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CREATING A TOOL TO EXPLORE INTERGENERATIONAL UNDERSTANDINGS THROUGH THE USE OF VIRTUAL REALITY IN MALAYSIA

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INTRODUCTION

This paper provides an introduction to a research-creation project, focusing on developing a prototype Virtual Reality (VR) educational tool. Younger people in Malaysia have limited exposure to or interest in information relating to the elderly, resulting in an intergenerational disconnect. The wider project aims to develop a VR teaching tool inspired by an existing role-playing simulation game (Aging Game). As a storytelling-based experience, VR can be used to share the discomfort faced by older people when using information and communications technology (ICT) such as computers/ cell phones, internet and social media.The project is to explore the potential VR has to act as a bridge between the generations and to raise awareness in younger people about intergenerational issues. The primary focus of this discussion paper is to discuss design and modification of the VR tool for creating interactive experiences that inhabit both the real and the unreal (virtual) world.

DIGITAL SOCIETY AND AGING

Information and communications technology (ICT) is a broad field encompassing digital tools, devices, applications and networking systems that enable communications and interactions. Smartphones and computers, with the internet as the backbone, are the most heavily used ICT devices. However, the adoption of these technologies remains relatively low among people aged 60 and above. The Malaysian Communications and Multimedia Commission (MCMC) reports that this age group constitutes the highest number of non-internet users.[1] This has led to a "digital divide" where elderly people lack access to ICT or value creation that they can contribute to society due to IT illiteracy.[2] Research suggests that ICT can enhance the quality of life and independence of older people[3] by helping them stay active through online communication, reducing loneliness, gaining access to information and increasing life satisfaction.[4] Through video calls and messaging apps, older people can stay connected to their friends and family. Social media can help in

expanding their social circle by encouraging them to join groups with similar interests, creating a sense of belonging and community integration. Without ICT adoption, older people may face social isolation[5] and a lack of self-esteem[6] as they struggle to keep up with new norms for society and lose autonomy in their personal lives.

Age-related challenges, such as vision, hearing and mobility issues, pose obstacles for older people using technology.[7] Complex interfaces and small displays can hinder usage, especially for those with cognitive impairments.[8] Older people with memory deficits may struggle to learn and recall functions on mobile phones with complicated interfaces or too many options.[9] They prefer technology that is easy to learn and adapt to, provided that the benefits outweigh the effort required.[10] Lack of confidence and fear of making mistakes can discourage older adults from using new platforms like social media,[11] and they may not perceive technology as a way to support their life or maintain independence.[12] However, these perceptions are often based on a lack of understanding and inadequate training.[13] Older adults may rely on younger relatives for assistance with ICT,[14] but not all are willing to seek help because they don't want to burden others. Addressing the digital divide becomes challenging when both older and younger generations lack the willingness to proactively seek or provide help.

INTERGENERATIONAL UNDERSTANDING

Providing the right support to older learners leads to a higher utilisation rate of technology amongst this cohort.[15] Intergenerational support is important to create a positive, understanding environment when helping older people to adapt to new technology.[16] However, such environments are hard to achieve when some young people have negative perceptions of the elderly. Young people may describe older people as pessimistic, conservative and grumpy,[17] or view them as a burden due to their decreased independence.[18] Such ageist attitudes can lead to discrimination and social exclusion of the elderly, and neglect of their welfare needs.[19] It has also been reported that young social workers may show less interest in supporting older people and their families.[20]

It can be difficult for a young person to comprehend the problems and challenges faced by an elderly person, as there are many differences in life experience due to age, physical and cognitive abilities, lived experiences, life roles and even life goals.[21] To encourage a stronger sense of connection for younger people towards older people, a simulation learning method called the Aging Game has been introduced as an educational tool for healthcare students.[22] However, such role-playing simulation activities are costly, time-consuming and labour-intensive.[23] It is our hope that Virtual Reality (VR) has the potential to develop simulation games which provide realistic scenarios which can be difficult to recreate (or cannot be recreated) in the classroom due to the limitations of real-life settings.

VIRTUAL REALITY

VR has been referred to as an "ultimate empathy machine" because it can allow people to experience a higher sense of involvement, thereby creating understanding of others' perspectives or emotions.[24] A fully immersive VR experience involves a head-mounted display unit (HDM) that blocks users from seeing the real world and replaces it with the virtual environment. VR has the potential to support complex narratives, to convey a story that generates viewer interactions and

intensifies emotions, thus enhancing the user's empathetic response.[25] It can also be used to replicate dangerous situations or carry out trials without harm to the users.[26] Research conducted to compare the empathetic response of participants towards homeless people using VR, on the one hand, and traditional media portraying the same narrative conditions, on the other, found that participants engaged in VR tasks exhibited a longer-lasting empathetic response and displayed greater willingness to support homeless individuals by signing a petition.[27] Whilst far from prompting systemic change, in this instance VR possessed a greater ability to translate empathetic responses into actionable outcomes compared to traditional media.

