Computers in Human Behavior 65 (2016) 210–219

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Full length article

Leveling up: Are non-gamers and women disadvantaged in a virtual world classroom?

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ARTICLE INFO

Article history:
Received 11 April 2016
Received in revised form
20 July 2016
Accepted 22 July 2016
Available online 30 August 2016

Keywords:
Virtual worlds
Online education
Gaming experience
Gender
Open wonderland

ABSTRACT

Today's young gamers are tomorrow's students who expect more immersion from their online learning experiences. Teachers and administrators, however, must ask are some students at a disadvantage in such a class and does gender play a role? We examine the degree to which gaming experience and gender influence sense of presence in a virtual world learning classroom. Feelings of presence are key to involvement in virtual worlds. Participants, 348 undergraduates, interacted within a custom designed virtual world classroom focusing business negotiation skills. Results reveal that while gaming experience gives a slight advantage, lack of previous software ownership and gender do not put learners at a disadvantage. This finding shows that non-gamers and females can equally participate in a virtual world classroom, relieving concerns of adoption.

I would like to know how many female students enjoy playing Minecraft, compared to the male students? Will students who already have a grasp of the specific game being used… fair better… then students who have never played that particular game?

Forum question in response to a post on using Minecraft in the classroom http://www.edutopia.org/blog/minecraft-in-classroom-andrew-miller.

1. Introduction

This study explores the possible downside experienced by learners when introduced to a virtual world learning space. Specifically, we consider the lack of gaming experience and effects of gender and ask if groups of students will be left behind when a teacher adopts a virtual world instruction method.

Studies of the prevalence of video game playing indicate that, while it is highly extensive among the young, there is still a significant minority of about one in five university students who are not active gamers (Gentile, 2009; Thomas & Martin, 2010). The Entertainment Software Association recently reported women over 18 are gaming at a higher rate than boys under 18 (33% compared to 15%), showcasing how video games are now mainstream (Entertainment Software Association, 2014). That same report shows 26% of game players are under 18 and the average gamer age is 35. Assuming college students are comfortable and experienced with virtual worlds may be dangerous. Less than half of Americans report three or more hours of computer game play a week. This means there is clearly a population of young people engaging in hobbies other than computer gaming with little to no opportunity for, or interest in, PC gaming or console use.

PC Gaming is leading a revolution in interface design, pioneering first-person perspectives and self-efficacy, allowing players to wander in virtual worlds, control their own avatar's appearance, and even form social networks with other players. Sandbox games (a reference to the free-form play of a child's sandbox) allow players to construct everything within the game (e.g., *Minecraft*; Mojang and Microsoft Studios) and worlds that provide components to users that, erector set-like, they can construct their preferred possessions (e.g., *The Sims*; Electronic Arts). Users actively seek these fully immersive environments, feeling a freedom to explore sans linear narrative, while moving between virtual environment and peer social interaction (Lim, 2011, pp. 271–287). In a very short number of years, virtual worlds have come to dominate gaming because of the freedom players experience in creating their own

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http://dx.doi.org/10.1016/j.chb.2016.07.033
0747-5632/

storylines. The Sims, for example, dominate video game sales, accounting for one third of the top 20 PC game unit sales (Entertainment Software Association, 2014).

Students with gaming experience are familiar with the conventions of self-constructed virtual world narratives. Students lacking video gaming experience may be disadvantaged in the increasingly rich milieu of online educational delivery as augmented reality and virtual reality grow in adoption. A further consideration is the objectification of and violence against women in video games that has been an alienating issue within the industry since the 1980s (Kent, 2010). Rather than declining, the Internet has amplified this problem, as seen in recent public debates; such as, gamergate (Parkin, 2014) and Penny-Arcade (Salter & Blodgett, 2012). Disturbingly, these cases include threats of violence against women that Salter and Blodget attribute to a perception, by the male-dominated hard-core gaming market, of a threat from the increasing participation of women in casual gaming.

2. Literature review

While keeping the attention of students is one aim of the gamification of education, the ultimate goal is to encourage self-efficacy, leading to a constructed learning space with students creating and following their own learning directions. Gamification focuses on a transformation of the classroom in ways that extend far beyond simple badges of achievement (Kapp, 2012). Today's students commonly interact with their educational institutions through virtual links. In fact, according to the Sloan Consortium study conducted in 2010, nearly 30% of college students participate in online courses (Allen & Seaman, 2010). While the Babson Survey Research Group 2011 study reports approximately 31% of college students are taking at least one online course (Allen & Seaman, 2011). If educational institutions are to thrive in such an environment, they need to understand predictors of student engagement and motivation (Friedman & Friedman, 2014) in order to construct successful online delivery systems that assure no students are disadvantaged. The foundation of that understanding is the source of virtual world environments, namely video games, which we examine next.

