is a middle-aged woman balancing a busy career and family obligations. We developed characters to highlight various common experiences that can make self-advocacy difficult in the context of cancer. We knew that users may not identify with each character, but their experiences were common enough that users could grasp the learning objectives.

After the characters were developed, the same panel of patient advocates, clinicians, nurse researchers, and gaming professionals met to map the learning objectives of Strong Together (e.g., specific self-advocacy skills) onto the characters' storylines. We gave each character central self-advocacy struggles that are the focus of their interactions and decision points. But we also interwove all learning outcomes into each storyline so that all learning objectives were present with varying degrees of depth. The panel's goals were to make realistic challenges, decision points, and consequences that reflected real-world patient experiences. We carefully reviewed the language, tone, and wording to reflect what women with cancer likely experience. A primary concern was that the negative consequences associated with selected poor decisions did not overwhelm or upset users while still providing upfront preparation for challenges they would likely experience in the future. We were careful not to include sensitive or overwhelming information (e.g., prognostic information) and touched on the availability of palliative and supportive care services lightly with extensive input and consensus-building from the panel.

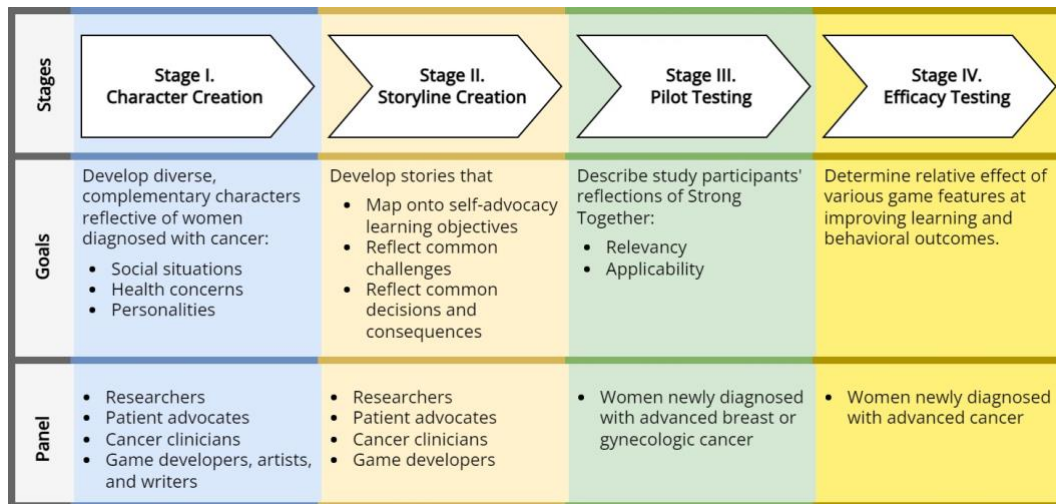


Figure 1: A summary of the participatory design process taken by our team during the development of Strong Together, in four stages.

3.1 Describing Strong Together

Strong Together is a single-player 2D visual novel developed in Unity for deployment on mobile devices. It is designed to encourage self-advocacy skills and explore realistic challenges and decisions taken on by its desired audience of players: patients newly diagnosed with cancer. In the game, players experience five stories starring three characters, and each meant to explore different archetypes of patients (shown in the top-left corner of Figure 2), featuring narrative-changing decisions in healthcare, domestic, and workplace settings, encountering hardships related and unrelated to care.

3.2 Identifying Key Features

Following the initial development of Strong Together, our team was invested in clearly articulating core design approaches and assumptions that went into its development by synthesizing insights from the patient advocates and the team of SimCoach Games designers, developers, and artists. Our team found it necessary to analyze the process of design components of the game as they are different from narratives and characters that were directly inspired by the patient advocates. In discussion with SimCoach Games' employees, we hoped to discover the assumptions that went into Strong Together's design but went unsaid. We asked questions about components of the game that, if removed, would "break" it. Three key features stood out as worthy of future evaluation: first-person perspective, implicit audio-visual feedback, and soft fail states. In these three features, we see a set of assumptions worth challenging and hypotheses worth testing, which may help us more precisely evaluate Strong Together in future work.