Examples of existing VR narratives designed to increase empathy or understanding

Becoming Homeless: A Human Experience offers a narrative experience of living as a homeless person.[28] The VR environment closely resembles the real world and users interact with it as they try to overcome the difficulties of homelessness. Players are transported automatically to different scenarios while guided by an audio narrator. The VR experience is intended to generate an emotional connection and encourage users to empathise with homeless people by engendering feelings of anxiety and fear when users are faced with the necessity of acting in unfamiliar roles, standing in the shoes of the homeless person. This project successfully demonstrates how VR can serve as a medium to generate empathy and understanding of a particular social issue.

Goliath: Playing with Reality tells the true-life story of a man with schizophrenia through the medium of an audio narrator and animated visual representations. The VR environment consists of stylistically unrelated scenes that may appear confusing or disturbing, but are intended to give players a sense of how a schizophrenia patient views their reality. Some scenes are interactive, while others are not, and players are more like observers rather than the protagonist. Nonetheless, the game enables players to gain some understanding of the world that a schizophrenia patient experiences, from the patient's own standpoint.

The Key is a VR experience that presents the story of a refugee through metaphorical visual representations and an audio narrator. The game is structured as a progressive exploration of a symbolic dreamlike environment as the player uncovers the narrator's forgotten story as a refugee. The developer does not expect the audience to fully understand all of the metaphorical elements presented; however, a significant message is revealed at the end through the narrator herself after her memories have been recovered.

The principles underlying these three VR experiences were closely tied to the impetus behind our project: to enhance understanding of a group of individuals who have been neglected or misunderstood. These VR projects emphasised storytelling and narratives in creating and engaging users in immersive learning experiences. In *Becoming Homeless, Goliath* and *The Key*, the stories are presented within predetermined scenarios and frames, with an audio narrator serving as the storyteller. There are few interactions or choices involved, and none of the actions taken will have an impact on the plot. As a result, this kind of storytelling feels 'scripted,' supplied with a predetermined route, despite users having some freedom to interact.[29] This approach helps in supporting a narrative structure which ensures the continuation of the story.

In this project, however, we are interested in exploring the implications of an alternative, non-linear narrative.[30] The Aging Game primarily utilises experiential learning through task performance.[31]

Allowing players to interact in real time does not always result in generating events that are perceived as intended for narrative development.[32] Some people learn more effectively when they connect positive feelings with a particular element and physically interact with it in a specific context, rather than passively accepting information.[33] This opens an avenue for exploring other kinds of storytelling that can utilise the VR's interactive features, potentially enhancing the immersion level to achieve higher learning outcomes. Whether the degree of autonomy exerted in a storytelling VR scenario impacts learning motivation is an important question.

DESIGN PROGRESS

Ideation, development, challenges and testing

The development of a prototype took around three months, and was created using Unity, Steam VR and Samsung HMD Odyssey. The first design choices considered in this project related to the storytelling mechanics. While a predetermined storyline is a more secure choice than a fully multi-story pathway due to the nature of VR's 360-degree navigational mode, limiting the freedom to explore reduces the players' sense of autonomy,[34] so environmental storytelling was explored in this project, allowing players to explore with minimal interruptions and providing them the capacity to construct the story through their choices and level of understanding of the game. The narrative centred on the problems and challenges that older people face with technology. An elderly woman, inspired by the mother of one of the authors, lacks technological literacy. Her life is focused on her family and home and her role as a housewife. The game environment is based on Sungai Lima, a fishing village in Selangor, Malaysia, which the players explore at night. In traversing this environment, players hold a torch to navigate through the darkness. The story and its environment are desivgned to highlight differences in lifestyles and intergenerational engagement with ICT to encourage younger people to reflect on these dissonances.

Figure 1. The fishing village environment.