2.1. Video gaming

The market for video games topped US$15 billion in sales for 2014 (Entertainment Software Association, 2014), including a vast diversity of game platforms, prices, and genres. Arsenault (2009) points out the difficulty in classifying gaming as game genre labels describe a feeling of play more than defining any clear demarcating taxonomy. A first person shooter (FPS) emphasizes experiencing gameplay through the eyes of the protagonist who moves within a three dimensional space. This game genre was pioneered by id Software, in 1992–93, with *Wolfenstein 3D* and *Doom*. Recent examples include *Far Cry* (Ubisoft), *Half-Life* (Sierra Entertainment and Valve Corporation), and *Call of Duty* (Activision). The popularity of the FPS genre now attracts development budgets larger than Hollywood movies. Simulation games (SIM) copy real life activities that often lack specific goals (a sandbox game), such as *The Sims* (Electronic Arts), or include clear goals, like *Madden NFL* (EA Tiburon). Role playing games (RPG) focus on developing a character, choosing appearance, and building skills. Gameplay in RPGs emphasizes tasks relating to logical thinking and problem solving while individually, or in groups, on a quest. The quest generally follows a linear story, such as in *Mass Effect* (Microsoft Game Studios and Electronic Arts) and *Skyrim* (Bethesda Softworks). Beginning with local area networks, later migrating to the Internet, RPG gamers seek social interaction and cooperation through massively multiplayer online role playing games (MMORPG), such as *World of Warcraft* (Blizzard Entertainment).

The appeal of a constructed space was recognized as early as 1986 by LucasFilm's with the virtual world of *Habitat*—the first incarnation of an MMORPG. Players of MMORPGs improve their mood states (Hussain & Griffiths, 2009; Youn, Lee, & Doyle, 2003) and derive social support from other players (Longman, O'Connor, & Obst, 2009). It is the opportunities to increase students' participation, involvement, enjoyment, and overall motivation in education that rationalizes over two decades of integration of gaming into the education setting.

2.2. Virtual worlds in collaborative learning

Academics increasingly report the adoption of virtual environments in educational settings (Mikropoulos & Natsis, 2011). References to virtual environments emphasize their capability to encourage students in the co-construction of knowledge (De Lucia, Francese, Passero, & Tortora, 2009; Jamaludin, Chee, & Ho, 2009; Jarmon, Traphagan, Mayrath, & Trivedi, 2009), collaboration (Jarmon et al., 2009), and critical thinking (Herold, 2010). With their fully immersive spaces, Second Life and, more recently, Minecraft are increasingly popular for instruction (Schifter & Cipollone, 2013, pp. 2951–2955). Science educators use virtual environments (De Lucia et al., 2009; Mikropoulos & Natsis, 2011) as do liberal arts teachers (Echeverría et al., 2011).

Learning results in virtual worlds are often directly attributed to increasing engagement (Cheong, 2010; Wrzesien & Alcañiz Raya, 2010), interaction, and critical thinking (Herold, 2010; Jamaludin et al., 2009). It is a lack of these attributes in massive open online courses (MOOCs) that is associated with high dropout rates (Henning et al., 2014). Participants in MOOCS simply feel a lack of social interaction and support. Successful development of MOOCs require some component that increases interaction and learner self-efficacy (Mackness, Mak, & Williams, 2010; Mak, Williams, & Mackness, 2010, pp. 275–285) in order to show better results (Breslow et al., 2013). The asynchronous nature of MOOCs, and the lack of interaction combine to lower feelings of involvement, leading to problems in self-efficacy as learners are left on their own, without role models and with very tenuous connections to the class material, instructor, and, most importantly, other learners. Research into the educational exploitation of massively multiplayer online games (MMORPGs) provides valuable insights on issues of engagement, commitment, learner connectedness, and distributed learning.

2.3. Involvement through feelings of presence

Asynchronous technologies do not allow for immediate feedback between participants, which hinders many parts of communication, such as, dialog, feedback, and context. Virtual immersive software, that is synchronous, can offer these aspects of communication (Grodal, 2000). Increasing levels of synchronous interaction improves degrees of immersion, which leads to higher levels of user involvement. This experience succeeds by evoking a greater psychological sense of presence (Steuer, 1992). Thus, feelings of presence are key to the success of a virtual world, while also instrumental in offering an environment for self-efficacy among learners.

Within a virtual world, players face fluid situations and are presented with continuous choices requiring responses and involvement (Nelson, Keum, & Yaros, 2004). The more open the virtual world (sandboxed) the more learners are free to cooperate and use the space in ways they construct, rather than a linear

progression. This cannot happen if students do not feel involved with the virtual world, a feeling that increases with feelings of presence.

The psychological construct of presence is referenced in numerous studies (Mikropoulos & Natsis, 2011) as a key to improving involvement and, by implication, outcomes. Feelings of immersion increase in virtual reality medical simulations along with increases in interaction, imagination, and motivation (Huang, Rauch, & Liaw, 2010). Immersion often increases through technological improvements, such as interface design. Vividness and interactivity (see Fig. 1) facilitates feelings of presence in a similar way to Massively Multiplayer Online Role Playing Games (MMORPG). Thus, in the virtual world classroom, the more learners have feelings of presence, the more they can feel comfortable interacting with other learners, and the environment, which further increases feelings of presence.