Though plot and decision points that reflect patient experiences were obvious inclusions from patient advocate perspectives, a more subtle detail of Strong Together's narrative is its perspective. Across the five stories, players make decisions while inhabiting one of three pre-written characters, each having their own specific backgrounds and personalities. The alternative, that players instead play from a first-person perspective, i.e., they are playing as a version of themselves that is experiencing the game's set of narrative experiences, was potentially desirable to patient advocates but not the preference of our designers, who preferred the narrative specificity of Strong Together's third-person perspective.

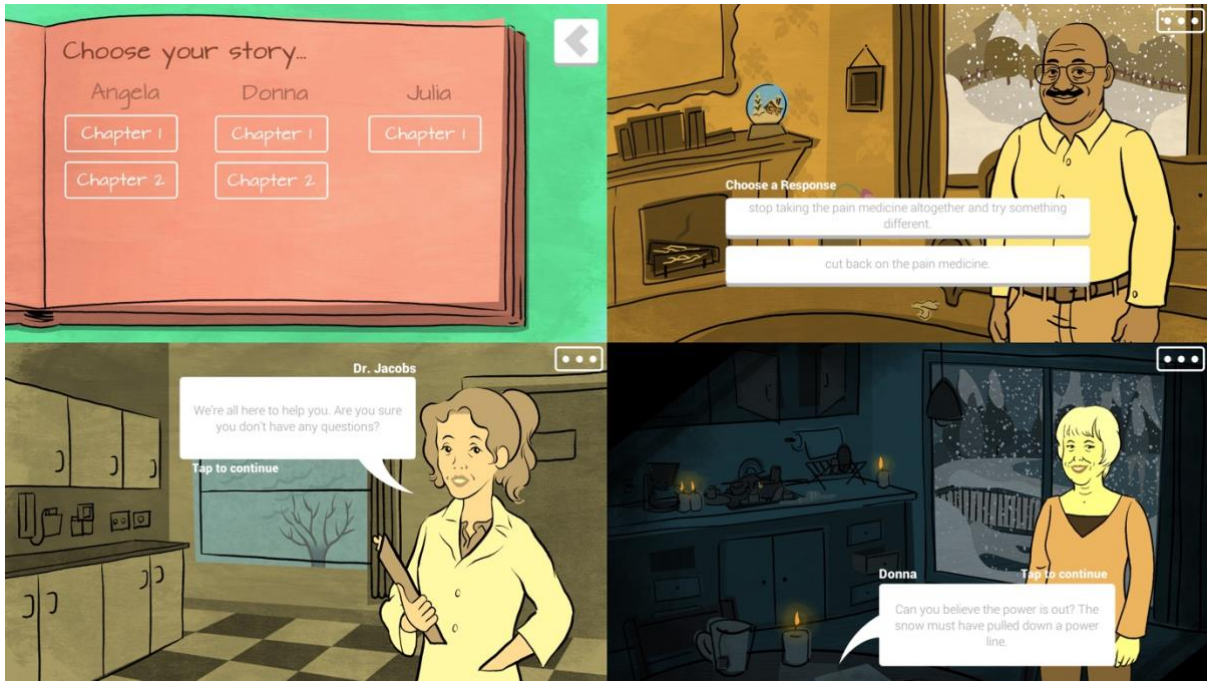


Figure 2: Four screenshots from Strong Together. Top-left shows the chapter-select screen where players choose which story to play. Top-right shows a decision point where the narrative will branch according to the player's choice. Bottom-left shows a game state where the player has made choices that have negatively impacted the player-character's well-being, which is implicitly conveyed to the player through a lack of foliage out the window and a reduction in color saturation. Bottom-right shows a scene of the player-character experiencing hardship that is not directly related to their illness, in this case, a power outage.

The implicit feedback system might be the most subtle among the three features. In addition to dialogue that conveys plot points relevant to the player-character's physical and mental well-being, behind-the-scenes the game quantitatively tracks this status as a numerical quality-of-life score, ranging from 0 to 100. Colors, foliage, and weather reflect the character's well-being, with low quality of life indicated by color desaturation, foliage loss, and worsening weather (e.g., increasing cloud coverage or rain). Improvements in the quality of life are subtly communicated through opposite aesthetic changes. However, there is much concern that users may not notice or appreciate this feedback in its subtlety. An alternative feedback scheme, such as displaying the player-character's quality of life through an on-screen health bar, may be perceived differently.