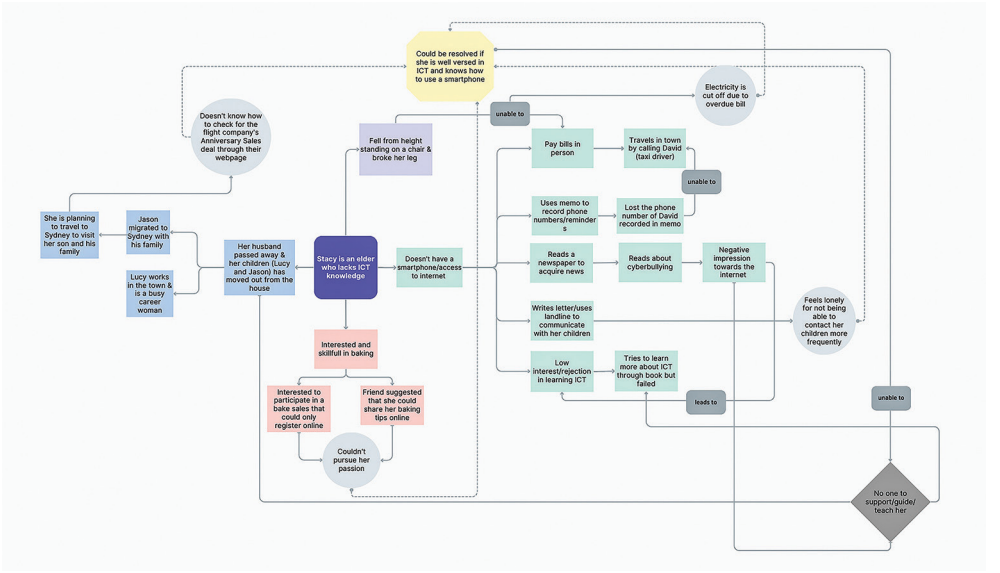


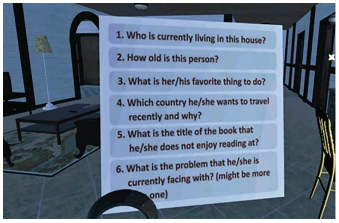
Figure 2. Flowchart of the events in the VR story.

The next step was to strategise the interactions possible for the story within the VR environment, given the limitations of both the software and hardware, and to establish an identifiable chain of events as part of setting up an environmental scenescape.[35] The structure and event flows within the story are illustrated in the flowchart in Figure 2.

Questions were presented at the start of the simulation to cue exploration before the gameplay began. Setting clear and specific goals was important for engaging attention and generating motivation for players.[36] Clues to the game task could be obtained through interactions and observation, including opening doors, drawers and cabinets, as well as picking up objects. Prioritising player safety and comfort, teleportation was introduced to reduce motion sickness when players were moving between points, despite the possibility of lower immersion levels as teleportation does not resemble movements in real life.[37] Other considerations for player safety were keeping gameplay time short to avoid discomfort from prolonged VR exposure.[38]

The game was exhibited during the Sunway University open day, and a total of seven students were recruited for user testing, which was conducted by one of the authors. Each participant was briefed with a basic tutorial on the controls used in the game and given ten minutes to explore the environment and complete the game task. An in-depth interview of each participant was conducted after the gameplay experience, alongside observational data collected by the author throughout the session.

Figure 3. Set-up for the open day trial exhibition of the game at Sunway University.



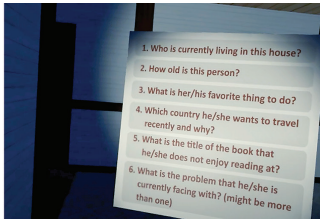


Figure 4. A pop-up view of the game questions can be triggered by a button at any location and time position (post-modification).

Figure 5. Set-up of the tutorial room (post-modification).

Figure 6. Flickering lights were added as a visual cue, replacing the original green light (post-modification).

Discussion and interview responses

Motivations

A high-immersion VR environment allows users to disconnect from the real world and feel more involved in the experience.[39] Factors which determine the level of emotional attachment to the experience include how enjoyable and meaningful it is felt to be and the relevance of the content to the participant.[40]

The findings from the open day exhibition indicated that most participants rated their experience as fun and enjoyable. However, its effectiveness in stimulating understanding through learning about the aging issue was questionable, as most participants failed to complete the task of developing a chain of events to reveal the whole story. Thomas Malone suggests that curiosity is one of the elements that cultivates an enjoyable learning experience, and a person's curiosity is based on the unexpected and constructive feedback they receive throughout the experience.[41] In this project, the questions were intended to evoke curiosity, but a lack of feedback caused some participants to become confused and lose motivation. Thus, the uncompleted tasks stalled learning opportunities and simulation potential to generate understanding. Participants' responses in the post-game interviews suggest that those who preferred exploration and multi-choice gameplay remained engaged, paying more attention to the details of the environment and giving more thought to analysing the questions and clues than the other respondents.