As a predecessor of MOOCs, MMORPGs share numerous elements with their educational cousin's goals and methods. Players of MMORPGs often form teams made up of members at distant geographic locations. Similarly, for MOOCs, forming support groups is also helpful in overcoming large class size and interpersonal the nature of MOOCs (Al-Atabi & DeBoer, 2014). In both MMORPGs, team work normally includes feelings of presence that includes personalizing one's avatar, viewing team members' avatars, and carrying on real-time audio conversations. Similarly, increasing opportunities for a sense of community improve attitudes toward MOOCs (Takkunen & Rosato, 2014). This approach increases feelings of social presence and leads to increasing levels of participation and commitment. Increased feelings of presence improve student attitude when overcoming a learning curve, such as the technology commonly involved with MOOCs or a MMORPGs.

2.4. Self-efficacy depends on presence

A sense of cognitive presence is important as it enables an exploration, testing, and discussion of emergent ideas (Kop, Fournier, & Mak, 2011). Without successfully executing these behaviors, within a virtual world, a learner will experience difficulties in self-efficacy, as confidence of success drops. At the most basic level is a learner who cannot successfully operate his/her computer to even enter a virtual world class. Software and hardware issues can prevent audio and microphones from working. Such fundamental problems are most often caused by lack of familiarity with the relevant systems (human error).

When hardware and software are operated successfully, feelings of presence are triggered by engaging students with technologies such as video conferencing, blogs, wikis, and social networks. Virtual worlds offer an excellent opportunity to enhance feelings of presence with high levels of engagement and personalization (Takkunen & Rosato, 2014). Teachers, however, must face students with a wide range of computer experience, and this leads directly to questions of self-efficacy. Prior experience in a gaming genre includes a large amount of received knowledge that instils gaming conventions (Leidner & Jarvenpaa, 1995). The synchronous nature of a virtual world session increases feedback, participation, and feelings of presence (Mackness, Waite, Roberts, & Lovegrove, 2013), but only if systems are working smoothly for the learner. Visually accurate avatars and environments are not required for high levels of presence (Chen, Warden, Wen-Shung Tai, & Chen, 2011; Jin, 2009; Jin & Park, 2009; Slater, Pertaub, Barker, & Clark, 2006), meaning even low power computer systems may be used along with abstracted virtual world environments, as long as users smoothly enter the virtual world and feel at ease interacting with others.

Augmenting reality is the strength of computer systems, rather than imitating reality (Dillenbourg, 2008). The feeling of presence builds through the illusion of being inside an environment, and this helps improve feelings of mastering the systems and thus generates self-efficacy. The illusion prolongs as individuals' actions correspond to responses within the environment (Groenegress, Thomsen, & Slater, 2009). Video game interactivity increases sensory-involvement (Vorderer, 2000), over traditional media (Steuer, 1992) allowing interaction and control from a personal point of view (Grodal, 2000; Nelson, 2002). Even early video games evoke a sense of presence (Steuer, 1992). Presence is widely cited across numerous studies as key to improving involvement (Mikropoulos & Natsis, 2011). A learner lacking the received knowledge of video games, or having had negative experiences, will form negative feelings that defeat the best intentions of an educational virtual world.

2.5. Gender

Gender-based differences in gaming are widely observed (Cassell & Jenkins, 2000; Schott & Horrell, 2000). Thornham (2008) points out preconditions, positions, and performances in video games are always negotiated, implying female gamers face the same issues in cyberspace as they do in the offline world. In the early 2000s, Bryce and Rutter (2003) found games such as Quake 3 and Everquest presented points of resistance to gender stereotyping. Maher and Hoon (2008) argue that gender is brought into cyberspace from the outside world, but players can challenge stereotypes. Top FPS games such as *Fallout 3*, *Mass Effect*, and *Skyrim* offer players a choice of gender, although most of the realistic FPS games have a strong military element with high levels of violence that appeal to male protagonists.

Fig. 1. Group technical training session and video on demand lecture delivery.

Richard (2012) surveys the state of virtual world video game play, finding increases in female roles, but inconsistently, ranging from somewhat simplistic implications in *Mass Effect*, and somewhat buggy dialogs and behaviours (*Fallout New Vegas*), to the more fleshed out female characters in *Skyrim*. Even so, Richard points out the semiotics of game's marketing efforts, such as box cover art, do very little to convey the diversity message (Richard, 2013). Higher game sales correlate with cover art where female characters are non-central and sexualized (Near, 2013). Video game advertising, as shown in content analysis, upholds media stereotypes of race and gender (Behm-Morawitz, 2014). In her YouTube series, *Tropes vs Women in Video Games*, Sarkeesian points out that women can be gamers, enjoying video games, but the industry continues to focus on tropes that are not fading away (Sarkeesian, 2015). Gaming magazine content analysis, over twenty years, shows a shift from portraying females as innocent and in need of a rescue to sexy heroes, i.e., from benevolent sexism to hostile sexism (Summers & Miller, 2014).