Similarly inspired by concerns about users being unable to notice or appreciate game mechanisms, we shifted our focus to the game's soft fail states, which may have disincentivized replaying sections of the game. To ensure comfort for cancer patients experiencing the player-character's stories, our team crafted narratives that contained only soft forms of failure, which have both emotional and mechanical implementation. In terms of the former, even the worst health outcomes were described as relatively mild, and choices are often recoverable, allowing any poor decision to be countered later by a better decision. A potential problem with both implementations is they likely discourage replaying the game, which may be less beneficial for learning self-advocacy skills. An alternative feature of Strong Together could utilize less recoverable fail states with more intense health outcomes, explicitly encouraging users to learn from mistakes and recover through replaying.

4. Methods

Women diagnosed with advanced gynecologic or metastatic breast cancer in the past three months were recruited from an academic cancer center in Pittsburgh, Pennsylvania. Participants were part of a larger randomized clinical trial (NCT03339765) evaluating the initial efficacy of the *Strong Together* serious game. Participants were randomized to receive the intervention and completed one-on-one semi-structured qualitative interviews with a research assistant at the end of the three-month intervention period. Three trained research assistants were not members of the game development team and were otherwise unbiased towards the evaluation of the intervention. These research assistants conducted interviews over the phone or in-person

depending on patient preference. We audio-recorded all interviews and transcribed verbatim by TranscribeMe.com with no identifiable information included.

We extracted participants' responses to selected interview questions that aligned with the purpose of this manuscript for the analysis including participants' reflections on how Strong Together reflected their experiences and taught them self-advocacy skills. The analysis consisted of simple descriptive content analysis by two coders utilizing Microsoft Excel. Two coders independently reviewed and coded the transcripts and subsequently met to discuss the discrepancies and achieve consensus. Initially, coders developed a preliminary codebook, which they utilized to code 20% of the transcripts to calculate the inter-coder reliability and refine the codebook. The coders repeated this process to achieve satisfactory inter-coder reliability (O'Connor and Joffe, 2020), which was .72 in this study. The resulting codebook was then applied to complete the analysis.

5. Results

A total of 34 participants who completed the interviews were included in the analysis. Participants' demographics are listed in Table 1. The average age of the participants was 59.4 years (SD = 13.0), with the majority self-identifying as White (85.3%). Two themes were identified: (1) Realistic and Engaging Storylines and (2) Learning Outcomes from Strong Together.

Table 1: Participant Demographics (N=34)

	Mean (SD)	N (%)
Age	59.4 (13.0)	
Years of formal education	14.0 (3.1)	
Current relationship status		
Married or living with a partner		23 (67.6)
Never married		5 (14.7)
Separated, divorced, or widowed		6 (17.7)
Racial identity		
White		29 (85.3)
Black		4 (11.8)
Asian		1 (2.9)
Latina ethnicity		1 (2.9)
Current employment status		
Employed		9 (26.4)
Unemployed		1 (2.9)
Other		3 (8.8)
Unknown		21 (61.9)
Difficulty paying for basic needs ("somewhat" or "extremely")		14 (41.1)
Current income does not meet basic needs		6 (17.6)

5.1 Realistic and Engaging Storylines

Most participants (n = 26) found various storylines and challenges in the serious game to be realistic and reflect their everyday experiences facing cancer. These challenges include finances, symptom management, nutrition, family matters, and others. Participants who didn't fully relate to the storylines indicated they already had a strong support system or had not experienced the portrayed challenges (n = 6). Additionally, 7 participants noted that they found the storylines reasonable and applicable to other individuals with cancer at different stages of life and cancer journey. Participants predominately (n = 21) reported enjoying the game. However, a few participants (n = 3) expressed that while they enjoyed the serious game, they did not always agree with the proposed best solutions.