Participants with similar backgrounds, who share the same life experiences and family structure, were able to define and relate to the full story and expressed empathetic attitudes towards the aged, a result which aligns with previous findings that we exhibit stronger sense of connection and a sense of identity with people we recognise, or people who we consider to be like us.[42] Participants without similar experiences required more prompting to develop the necessary understanding of the issues.

VR was a new experience for many of the participants, who mentioned that they had difficulty with the controls. One participant stated, "I don't quite understand why the green light appears on the chair." Not understanding the mechanics of the game meant that the effectiveness of the experience was much reduced. The green light indicated that an object in the environment was interactable. For the next iteration of the game, one design solution was to set up a tutorial room for in-world pre-training so that users could to adapt to the VR controls prior to the session in order to reduce their cognitive load when playing.[43]

During the debriefing session after the game, it was observed that participants were more likely to put the story pieces together during the interview session when they were able to communicate with the interviewer and assimilate their thoughts,[44] including their insights about intergenerational understanding. As one of the participants remarked: "I think it's sad that she is living alone. It must be a little lonely when I think about it. And she wants someone to accompany her, that's what I have been thinking about … I was thinking, yeah, it's a real person. I was slowly getting into all these bits, so I like that part of it."

Moments such as this were encouraging and showed the potential for the tool to enable younger players to form new perspectives and emotional connections with the problems and challenges faced by the elderly. Another discovery was that even though some participants did not complete

the task and did not fully comprehend the story, they still enjoyed VR as a novel experience. While this aspect doesn't aid the project's main objective, it does show the potential for VR to engage users' attention.[45]

Autonomy versus control

Harvey Smith and Matthia Worch presented the concept of environmental storytelling at the Game Developers Conference 2010, in San Francisco. Building on the work of others, such as Carson's "Lessons from the theme Park," (2000) they defined environmental storytelling as the "act of staging player-space with environmental properties that can be interpreted as a meaningful whole, furthering the narrative of the game."[46] Without using cutscenes and dialogues to present important or contingent information to the players directly, environmental storytelling allows players to explore and investigate, to deduce and reach their own interpretation as to what is happening or has happened.[47] Players respond as active participants in uncovering the story through their own interpretations based on their own choices, making the experience more memorable and meaningful.[48] One non-VR project that incorporates this storytelling method is *Gone Home*, an interactive exploration simulator in which players explore and interact with the objects and elements in a house to uncover the story of the people who live there. The simulation aspects of *Gone Home* were a consideration in the development of the education tool in our own project.

Environmental story setting in VR allows users to view peripheral areas that are normally limited in traditional cinematic screen settings.[49] The user's vision can expand to include a wider field according to their body movements and behaviour. Despite reduced control over narrative flow, the ability to explore and interact enhances players' motivation. The majority of participants responded that they enjoyed teleporting around the environment and having the ability to explore. However, some participants reported that they struggled in searching for the relevant clues as they felt overwhelmed by the decorative elements in the environment.

One of the challenges of employing visual cues in a VR game is that, with a 360-degree navigational mode, it is difficult to predict the user's viewpoint,[50] and ways to navigate players to 'points of interest' need to be found for the game goals to be achieved within a shortish time limit. Visual cues used to direct attention to desired areas[51] included a green light which indicated that an object was interactable when touched. As mentioned above, some visual cues turned out to be less intuitive or effective than planned. While a time limit of ten minutes was set as a control factor to prevent discomfort or VR motion sickness, it also hindered the overall game experience. Some participants felt that ten minutes was too short to fully explore the environment and take in the complete story.

Realism in VR Storytelling

It has been suggested that realism is essential for VR training for professionals such as surgeons, firefighters and pilots.[52] However, the validity of realism depends on the context in which the VR experience is being presented to the user. The question here is, what should we prioritise in terms of user experience when creating VR interactions – immersion or realism? One suggestion is that user preference should be used to evaluate the effectiveness of VR experiences;[53] some users prefer simplified controls, while others see the controls as part of the immersion experience.

The extent to which a user's imagination is stimulated depends on the degree of 'realness' of the VR environment, which can in turn affect the participant's motivation to engage in the activity.[54] Realism in VR is achieved by a combination of visual, auditory, interactive and sensory stimulations.[55] Equipment such as gloves and controllers can incorporate haptic responses or feedback signals, such as vibration sensations, to users[56] when they interact with the VR environment.[57] The interrelation between these components of VR help determine the interactivity and immersion levels that stimulate a user's imagination.[58]

Striking a balance betweeen interaction, engagement and content is crucial in setting up the VR storytelling environment.[59] Defining 'realism' is a difficult task in VR applications. For some, replicating actions that are near-identical to real-world settings can help in enhancing the immersion level. Others believe that high-quality, detailed and complex graphics are required, while yet others argue that the conditions for 'realism' have been achieved if users successfully recognise the environment or items within it, even if intricate details are lacking.[60] The torch-lighting device was introduced into our game to accurately simulate the grabbing sensation of taking a torch in real life using the controls of the VR controller, including button pressing. However, we found that participants frequently dropped the torch as they struggled to continuously press the button for light. While some participants found this element realistic, many found it cumbersome, which detracted from gameplay as well as our objectives.