Within virtual world game settings, Lin (2008) finds female players often hide their gender, or avoid live communication with other players. When a player's voice is feminine it attracts nearly three times more negative comments from male players, even when controlled for player skill level (Kuznekoff & Rose, 2013). Fox and Tang (2014) find sexist attitudes relate to a gamer's masculinity norm of power over women and masculinity norm of heterosexual self-presentation. Within the gaming context, even when females are on par with males, they feel less confident (Bertozzi, 2008).

Game genres like FPS and real time strategy (RTS) are played more by males, compared with RPG games, but even RPG games are played by only a fifth of gamers (Ghuman & Griffiths, 2012). When considering serious gamers, such as FPS, they are almost exclusively male, while female serious gamers prefer the RPG genre (Fritsch, Voigt, & Schiller, 2006, p. 16). Additionally, that study shows males ages 11 to 20 far outnumber females, with female gamer age distributed more in the 21 to 40 range. In Taiwan, for example, male students exhibit higher levels of video game addiction (Chiu, Lee, & Huang, 2004).

The wider gender culture plays an important role that is inescapable, as gender stereotypes carry over to the gaming world (Carr, 2005; Holz Ivory, Fox, Franklin Waddell, & Ivory, 2014). Hussain and Griffiths' (2008) study of MMORPG players show males (40%) find it easier to converse online than offline as compared to females (6%). Gender bias affects game design itself, with women developers a minority in the video games industry (Prescott & Bogg, 2011). Computer gaming is less a cause or modifier of behaviour than a reflection of values brought to the virtual world (Jansz & Tanis, 2007). Males do play more computer games at home and thus have more experience in computer use and troubleshooting, setting them more at ease and better preparing them for a virtual-world classroom experience. Current findings do not clearly indicate if an advantage is gained based on gender, leading us to our first hypothesis:

H1. In a virtual-world classroom setting, male students will experience higher levels of presence than female students.

2.6. Software ownership

Fundamental to any virtual world class involvement is the smooth operation of software and hardware (Pellas, 2014). Owolabi and Adegoke (2014) find that both computer ownership and experience are not predicators of self-efficacy. Hardware/software experience, therefore, may not be a requirement for student adoption of information technologies used in class, but it may lend an advantage to some. High levels of home computer exposure are associated with lower computer anxiety (Colley, Gale, & Harris, 1994). Students who use computers at home take advantage of university information technologies more than those who use technology less at home (Selwyn, 1998). Kuhlemeier and Hemker (2007) find that home computer ownership increases the IT capabilities of young people. Mumtaz (2001) also reports that, for young people, computers in the home increase confidence and fluency in dealing with IT equipment. Thus, just the use of computer systems increases experience.

Students may have high levels of self-efficacy in the learning domain but lack the ability to exhibit self-efficacy in the technical domain, which is part of a functioning virtual world. This is particularly true as a virtual world is joined remotely, requiring students to manage their own hardware, software, and Internet connectivity (Warden, Stanworth, Ren, & Warden, 2013). Students with less experience get bogged down by technical issues that distract from the virtual experience, interfering with feelings of presence. Software purchasing and ownership serves as a proxy for experience, with learners who purchase more software having increasing levels of experience in installing, working out hardware compatibility issues, and generally solving technical problems.

H2. In a virtual-world classroom setting, students who have purchased more software experience higher levels of presence than students who have purchased less software.

2.7. Gaming experience

Frequent gamers show a more positive attitude toward gaming as compared to non-gamers (Bonanno & Kommers, 2008). Gamers foster skills that facilitate engagement with virtual worlds, putting them at a potential advantage in online learning contexts (Dede, 2005). Studies consistently find that computer game playing improves physical abilities such as hand-eye coordination and reaction times while increasing feelings of self-esteem (Griffiths, 2002). Game playing strengthens spatial visualization (Feng, Spence, & Pratt, 2007) that translates into an advantage as players are already adept in interpreting two dimensional images on a screen into the three-dimensional online environment. Medical practitioners, for example, perform examinations (e.g., endoscopy) more effectively and quickly when they are experienced game players (Enochsson et al., 2004; Sedlack & Kolars, 2004).

As yet, few studies critically examine the relationship between the application of skills, developed through recreational game playing, and learning (Bennett, Maton, & Kervin, 2008). The evidence that game playing is associated with the development of valuable real world skills, is sufficient for these activities to be include in a learning curricula (Mitchell & Savill-Smith, 2004). Learning to represent one's self in a virtual space includes conventions of location and causational factors in activities that enable one to experience feelings of presence (Annetta & Holmes, 2006).

Controlling an avatar can combine with projecting oneself through an avatar, in what Gee (2005) labels a projective stance, which can be especially useful in developing skills. Games, especially those in the FPS genre, focus on the use of an avatar to facilitate interaction. Players, as avatars, assimilate a portfolio of skills in navigating and interacting in their respective gaming worlds. Such skills, combine with an enhanced capacity in spatial recognition, likely helping students engage as avatars in a virtual world learning environment. Thus, we may conclude, those without gaming experience are actually disadvantaged when engaging in virtual world learning environments, presenting a serious challenge to an educational paradigm of virtual delivery and self-efficacy with equitable opportunities for all learners.