They were realistic, when I went through them, the one with the single mother, I could relate to that because that's me, but they hit all the different scenarios of people in their life, whether they are younger or older or married or not, or have children. – Patient 24

Angela's [game character] dealing with the fatigue and trying to take care of her daughters and her house and everything, you can relate to that real easy.... You could say, "Yeah. Okay. I really was tired." I understand why she would call off a day of work and finally ask Kat to help her. – Patient 23

5.2 Learning Outcomes from Strong Together

Through their experiences with Strong Together's storylines, many participants (n=27) noted positive changes in their attitudes towards self-advocating. These behavioral and emotional changes made many participants feel more comfortable asking for help and speaking up about their discomfort or other issues they experienced. For these participants, they contextualized their improved attitudes and behaviors in relation to their healthcare team and social network.

I guess, don't be afraid to ask questions was the main thing. Because I always feel like we could be annoying to the doctors, nurses. You're always afraid you're imposing. And it did show you that that's what they're there for. – Patient 10

Some participants (n=7) noted how the various storylines reassured them by reinforcing that they were already correctly advocating for themselves by speaking up and seeking more information about their condition.

I feel like I was already an informed decision maker; it just reinforced how I was already feeling. – Patient 11

The 7 participants who experienced little to no significant changes in self-advocacy after engaging in the serious game cited that the lessons conveyed through the storylines were ones they already knew or followed. Some (n=4) also mentioned that they had a pre-existing support system in place already, whether it be a partner, family member, or friend. However, despite these 7 participants having minimal changes, they did not mention having any strong dislikes regarding Strong Together. Indeed, 4 participants with no significant changes either stated that the storylines were realistic and relevant to their own experiences or acknowledged that Strong Together could be applied to other cancer patients.

6. Discussion

Strong Together exemplifies a participatory design approach that is uncommon in the world of serious games, particularly those in healthcare (Khaled & Vasalou, 2014). This patient-centered approach began during initial game development stages and was then assessed systematically through qualitative interviews during a clinical trial. Over the course of the 34 interviews conducted, we distilled several lessons regarding patient-focused serious game design. Foremost among these was engaging with participants regarding their experiences inside and outside the game. Their statements showed that most participants found the storylines and scenarios realistic and relevant to their own lives, a detail of utmost importance given the prominent role of realistic life scenarios in the efficacy of narrative game-based interventions (Zhou et al., 2019).

Through sensitive discussions around these experiences, we found how these scenarios helped participants stay engaged with the characters and game. Due to the painstaking nature of serious game development and qualitative testing, however, this type of feedback loop early in development is rare and requires commitment from all stakeholders, as demonstrated in similar patient-centered design processes in non-game applications (Wolpin & Stewart, 2011; Ector et al., 2020). Conducting interviews and extracting key lessons from the feedback leads to the further development and enhancement of specific game and story features, which in turn leads to more testing. Participants must also commit to engaging with the story and playing through the various scenarios to understand the goals of Strong Together. Through this patient-focused approach to design, we can begin to create more effective serious games that align with the needs and preferences of their players, adding to a growing literature that suggests a strong utility of patient-centric design in supporting greater uptake and efficacy in healthcare-related interventions (Wolpin & Stewart, 2011; Ector et al., 2020; Verwij et al., 2023).

In this work, we described the process by which we analyzed the design procedures of Strong Together to reach three core features of the game that may contribute to its efficacy: a third-person perspective, implicit aesthetic feedback, and soft fail states. We are presently continuing this work with a proper evaluation of those three

features (Healy et al., 2022), for future publication. We have implemented three alternative versions of Strong Together that subvert those features: a first-person perspective, explicit feedback, and hard fail states. This work is essential in reaching greater specificity in which features of Strong Together contribute to its efficacy, potentially verifying our design and analysis procedures.

7. Conclusion

In Strong Together's design and evaluation, we present two core contributions: methodological and practical in the design of serious games. First, we described our application of participatory design throughout multiple game development stages, representing the consistent involvement of end-users and stakeholders during key decision points during the game's conceptualization and deployment. Second, we highlight features of the Strong Together game that contribute to end-users' uptake of the learning objectives. Based on the feedback from participants, we encourage other serious game developers to follow similar participatory design steps to ensure the relevancy and applicability of games to the perspectives of the end-user.