The next stage

Limitations of the study included the complexity and time-consuming nature of VR development, which made it difficult to conduct adequate user testing with the limited resources available. While VR has been around for over a decade, it is still an emerging technology, we experienced hardware issues including low-resolution imagery,[61] unstable game displays and other glitches which were beyond our control. To overcome such limitations, we suggest that the evaluation of the performance of VR environmental storytelling be broken into several stages (Figure 7).

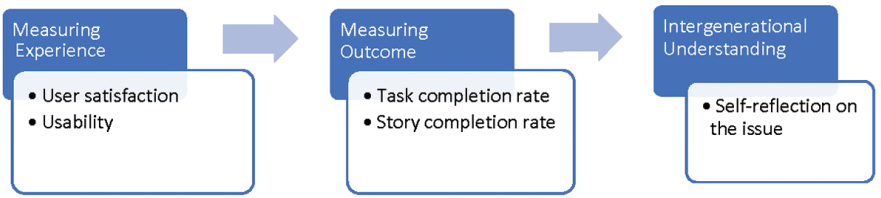


Figure 7. Diagram showing stages for evaluating the effectiveness of VR environmental storytelling.

Several modifications were made to enhance the game experience, including a pop-up function so that users could view the questions at any time during the game; changes to the visual cues; changes to player controls to eliminate the torch-dropping problem; and longer play times (20-30 minutes). Follow-up pilot tests showed that these changes improved the gameplay experience, but further research is needed to determine whether they are sufficient to help users advance to the next stage and achieve the project's ultimate goal of raising awareness and inspiring intergenerational understanding.

FUTURE POTENTIAL AND SUGGESTIONS

This paper describes the use of VR in the Malaysian context, but our experience will usefully inform similar projects in other locations. With its immersive and interactive capabilities, VR environmental storytelling is particularly impactful for younger generations, as it enables them to immerse themselves in shared experiences that resonate with their digital-native sensibilities. This ongoing research–creation project holds the potential to serve as an educational tool, not only for younger people, but also for software designers looking to create ICT interfaces that can cater to the needs of older people.

Looking ahead, the integration of storytelling and VR promises exciting opportunities for fostering intergenerational understanding. However, VR is only one component of many activities in the community and education tool box for fostering these connections and bridging generational divides. Project such as this can be integrated in community inclusiveness programmes, encouraging younger people to actively participate in such programs – an approach which has been successfully used in Malaysia to foster social connections and mutual learning and support between older and younger generations.[62]

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Ethical approval was obtained.

Giselle Su Hong Gick is a Research Fellow at the Centre for Research–Creation in Digital Media, Sunway University, Malaysia. Her research focuses on Virtual and Augmented Reality for learning and education, as well as narratives and storytelling. She seeks to explore new approaches to digital media and provide innovative perspectives on the intersection of technology and creativity.