H3. Students with lower experience levels of computer gaming exhibit lower levels of presence in a virtual world classroom setting.

3. Method

Employing a natural setting, data is drawn from students in a class partially delivered through a virtual world setting. Students taking an undergraduate class on business negotiation attend approximately one third of classes (6 of an 18 week total) in a virtual world setting. Another third of the class is delivered through online video lectures and online assignments (see Fig. 1 and video: https://youtu.be/nsjoQwySwwY?t=1m6s). The remaining third is in-class lecture and demonstrations of the technology (see video: https://youtu.be/nsjoQwySwwY?t=24s). These demonstrations normally occupied 50 min of a face-to-face class, where students were randomly chosen to enter the virtual world, while the instructor projected the activity on a screen for all students to view. Students were asked to bring to class their PCs, if portable, and then to raise technical questions as needed. Lastly, all students were required to pass a test of their ability to use the virtual world, by attending a scheduled session in a learning lab, showing they were able to enter the virtual world and communicate in it. Again, students were required to bring their own computers and headsets, in order to confirm capabilities.

Supplementary video related to this article can be found at http://dx.doi.org/10.1016/j.chb.2016.07.033.

Instruction focuses on learning and practicing negotiation skills for business, and incorporates a game-like role playing structure, as teams represent firms with goals related to product purchase/sale, price, delivery time, and quality (see Fig. 2 and video https://youtu.be/nsjoQwySwwY?t=1m30s). The class is open to all departments, but mostly of interest to business majors. This class has been executed online through a virtual world for the past five years, with virtual world design and accompanying instructional materials developed over that time. Development of this study's virtual world and student acceptance has been covered in previous publications (Chen et al., 2011) as well as showing student enthusiasm for such an approach and the importance of feelings of presence in immersing in the virtual world. This elective class has received positive student reviews and enrolment has increased each year of its offering.

The researchers employ Open Wonderland for its numerous advantages over the often used commercial offerings, i.e. Second Life. Open Wonderland, an open source project, enables researchers to build fully immersive environments that fit exactly what they need, and then retain that effort for long-term continued use. The requirement, however, is to run a server dedicated to the effort. Open Wonderland is similar in its software architecture to the hugely popular virtual world game Minecraft, in that it is Java-based and cross-platform compatible. No download or install is required, only Java, an Oracle freely available plugin.

Feelings of presence in Second Life are often reported on, but the opportunity to manipulate the virtual space is somewhat limited as users entering Second Life can move to locations within Second Life that are not part of an experiment. The current study implemented an isolated virtual world, not connected to any other parts, allowing complete manipulation of the setting in order to align closely with instructional goals.

Respondents include 348 undergraduate students, ages between 20 and 24, taking this elective class. Students are introduced to the virtual component of the class during the first class meeting, with physical classroom-based lectures following, including instructions/examples of software use, headset/microphone setup, and troubleshooting.

3.1. Virtual world design

The current study implemented an isolated virtual world, built in Open Wonderland, thereby allowing complete design manipulation of the setting in order to test the impact on subjective feelings of presence. This has the advantage over a commercial virtual world, like Second Life, as the class material and the virtual world can be closely aligned. Second Life has received much research attention as a tool in virtual world educational settings in describing attempts at creating immersive virtual environments (Andreas, Tsiatsos, Terzidou, & Pomportsis, 2010; Cheong, 2010; Herold, 2010; Jamaludin et al., 2009) but requires use of existing virtual environments and ties students into a commercial platform outside the researchers' control. During the technical training sessions students demonstrated their technical ability to communicate clearly with other students within the virtual world. They are also briefed on how to view class lectures that are delivered through video on demand asynchronously (see Fig. 1).

The virtual world custom created within Open Wonderland, includes two distinct areas. The first, facilitated synchronous delivery of lectures and teaching materials such as slides and supplemental information. The second area included a small campus, with multiple buildings, including transportation to the actual negotiation area (see Fig. 2). The negotiation area includes isolated office space for each group to plan privately. Discussions inside any of these rooms, cannot be heard from outside the room. Thus, the environmental design fits important aspects of negotiation theory, including the ability to keep secrets, within a team, while meeting with other teams for secret negotiations, also including communal spaces for open communications/negotiation. Within the virtual world, students can also privately message each other and use a simulated mobile phone calling feature. Additionally, learners may use communication channels outside the virtual world, such as Facebook chat, or Skype, for example.

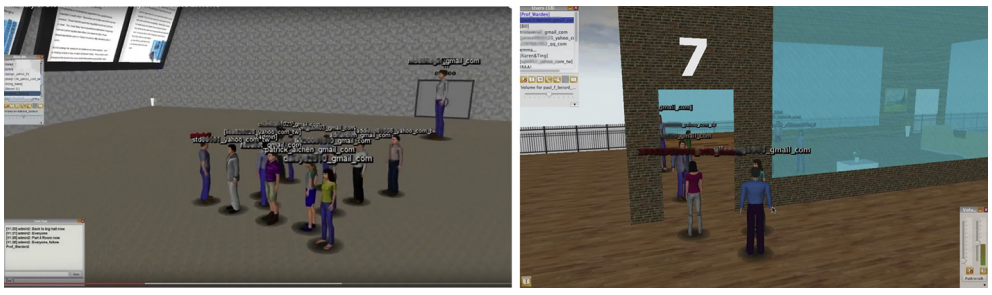

Fig. 2. Virtual world group review and students negotiating inside the virtual world.