References

- Ahmed, F. et al. (2023) 'Applications of serious games as affective disorder therapies in autistic and neurotypical individuals: a literature review', *Applied Sciences*, 13(8), pp. 4706.
- Aigner, C. et al. (2023) 'BreathIn—A Serious Game to Support Patients with Smoking Cessation: Analysis and design study for a mobile serious game to help patients quit smoking', in *Proceedings of the 2023 7th International Conference on Medical and Health Informatics*, pp. 239–244.
- Alvarez, J. et al. (2019) 'Design games and game design: relations between design, codesign and serious games in adult education', *From UXD to LivXD: Living eXperience Design*, pp. 229–253.
- Arif, Y.M. et al. (2024) 'A Systematic Review of Serious Games for Health Education: Technology, Challenges, and Future Directions', *Transformative Approaches to Patient Literacy and Healthcare Innovation*, pp. 20–45.
- Bogost, I. (2007) *Persuasive games: The Expressive Power of Videogames*. Cambridge: MIT Press.
- Bruner, J.S. (1991). 'The Narrative Construction of Reality', *Critical Inquiry*, 18(1), pp. 1-21. <https://doi.org/10.1086/448619>.
- Chan, R. and Nekhlyudov, L. (2023). 'Overview of cancer survivorship care for primary care and oncology providers', *UpToDate*. Available at: <https://www.uptodate.com/contents/overview-of-cancer-survivorship-care-for-primary-care-and-oncology-providers> (Accessed: 27 April 2024).
- Chen, E. et al. (2020) 'Enhancing community-based participatory research through human-centered design strategies', *Health promotion practice*, 21(1), pp. 37–48.
- Chittaro, L. (2023) 'Improving knowledge retention and perceived control through serious games: a study about assisted emergency evacuation', *IEEE Transactions on Visualization and Computer Graphics* [Preprint].
- Clemensen, J. et al. (2017) 'Participatory design methods in telemedicine research', *Journal of telemedicine and telecare*, 23(9), pp. 780–785.
- Damaševičius, R., Maskeliūnas, R. and Blažauskas, T. (2023) 'Serious games and gamification in healthcare: a meta-review', *Information*, 14(2), pp. 105.
- De Croon, R., Klerkx, J. and Duval, E. (2014) 'Designing a useful and usable mobile EMR application through a participatory design methodology: a case study', in *2014 IEEE International Conference on Healthcare Informatics*. IEEE, pp. 176–185.
- Donetto, S. et al. (2015) 'Experience-based co-design and healthcare improvement: realizing participatory design in the public sector', *The Design Journal*, 18(2), pp. 227–248.
- Dykes, P.C. et al. (2014) 'Participatory design and development of a patient-centered toolkit to engage hospitalized patients and care partners in their plan of care', in *AMIA Annual Symposium Proceedings. American Medical Informatics Association*, pp. 486.
- Ector, G. (2020) 'The Development of a Web-Based, Patient-Centered Intervention for Patients With Chronic Myeloid Leukemia (CMyLife): Design Thinking Development Approach', *Journal of Medical Internet Research*, 22(5). <https://doi.org/10.2196/15895>.
- Fanfarelli, J.R. (2021) 'Assessing Computational Thinking Pedagogy in Serious Games Through Questionnaires, Think-aloud Testing, and Automated Data Logging', in *2021 IEEE/ACIS 20th International Fall Conference on Computer and Information Science (ICIS Fall)*. IEEE, pp. 149–152.
- Harper, A. and Mustafee, N. (2023) 'Participatory design research for the development of real-time simulation models in healthcare', *Health Systems*, 12(4), pp. 375–386.
- Healy, P. et al. (2022) 'A narrative serious game to teach Self-Advocacy skills in advanced cancer,' *Procedia Computer Science*, 206, pp. 162–172. <https://doi.org/10.1016/j.procs.2022.09.095>.
- Jamjoom, Z.A. and others (2022) 'Designing A Novel Vascular Surgery Practice Tool A Participatory Design Approach'. PhD Thesis.
- Khaled, R. and Vasalou, A. (2014) 'Bridging serious games and participatory design,' *International Journal of Child-computer Interaction*, 2(2), pp. 93–100. <https://doi.org/10.1016/j.ijcci.2014.03.001>.