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1. Malaysian Communications and Multimedia Commission, *Internet Users Survey 2020*, https://www.mcmc.gov.my/skmmgovmy/media/General/pdf/IUS-2020-Report.pdf
2. Hafisah Yaakob, Wan Hartini Wan Hassan and Faridah Pardi, "Digital Divide among Elderly Workers – a Comparative Study between Public and Private Sectors in Melaka," *Asian Journal of University Education*, 12:1 (2016), 53-81, https://ir.uitm.edu.my/id/eprint/42042/
3. Naoko Iwasaki, "Usability of ICT Applications for Elderly People in Disaster Reduction," *Journal of E-Governance*, 36 (2013), 73-8, https://doi.org/10.3233/GOV-130338
4. Luciano Gamberini, Mariano Alcañiz, Giacinto Barresi, Malena Fabregat, Francisco Ibañez and Lisa Prontu, "Cognition, Technology and Games for the Elderly: An Introduction to Eldergames Project," *PsychNology J.*, 4 (2006), 285-308.
5. Rana Mostaghel, "Innovation and Technology for the Elderly: Systematic Literature Review," *Journal of Business Research*, 69:11 (2016), 4896-900, https://doi.org/https://doi.org/10.1016/j.jbusres.2016.04.049
6. Ioana Iancu and Bogdan Iancu, "Elderly in the Digital Era. Theoretical Perspectives on Assistive Technologies," *Technologies*, 5:3 (2017), Art. 60, https://doi.org/10.3390/technologies5030060
7. Lena Rosenberg, Anders Kottorp, Bengt Winblad and Louise Nygård, "Perceived Difficulty in Everyday Technology Use among Older Adults with or without Cognitive Deficits," *Scandinavian Journal of Occupational Therapy*, 16:4 (2009), 216-226, https://doi.org/10.3109/11038120802684299. See also Iancu and Iancu, "Elderly in the Digital Era."
8. Sofianiza Abd Malik and Muna Azuddin, "The Use of Technology by Older People," *International Journal of Interactive Digital Media*, 1:3 (2013), 65-8. See also Zoe Roupa, Marios Nikas, Elena Gerasimou, Vasiliki Zafeiri, Lamprini Giasyrani, Eunomia Kazitori and Pinelopi Sotiropoulou, "The Use of Technology by the Elderly," *Health Sci J*, 4:2 (2010), 118-126.
9. Sri Kurniawan, Murni Mahmud and Yanuar Nugroho, "A Study of the Use of Mobile Phones by Older Persons," *CHI EA '06: CHI '06 Extended Abstracts on Human Factors in Computing Systems* (April 2006), 989–94, https://doi.org/10.1145/1125451.1125641
10. Ibid.
11. Bran Knowles and Vicki L Hanson, "The Wisdom of Older Technology (Non)Users," *Communications of the ACM*, 61:3 (2018), 72-7, https://doi.org/10.1145/3179995
12. Sebastiaann Peek, Katrien Luijkx, Maurice Rijnaard, Marianne Nieboer, Claire Voort, Sil Aarts, Joost Hoof, Hubertus Vrijhoef and Eveline Wouters, "Older Adults' Reasons for Using Technology while Aging in Place," *Gerontology*, 62:2 (2015), 226–37, https://doi.org/10.1159/000430949
13. Malik and Azuddin, "The Use of Technology," 67.
14. Peek et al., "Older Adults' Reasons."
15. Malik and Azuddin, "The Use of Technology," 67-8. See also Roupa et al., "The Use of Technology."
16. Shannon Freeman et al., "Intergenerational Effects on the Impacts of Technology Use in Later Life: Insights from an International, Multi-site Study," *International Journal of Environmental Research and Public Health*, 17:16 (2020), Art. 5711, https://doi.org/10.3390/ijerph17165711
17. Carmen Requena Hernandez and Marta Zubiaur Gonzalez, "Effects of Intergenerational Interaction on Aging," *Educational Gerontology*, 34:4 (2008), 292-305, https://doi.org/10.1080/03601270701883908
18. Derya Cinar, "Investigation of the Attitudes of University Students to Discrimination of the Elderly," *Northern Clinics of Istanbul*, 5:1 (2018), 25-30, https://doi.org/10.14744/nci.2017.10437
19. Patrick Corrigan, "How Stigma Interferes with Mental Health Care," *American Psychologist*, 59:7 (2004), 614-25, https://doi.org/10.1037/0003-066x.59.7.614
20. Anna Azulai, "Ageism and Future Cohorts of Elderly: Implications for Social Work," *Journal of Social Work Values & Ethics*, 11:2 (2014), 2-12.
21. Arms Tamatha, Angela Sardina, Noell Rowan and Candy Ashton, "Use of the Into Aging Game to Improve Empathy among Nursing, Recreational Therapy, and Social Work Students," *International Journal for Human Caring*, 24:2 (2020), 76-83, https://doi.org/10.20467/humancaring-d-19-00045
22. Beverly W Henry, Amy D Ozier and Amy Johnson, "Empathetic Responses and Attitudes about Older Adults: How Experience with the Aging Game Measures Up," *Educational Gerontology,* 37:10 (2011), 924-41, https://doi.org/10.1080/03601277.2010.495540
23. Carolinda Douglass, Beverly W Henry and Irene M Kostiwa, "An Aging Game Simulation Activity for Allied Health Students," *Educational Gerontology*, 34:2 (2008), 124-35, https://doi.org/10.1080/03601270701700417