3.2. Presence construct

Respondents' experience of feelings of presence are measured with the 7-item telepresence scale from Klein (2003), often used to measure feelings of presence in virtual settings (Kim & Biocca, 1997; Nelson, Yaros, & Keum, 2006; Persky et al., 2009). Respondents indicate agreement with statements along a 1 to 7 scale, with 7 = agree very strongly and 1 = disagree very strongly (Andreas et al., 2010; Cheong, 2010; Herold, 2010; Jamaludin et al., 2009).

The presence survey is administered after the fifth virtual world class session (the penultimate class for the semester), through an online questionnaire participants completed as class ended. Scores for feelings of presence are averaged for a single score. Data concerning gender, gaming experience, gamer and software ownership are included in the first survey administered earlier in the semester, before online class meetings start.

4. Findings

Respondents total 102 males and 246 females, with gaming experience differing significantly by gender across all measures. As a manipulation check, general software (non-gaming) is compared and does not statistically differ between the genders, showing non-gaming experience of computer and software usage is equivalent across genders. Male respondents, however, report higher gamming behaviour across all measures: software ownership (1.32 vs 0.22; $t = 5.15$; $p < 0.00$), currently play video games (0.37 vs 0.08; $t = 5.37$; $p < 0.00$), time playing (1.39 vs. 0.29; $t = 5.34$; $p < 0.00$), frequency of play (0.62 vs. 0.16); $t = 4.19$; $p < 0.00$), and ownership of video game systems (1.35 vs. 0.27; $t = 4.77$; $p < 0.00$). Measures of presence exhibit high reliability, with all seven survey questions obtaining a Cronbach's Alpha of at least 0.9 (see Table 1).

As male participants report more experience with gaming, we employ an ANOVA to test for differences in feelings of presence based on gender. Feelings of presence in the virtual world class do not differ significantly across gender. Males and females experience the same feelings of presence in class, with only feelings of being in the world and forgetting that the simulation is not the real world showing differences approaching the $p < 0.10$ level (see Table 2). Thus, hypothesis one is rejected.

Simply purchasing and owning more gaming software does not have an effect on feelings of presence, as shown in Table 3. The grouping question is: *How often do you purchase gaming software (including PC, console, tablet, phone, CDs, DVDs, cartridge)?* The response options included: daily, weekly, once to twice a month, once to twice in six months, once to twice in a year, once every few years to not much at all. The six point-scale is reduced to three levels: Frequent (daily to weekly); Infrequent (once to twice a month to once to twice in six months); Rarely (once to twice in a year to once every few years to not much at all). Respondents who report more frequently purchasing game software do not report higher levels of presence as compared to those who buy less. The experience of purchasing and installing software, or the lack of it, are not an advantage or disadvantage to experiencing levels of presence in a virtual world classroom. Thus, hypothesis two is rejected.

While simply owning a game has little measurable influence on experiencing feelings of presence, actual gaming experience does have some impact. Measurement of game play frequency is obtained through the question: *How often (approximately) do you currently play video games?* The response options include: daily, weekly, once a month, once in 6 months, once a year, less than once a year or never. The six point-scale (daily, weekly, monthly, every half-year, every year, less than once a year) is reduced to four points, with no students reporting every year or less than once a year. Participants who report higher frequencies of gaming also report higher levels of feelings of presence in three areas: 1) I felt I was in the world the computer created, 2) I forgot that I was in the middle of an experiment, and 3) the virtual world seemed to me somewhere I visited rather than something I saw. The remaining four measures of presence are not statistically significantly higher among those reporting higher frequency of game ownership (see

Table 2
Feelings of presence[a] by gender[b] ANOVA results.

	F	Gender	N	Mean	SD	SE
In world	2.17 p > 0.14	0	246	3.57	1.42	0.09
		1	102	3.71	1.53	0.15
Forgot in trial	0.81 p > 0.37	0	246	3.70	1.59	0.10
		1	102	3.71	1.45	0.14
Body room mind comp	0.01 p > 0.94	0	246	3.29	1.45	0.09
		1	102	3.51	1.36	0.13
Visited not saw	0.53 p > 0.47	0	246	3.22	1.49	0.10
		1	102	3.43	1.36	0.13
SIM not real world	2.58 p > 0.11	0	246	3.34	1.60	0.10
		1	102	3.40	1.38	0.14
Forgot surroundings	0.74 p 0.39	0	246	3.10	1.54	0.10
		1	102	3.09	1.39	0.14
Came back to real world	0.33 p > 0.57	0	246	3.30	1.55	0.10
		1	102	3.55	1.45	0.14

Note.
[a] 1 = disagree very strongly, 2 = disagree strongly, 3 = disagree, 4 = neither agree nor disagree, 5 = agree, 6 = agree strongly, 7 = agree very strongly.
[b] Gender 0 = female, 1 = male.

