Lessons from Game Studies to Enhance Gamification in Education

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ABSTRACT

This paper presents the results of the study of a cohort of college graduate and undergraduate students who participated in playing a Massively Multiplayer Online Role Playing Game (MMORPG) as a gameplay rich with social interaction as well as intellectual and aesthetic features. Statistically significant differences among our participants' perception, sensation seeking, and satisfaction in relation to gameplay features are investigated. Results support the majority of pre-planned hypotheses and show potential important considerations to take into account when developing gamified content for educational applications. Furthermore, the limitation of the data used in this study is presented and future directions to remove the current limitation and proliferate results through qualitative research into players' in-game social interactions.

Keywords: Gamification, Educational Technology, Serious Games, Sensation Seeking, Statistical Significance

1. INTRODUCTION

The present study is situated at the intersection of two conversations. On the one hand, scholars in game studies are researching the burgeoning world of video games, a genre that has penetrated two-thirds of United States households and now constitutes a $10.5 billion industry [1]. On the other, many educators are exploring pedagogical uses of "serious games" [2] and even prospects for Gaming Across the Curriculum [3], guided by Gee's [4] dictum that "games are potentially particularly good places where people can learn to situate meanings through embodied experiences in a complex semiotic domain and meditate on the process." We believe *motivation* may be a fruitful concept for connecting these conversations and discovering beneficial lessons.

Game studies scholars have given much attention to the question of why people play video games and, in fact, have developed typologies [5] and scales [6] to gauge players' motivations. Drawing from these two conversations may help answer questions that are fundamental to each. For educators, the question is: What would motivate students to play serious games? For game designers, the question is: What motivates players to learn the game?

This paper presents initial findings of a large-scale study of several factors that might have a significant impact on why different groups of people participate in playing video games. Our goal is to find common factors that contribute to human enjoyment, satisfaction, and continued interest in playing video/computer games. Such factors could, we believe, potentially be utilized in developing effective educational games.

Looking further ahead, we argue the concept of motivation may offer a bridge to exploring not only individual in-game learning but, ultimately, in-game *social* learning. Vygotsky [7] famously held that "human learning presupposes a specific social nature" so that students are "capable of doing much more in collective activity." Motivation and ego-involvement are recognized by many disciplines, from psychology to communication studies, as keys to social interaction—vital factors in explaining, for example, how people manage their identities and relationships [8], process messages and change attitudes [9], and make social judgments [10]. Such an investigation will ultimately require, as Ward [11] advocated, a new view that game worlds are "not simply as artifacts of the 'real' world but [are] emerging societies in their own rights."

2. LITERATURE REVIEW

Research on the pedagogical uses of computerized games is largely clustered within two literatures. One is the literature of education and technology. The other is found in rhetoric and composition studies, a discipline that has long been open to "reading" visual domains as "texts" and seeing in these domains spaces for composing rhetorical claims.

Juul [12] addressed the fundamental question—what is a game?—by holding that a game must have rules and variable outcomes which are quantifiable as positive or negative; and that players must expend effort and then experience real-life attachment to and consequences from the outcome. Liebman [13] further suggested that games can be used four ways in education: as vehicles to convey course content; as "texts" that students "read" and analyze through gameplay; as media in which students create their own games; and as an overall approach to pedagogy that incorporates "game-like motivational systems" into course and assignment design.

While the literature in composition studies focuses on the latter three methods—games as "texts" [14], as media for student compositions [15], and as an approach to course design [3]—the education and technology literature centers on use of games to convey course material.

For example, researchers in [16] conducted a mixed-methods study with education major university students. Participants were able to detect embedded learning skills within the games and found the element of motivation important. However, while motivation was not found as a sufficient reason to use games in classroom, teachers found positive responses and peer modeling to be good factors in using game-based technology to deliver course contents.

A 'Deal or No Deal' game was used in [17] in an

introductory statistics course with the goal of entertaining students' understanding of the expected learning outcomes from the course. This alternative activity proves to enable instructors to introduce multiple concepts while efficiently assessing students learning and retention of the materials. Furthermore, repeated play of the game with which the students are familiar benefits students without making the activity tedious as perceived by students performing such tasks with traditional paper and pencil methods.

As part of a larger project financed by the Social Sciences and Humanities Research Council of Canada (SSHRC) from 2008-11, researchers in [18] "examined the impact of an online educational game on cognitive learning". Starting from the popular board game Parcheesi, an online game was created for a senior secondary school health education program. In comparing the subscale and total scores between males and females, no significant differences were found. This confirms that males and females can learn equally well in this setting.

Teoh in [19] examined the potential of simulation using Second Life (SL) in teacher education. It is worth noticing that simulations could be particularly relevant for special education teachers with students who have autism, Down's syndrome, or ADHD —to help pre-service teachers identify and be more empathic toward inclusive teaching in their future classrooms [20]. Simulations such as SL provide a rich platform for learning and exploration that could be used as an extra credit option, a supplementary tool, or an enhancement to teaching because it is hands-on, visual, experiential, individualized, adaptable, and customable; all principles of effective learning that parallel the simulated environment. In addition, SL has also led the way to other simulations development, such as Open Simulator [21], Open Cobalt [22], Kaneva [23], and Open Wonderland [24].

Means to enhance learning outcomes from playing serious games through the use of scripted collaboration in the game play are examined in [25]. As suggested in [25], "Gameplay for complex learning inherently is complex, and development requires expertise from both domain experts, pedagogical designers, text writers and software developers, [26] and [27]".