24. Fernanda Herrera, Jeremy Bailenson, Erika Weisz, Elise Ogle and Jamil Zaki, "Building Long-term Empathy: A Large-scale Comparison of Traditional and Virtual Reality Perspective-taking," *PLoS ONE*, 13:10 (2018), e0204494, https://doi.org/10.1371/journal.pone.0204494. See also Chris Milk, *How Virtual Reality Can Create the Ultimate Empathy Machine*, *TED Talks*, March 2015, 09:40 at https://www.ted.com/talks/chris_milk_how_virtual_reality_can_create_the_ultimate_empathy_machine
25. Philippe Bertrand, Jérôme Guegan, Léonore Robieux, Cade Andrew McCall and Franck Zenasni, "Learning Empathy through Virtual Reality: Multiple Strategies for Training Empathy-related Abilities Using Body Ownership Illusions in Embodied Virtual Reality," *Frontiers in Robotics and AI*, 5 (2018), Art. 26, https://doi.org/10.3389/frobt.2018.00026
26. Francisco Rebelo, Paulo Noriega, Emília Duarte and Marcelo Soares, "Using Virtual Reality to Assess User Experience," *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 54:6 (2012), 964-82, https://doi.org/10.1177/0018720812465006
27. Herrera et al., "Building Long-term Empathy."
28. Virtual Human Interaction Lab, Stanford University, *Becoming Homeless: A Human Experience* [film], https://stanfordvr.com/becominghomeless/ (accessed July 2020).
29. Michael Vallance and Phillip A Towndrow, "Perspective: Narrative Storyliving in Virtual Reality Design," *Frontiers in Virtual Reality*, 3 (2022), Art. 779148, https://doi.org/10.3389/frvir.2022.779148
30. Michele D Dickey, "Game Design Narrative for Learning: Appropriating Adventure Game Design Narrative Devices and Techniques for the Design of Interactive Learning Environments," *Educational Technology Research and Development*, 54:3 (2006), 245-63, https://doi.org/10.1007/s11423-006-8806-y
31. Henry et al., "Empathetic Responses," 924-41.
32. Ruth Aylett and Sandy Louchart, "Being There: Participants and Spectators in Interactive Narrative," *Lecture Notes in Computer Science*, 2871 (2007), 117-28, https://doi.org/10.1007/978-3-540-77039-8_10
33. Hugo Ariel Santos Garduño, Martha Idalia Esparza Martínez and May Portuguez Castro, "Impact of Virtual Reality on Student Motivation in a High School Science Course," *Applied Sciences*, 11:20 (2021), Art. 9516, https://doi.org/10.3390/app11209516
34. Jukka Ahlo, Kai Tuuri and Tanja Välisalo, "Exploring Gameful Motivation of Autonomous Learners," *Frontiers in Psychology*, 13 (2022), https://doi.org/10.3389/fpsyg.2022.825840. See also Richard M Ryan, C Scott Rigby, and Andrew Przybylski, "The Motivational Pull of Video Games: A Self-determination Theory Approach," *Motivation and Emotion,* 30:4 (2006), https://doi.org/10.1007/s11031-006-9051-8
35. Harvey Smith and Matthias Worch, "What Happened Here? Environmental Storytelling," *GDC Vault*, https://www.gdcvault.com/play/1012647/What-Happened-Here-Environmental (slide show of lecture presented at the Game Developers Conference 2010)
36. Rosemary Garris, Robert Ahlers and James E Driskell, "Games, Motivation, and Learning: A Research and Practice Model," *Simulation & Gaming*, 33:4 (2002), 441-67, https://doi.org/10.1177/1046878102238607
37. Aniruddha Prithul, Isayas Berhe Adhanom and Eelke Folmer, "Teleportation in Virtual Reality; a Mini-Review," *Frontiers in Virtual Reality*, 2 (2021), https://doi.org/10.3389/frvir.2021.730792.
38. Rebelo et al., "Using Virtual Reality," 964-82
39. Ibid.
40. Donghee Shin, "Empathy and Embodied Experience in Virtual Environment: To What Extent Can Virtual Reality Stimulate Empathy and Embodied Experience?," *Computers in Human Behavior*, 78 (2018), 64-73, https://doi.org/10.1016/j.chb.2017.09.012
41. Thomas W Malone, "What Makes Things Fun to Learn? A Study of Intrinsically Motivating Computer Games," *Dissertation Abstracts International*, 41:05 (1981), 1955B.
42. Bertrand et al., "Learning Empathy."
43. Oliver A Meyer, Magnus K Omdahl and Guido Makransky, "Investigating the Effect of Pre-training When Learning through Immersive Virtual Reality and Video: A Media and Methods Experiment," *Computers & Education*, 140 (2019), Art. 103603, https://doi.org/10.1016/j.compedu.2019.103603.
44. Philip Hardie, Andrew Darley, Lorraine Carroll, Catherine Redmond, Abraham Campbell and Suzi Jarvis, "Nursing & Midwifery Students' Experience of Immersive Virtual Reality Storytelling: An Evaluative Study," *BMC Nursing*, 19:1 (2020), https://doi.org/10.1186/s12912-020-00471-5
45. Werner Wirth, Tilo Hartmann, Saskia Böcking, Peter Vorderer, Christoph Klimmt, Holger Schramm, Timo Saari et al., "A Process Model of the Formation of Spatial Presence Experiences," *Media Psychology*, 9:3 (2007), 493–525, https://doi.org/10.1080/15213260701283079