Table 1
Reliability of presence[a] survey responses.

	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Cronbach's alpha if item deleted
A1) During the class, I felt I was in the world the computer created.	20.80	51.67	0.73	0.91
A2) During the class. I forgot that I was in the middle of a trial.	20.70	52.46	0.63	0.92
A3) During the class, my body was in the room, but my mind was inside the world created by the computer.	21.07	50.25	0.82	0.90
A4) The SIM world seemed to me “somewhere I visited” rather than “something I saw.”	21.14	51.64	0.71	0.91
A5) I felt I was more in the “SIM world” than the “real world” around me when I was doing the exercise in class.	21.06	48.84	0.82	0.90
A6) I forgot about my immediate surroundings when I was navigating through the SIM location.	21.34	49.66	0.79	0.90
A7) When the class exercise ended, I felt like I came back to the “real world” after a journey.	21.06	50.07	0.75	0.91

Note.
[a] 1 = disagree very strongly, 2 = disagree strongly, 3 = disagree, 4 = neither agree nor disagree, 5 = agree, 6 = agree strongly, 7 = agree very strongly.

Table 3
Feelings of presence[a] by game ownership[b] ANOVA results.

		Sum of squares	df	Mean square	F	Sig.
In world	Between groups	6.11	3	2.04	0.97	0.41
	Within groups	724.96	344	2.11		
	Total	731.07	347			
Forgot in trial	Between groups	15.76	3	5.25	2.22	0.09
	Within groups	814.76	344	2.37		
	Total	830.51	347			
Body room mind comp	Between groups	7.04	3	2.35	1.16	0.33
	Within groups	698.77	344	2.03		
	Total	705.82	347			
Visited not saw	Between groups	12.75	3	4.25	2.02	0.11
	Within groups	724.09	344	2.10		
	Total	736.84	347			
SIM not real world	Between groups	11.80	3	3.93	1.67	0.17
	Within groups	808.30	344	2.35		
	Total	820.10	347			
Forgot surroundings	Between groups	5.97	3	1.99	0.89	0.44
	Within groups	766.71	344	2.23		
	Total	772.68	347			
Came back to real world	Between groups	16.22	3	5.41	2.35	0.07
	Within groups	792.96	344	2.31		
	Total	809.18	347			

Note.
[a] 1 = disagree very strongly, 2 = disagree strongly, 3 = disagree, 4 = neither agree nor disagree, 5 = agree, 6 = agree strongly, 7 = agree very strongly.
[b] Includes all types of gaming software, PC, console, phone and, online. Ownership groupings: frequent (daily to weekly), infrequent (once to twice a month to once to twice in six months), rarely (once to twice in a year to once every few years to not much at all).

Table 4). Thus, hypothesis three is partially supported.

To explore the specifics of these issues, informal follow-up interviews, with respondents who indicated lower levels of gaming frequency, are now reported. The gap between experienced and non-experienced players is attributed to computer hardware issues, as most students with less gaming experience report encountering hardware difficulties. Hardware and software problems are not uncommon, across all gaming software. Very often, features, like 3D acceleration, that work fine on one hardware setup do not work on a slightly different platform. Experienced gamers have mastered troubleshooting such problems. Most importantly, we find across students with less gaming experience, a lack of confidence in overcoming surprises related to technology. Students reveal numerous issues, as simple as software update requests and audio headphone plugs, cause anxiety among inexperienced participants, often leading to frustration. In contrast, participants with experience take such bumps in stride.

5. Discussion

The primary aim of this study is to examine if differences in gender, software ownership, and gaming experience place learners at a disadvantage in virtual world learning classrooms. Our findings show that gender and previous software experience do not significantly disadvantage learners from experiencing the full benefit of a virtual world classroom. Even in the case of previous gaming

Table 4
Feelings of presence[a] by gaming frequency[b] ANOVA results.

		Sum of Squares	df	Mean square	F	Sig.
In world	Between groups	25.42	4	6.35	3.09	0.02
	Within groups	705.65	343	2.06		
	Total	731.07	347			
Forgot in trial	Between groups	29.78	4	7.44	3.19	0.01
	Within groups	800.74	343	2.33		
	Total	830.51	347			
Body room mind comp	Between groups	13.33	4	3.33	1.65	0.16
	Within groups	692.49	343	2.02		
	Total	705.82	347			
Visited not saw	Between groups	21.22	4	5.31	2.54	0.04
	Within groups	715.61	343	2.09		
	Total	736.84	347			
SIM not real world	Between groups	9.09	4	2.27	0.96	0.43
	Within groups	811.01	343	2.36		
	Total	820.10	347			
Forgot surroundings	Between groups	10.40	4	2.60	1.17	0.32
	Within groups	762.28	343	2.22		
	Total	772.68	347			
Came back to real world	Between groups	14.28	4	3.57	1.54	0.19
	Within groups	794.90	343	2.32		
	Total	809.18	347			

Note.
[a] 1 = disagree very strongly, 2 = disagree strongly, 3 = disagree, 4 = neither agree nor disagree, 5 = agree, 6 = agree strongly, 7 = agree very strongly.
[b] Gaming frequency groupings: daily, weekly, monthly, every half-year.

experience, non-gamers are only put at a limited disadvantage. While these less experienced learners report feelings of being inside the computer generated world, they fail to forget their surroundings, not feeling completely submerged within the virtual space. While distractions, caused by hardware, software, and a lack of experience in dealing with such issues, are enough to reduce feelings of presence, they do not totally eliminate the experience.