- Lewandowska, A. et al. (2020) 'Quality of Life of Cancer Patients Treated with Chemotherapy,' *International Journal of Environmental Research and Public Health/International Journal of Environmental Research and Public Health*, 17(19), pp. 6938. <https://doi.org/10.3390/ijerph17196938>.
- Lin, D.T. et al. (2023) 'ENTRUST: a serious game-based virtual patient platform to assess entrustable professional activities in graduate medical education', *Journal of Graduate Medical Education*, 15(2), pp. 228–236.
- Maqbali, M.A. et al. (2021) 'Prevalence of Fatigue in Patients with Cancer: A Systematic Review and Meta-Analysis,' *Journal of Pain and Symptom Management*, 61(1), pp. 167-189.e14. <https://doi.org/10.1016/j.jpainsymman.2020.07.037>.
- Maurin, K.D. et al. (2020) 'Use of a serious game to strengthen medication adherence in euthymic patients with bipolar disorder following a psychoeducational programme: A randomized controlled trial', *Journal of Affective Disorders*, 262, pp. 182–188.
- Mitsopoulos, K. et al. (2023) 'Neurosuitup: system architecture and validation of a motor rehabilitation wearable robotics and serious game platform', *Sensors*, 23(6), pp. 3281.
- Naul, E. and Liu, M. (2019) 'Why story matters: A review of narrative in serious games,' *Journal of Educational Computing Research*, 58(3), pp. 687–707. <https://doi.org/10.1177/0735633119859904>.
- O'Connor, C. and Joffe, H. (2020) 'Intercoder reliability in Qualitative Research: Debates and practical guidelines,' *International Journal of Qualitative Methods*, 19, pp. 1-11. <https://doi.org/10.1177/1609406919899220>.
- Pervanidou, P. et al. (2023) 'The impact of the ENDORSE digital weight management program on the metabolic profile of children and adolescents with overweight and obesity and on food parenting practices', *Nutrients*, 15(7), pp. 1777.
- Pietriková, E. and Sobota, B. (2022) 'Game development and testing in education', in *Game Theory-From Idea to Practice*. IntechOpen.
- Pollack, A.H. et al. (2016) 'PD-atricians: leveraging physicians and participatory design to develop novel clinical information tools', in *AMIA Annual Symposium Proceedings. American Medical Informatics Association*, pp. 1030.
- Rodrigues, S.M. et al. (2022) 'Digital Health–Enabled Community-Centered Care: Scalable Model to Empower Future Community Health Workers Using Human-in-the-Loop Artificial Intelligence', *JMIR formative research*, 6(4), pp. e29535.
- Rushton, E. and Corrigan, S. (2021) 'Game-Assisted Assessment for Broader Adoption: Participatory Design and Game-Based Scaffolding.', *Electronic Journal of e-Learning*, 19(2), pp. 71–87.
- Schmidt, M.E. et al. (2022) 'Late effects, long-term problems and unmet needs of cancer survivors,' *International Journal of Cancer*, 151(8), pp. 1280–1290. <https://doi.org/10.1002/ijc.34152>.
- Suleiman-Martos, N. et al. (no date) 'Effect of a game-based intervention on preoperative pain and anxiety in children: A systematic review and meta-analysis', *Journal of Clinical Nursing* [Preprint].
- Tian, L. et al. (2021) 'Redesigning human-robot interaction in response to robot failures: a participatory design methodology', in *Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems*, pp. 1–8.
- Verweij, L. et al. (2023) 'Effectiveness of digital care platform CMylife for patients with chronic myeloid leukemia: results of a patient-preference trial', *BMC Health Services Research*, 23(228). <https://doi.org/10.1186/s12913-023-09153-9>
- Wolpin, S. and Stewart, M. (2011) 'A Deliberate and Rigorous Approach to Development of Patient-Centered Technologies', *Seminars in Oncology Nursing*, 27(3), pp. 183-191. <https://doi.org/10.1016/j.soncn.2011.04.003>.
- You, K.-L. et al. (2023) 'Who Engages and Why It Matters?: Describing Participant Engagement in a Serious Game Intervention for Patients With Advanced Cancer.', *International Journal of Gaming & Computer-Mediated Simulations*, 15(1).
- Zhou, C. (2019) 'A Meta-analysis of Narrative Game-based Interventions for Promoting Healthy Behaviors', *Journal of Health Communication*, 25(1), pp. 54-65. <https://doi.org/10.1080/10810730.2019.1701586>