46. Ibid.
47. Don Carson, "Environmental Storytelling: Creating Immersive 3D Worlds Using Lessons Learned from the Theme Park Industry," *Game Developer*, 1 March 2000, https://www.gamedeveloper.com/design/environmental-storytelling-creating-immersive-3d-worlds-using-lessons-learned-from-the-theme-park-industry
48. Fern Griffiths, "Environmental Storytelling – How to Use a Games [sic] Level Design to Tell a Story," *Fable & Fern*, 30 May 2020, https://fable-and-fern.com/2020/05/30/environmental-storytelling- how-to-use-a-games-environment-to-tell-a-story/. See also Smith and Worch, "What Happened Here?"
49. Simone Arcagni and Adriano D'Aloia, "VR Storytelling: Potentials and Limitations of Virtual Reality Narratives," *Cinergie – Il Cinema E Le Altre Arti*, 10:19 (2021), 1-7, https://doi.org/10.6092/issn.2280-9481/13412
50. John Mateer, "Directing for Cinematic Virtual Reality: How the Traditional Film Director's Craft Applies to Immersive Environments and Notions of Presence," *Journal of Media Practice*, 18:1 (2017), 14-25, https://doi.org/10.1080/14682753.2017.1305838
51. Ibid.
52. Mafkereseb Kassahun Bekele and Erik Champion, "A Comparison of Immersive Realities and Interaction Methods: Cultural Learning in Virtual Heritage," *Frontiers in Robotics and AI*, 6 (2019), https://doi.org/10.3389/frobt.2019.00091
53. Sungchul Jung and Robert W Lindeman, "Perspective: Does Realism Improve Presence in VR? Suggesting a Model and Metric for VR Experience Evaluation," *Frontiers in Virtual Reality*, 2 (2021), https://doi.org/10.3389/frvir.2021.693327
54. Ibid.
55. Jyi-Chang Tsai, Lisa Y Chen and Hui-Yi Peng, "Exploring the Factors Influencing Consumer's [sic] Attitude Toward Using and Use Intention of Virtual Reality Games," *International Journal of Organizational Innovation*, 13:4 (2021), 160-175, http://ezproxy.sunway.edu.my/login?url=https://www.proquest.com/scholarly-journals/exploring-factors-influencing-consumers-attitude/docview/2521123132/se-2
56. Ibid.
57. Zhihan Lv, "Virtual Reality in the Context of Internet of Things," *Neural Computing and Applications*, 32:13 (2019), https://doi.org/10.1007/s00521-019-04472-7
58. Thomas B Sheridan, "Interaction, Imagination and Immersion[:] Some Research Needs," *Proceedings of the ACM Symposium on Virtual Reality Software and Technology – VRST '00* (2000), 1-7, https://doi.org/10.1145/502390.502392
59. Stefan Weber, David Weibel and Fred W Mast, "How to Get There When You Are There Already? Defining Presence in Virtual Reality and the Importance of Perceived Realism," *Frontiers in Psychology*, 12 (2021), https://doi.org/10.3389/fpsyg.2021.628298.
60. Jaziar Radianti, Tim A Majchrzak, Jennifer Fromm and Isabell Wohlgenannt, "A Systematic Review of Immersive Virtual Reality Applications for Higher Education: Design Elements, Lessons Learned, and Research Agenda," *Computers & Education*, 14:0360-1315 (2020), Art. 103778, https://doi.org/10.1016/j.compedu.2019.103778
61. David Checa and Andres Bustillo, "A Review of Immersive Virtual Reality Serious Games to Enhance Learning and Training," *Multimedia Tools and Applications*, 79:9-10 (2019), 5501-27, https://doi.org/10.1007/s11042-019-08348-9
62. Intan Liana Samsudin, Syed Iskandar Ariffin and Maimunah Sapri, "Intergenerational Program and Care: Analysis of Malaysia Intergenerational Modules, Policies and Guidelines," *International Journal of Law, Government and Communication*, 7:27 (2022), 13-25, https://doi.org/10.35631/ijlgc.727002