Purchasing and installing software requires some familiarity with personal computer systems that is above and beyond the typical experience of smart phone users with Apple iOS or Android APP installs. While we find learners with less software experience do not report lower levels of presence, gaming experience does have some effect on virtual classroom experiences.

Virtual gaming worlds, like World-of-Warcraft, Minecraft, and Second Life, are popular among teens. This popularity, however, disguises complexity. A quick Internet search shows tens of thousands of posts guiding gamers through the challenge of installing and configuring audio and video across a plethora of potential PC hardware configurations. In the face of this complexity, experience should give an advantage in getting up to speed in a virtual world classroom. Students with less gaming software experience (beyond casual gaming) do exhibit lower feelings of presence in three of seven dimensions. Thus, a virtual world learning space benefits, in a small way, from previous experience with gaming. These benefits come from a number of sources.

Benefits can accrue from familiarity with basic actions, i.e., how to move an avatar by mouse/keyboard manipulation, understanding spatial relationships in a virtual world, and suspension of disbelief. Previous gaming experience helps students imagine they are inside a virtual world, whereas those with less, or no, experience may require more time to understand a virtual classroom's conventions.

The first two decades of computer gaming were dominated by games marketed to boys and young men. Our results show that female students are not at a disadvantage in their experience of a virtual world classroom simulation. Times have changed from the end of the last century when computer gaming, and computer technology in general, was much more the realm of motivated (largely male) experts and hobbyists. The wide diffusion of the technology and the growth of the female gaming market bridges the gap observed in earlier research.

5.1. Limitations and future directions

The virtual world designed for this study includes settings that reinforce aspects of the class curriculum. However, most of these are of an architectural nature, with no objects within the space actually open to user manipulation, beyond learners own avatars. Although the programming capabilities of Open Wonderland do allow for many levels of user generated construction and modification of objects within the virtual world, our early testing shows that some students, by accident or on purpose, delete objects, move objects to spaces not related to tasks, or distort objects. This required a constant monitoring of the virtual world, as well as complex and time-consuming backup and restore efforts. We focus on using the virtual world for social interaction, rather than physical interaction. Thus, one serious limitation of the current study is that it only addresses verbal interactions—mainly spoken, and accompanying body language expressed through avatars. Numerous locations, such as office spaces, private meeting rooms, and lecture/learning spaces, give students many options for meeting and choosing how to follow up on learning material, but the main focus of effort is the actual business negotiation—a mainly discussion-based activity.

This type of class also relates to our focus on presence in that success reflects student feeling they are 'inside' the environment and behaving as if they are in an offline world negotiation. Teachers and researchers who apply a virtual world setting will have to consider not only the technical issues faced by students, but also their own time limitations in managing a virtual space. Creating a virtual world that closely matches the needs of a specific class is a far from trivial undertaking. As a designer increases complexity and options for students the amount of effort increases, as does the potential for problems among learners. The current study focused on a large class size, maximizing accessibility. Smaller class sizes may have much more potential for co-constructed and more complex virtual settings.

Current findings support the application of virtual worlds in contexts where social interaction is important, which can add a level of coherence to distance learning classes that in turn improve self-efficacy. Teachers looking toward platforms such as Minecraft may be able to benefit from students who have extended experience with the platform, making them able to construct virtual world spaces on their own, or even as part of a class. The use of synchronous virtual world activities to help improve self-efficacy of students learning in distance settings or joining in MOOCs is an important future direction of research.

6. Conclusion

The 1980s vision of cyberpunk and virtual reality, briefly overhyped in the 1990s, has now moved into the mainstream of computer interface design. Occulus Rift's virtual headset, purchased by Facebook for two billion USD$ in 2014, HTC's Vive, Microsoft's HoloLens, and Google's GoogleGlass are all evidence of an emerging mainstream trend towards innovative interfaces that emphasize augmentation and immersion. Rather than entering higher education and waiting to be exposed to such technologies, students will be wondering why their university's distance learning programs do not include such platforms. Aside from hardware and budget questions, educators must be concerned with the risk of putting some students at a disadvantage when adopting such teaching methods. The current research findings alleviate such concerns. Learners with little to no previous gaming experience are still able to experience virtual world classrooms with feelings of presence only slightly lower than those with gaming experience. A specific training time or short exercise to help such students learn the common interface conventions helps alleviate any gap.

Acknowledgments

This study was supported by the Ministry of Science and Technology in Taiwan, MOST 104-2511-S-005-004.

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