The work conducted in [28] presents a simple interactive toolkit to deliver assignment contents to a class of biology students. This work showed that while an easy to use game could benefit students to interact with their coursework in a convenient, and efficient way, a successfully gamified content should take into account ways of communicating with the audience in such a manner that the course content is not overwhelmed by the pervasiveness of the game features. Based on our investigation of the literature we are taking the next step of analyzing what factors play important roles in drawing different groups of population to engage with the contents.

We initiated a large-scale study of several factors which might have a significant impact on why different groups of people participate in playing video games. Our goal is to find common factors contributing to human enjoyment, satisfaction, and continued interest in playing. Such factors could potentially be utilized in developing group-specific or group-agnostic games to deliver educational materials and to improve participation and enjoyment while delivering needed services. Our initial findings of the study are presented here.

3. GAME CHOICE

The market based categorization of game genres in the current state of video games defines products into loosely organized categories which stem from similarities, in form, to prior well known releases [29]. In [29], the following genres are investigated, and we based our examination of a proper gameplay for our study based on this classification:

- **Simulation:** games are effectively "soft real-time simulations" [30] in that, a subset of real world is approximated and mathematically modelled while interaction is achieved by acquiring user input and producing human recognizable output. However, this genre specifically refers to the category of games that target sports and other real-life simulations such as dynamics of cities and communities.
- **Strategy:** divided into two categories of Real Time (RTS) and Turn Based (TBS), this genre targets player's ability to approach a complicated scenario by strategizing solutions to achieve a desirable endgame by combining aggressive, semi-aggressive, and diplomatic means. Perhaps this genre is the least of all game genres concerned with cinematic and visual effects, but one of the most difficult for producing Artificial Intelligence (AI) agents.
- **Action:** as the name suggests, this genre is the most performative [29], and require the player's physical and mental ability to coordinate effectively his/her sensory input with the mapping of actions available through the game's User Interface (UI). This genre is further categorized into Frist Person Shooters (FPS) and Third Person Shooters (TPS).
- **Role-playing:** closely tied to the literary genre of fantasy [29], this genre gives the player control over their alternate self in the game by presenting a myriad of potential character transformations. Placed within the subtext of a specific culture, or the development of a certain community spirit, combined with the potential complexity of the contextualization of such transformative characteristics and roles could make this genre of gameplay a target rich environment for a large number of human-oriented applications, in education, cultural accommodation, community organizations, etc. With the development of accessible and affordable internet connectivity, the RPG genre has taken a drastic turn in terms of accessibility and availability. Apperley postulates in [29] that, "Massively Multiplayer Online Role Playing Games (MMORPGs) blur the boundaries between games and community completely", thus "MMORPGs should be conceptualized as a convergent technology."

Based on the above categorizations of the video/computer games, and with the goal of finding suitable mediums for gamifying educational content, we selected a Massively Multiplayer Role Playing Online Game (MMORPG) called the Lord of The Rings Online [31] as the target game for this study. LOTRO is produced by Turbine Inc. and Warner Bros. Entertainment Inc.

Gameplay
In LOTRO players take the role of a character from four races; Man, Elf, Hobbit, or Dwarf. Each player can take a specialty from the nine designated classes, Burglar, Captain, Champion, Guardian, Hunter, Lore Master, Minstrel, Rune Keeper, and Warden. Some of the classes are available to all races (Minstrel, Guardian, and Hunter), while others are limited to a subset of the races, e.g. Rune Keepers are playable by Dwarves and Elves while Captain is only playable by the race of Men.

Players will be deployed to the middle-earth on one of the available game servers with two located in Russia; Fornost and Mirkwood, and all others located in North America [32]. Once in game, players will have the option of completing "Epic quests" designed as a part of the main story, or non-story, "Regional", "Raid", "Class", and "Fellowship" quests.

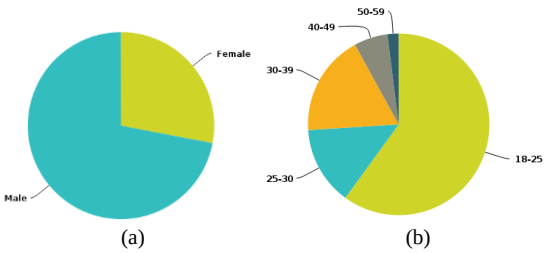
Game Selection Rationale
As a part of this study, we investigate such components of digital gameplay as character development, physical and fantastic settings, gameplay, visual and aesthetic components of the gameplay, as well as the social aspects. Our study is focused on finding features that are perceived commonly within or differently between different groups of participants, with the goal of developing guidelines to effectively design interactive gamified educational material.

As such, LOTRO will be a suitable medium to engage students in a social setting with the goal of performing specific tasks which require critical thinking, problem solving, social interaction, and other competencies that an educational setting targets. Furthermore, players who engage in MMORPGs such as LOTRO will help us understand what aspects of this genre draws them to play the game and what components of sensation seeking are most important for this target population.

4. RESEARCH METHOD

About 50 participants were recruited among students at the University of Houston-Victoria and were tasked to play the Lord of the Rings Online ™, over short, medium, and long durations of time.

Participants
The participants in the study were 36 male and 14 female undergraduate (72%) and graduate (28%) students ranging in age from 18 to 59. Sixty percent of the participants were 18-25, 14% were 25-30, 18% were 30-39, 6% were 40-49, and 2% were 50-59. The sample was diverse with 10% African American, 4% Asian, 28% Hispanic, and 58% Caucasian. Fig. 1 shows a visual breakdown of the participants' gender (a), and age (b), classification.



(a) (b)

Fig. 1. Classification of participants by (a) gender, and (b) age.

Materials and Procedure
Students participated in the study as part of computer science research project. Participants completed a 54-item game characteristics survey based on game characteristics identified by Wood et al. in [33] and by Yee et al. in [34]. Participants also completed the 18-item Gaming Motivation Scale (GAMS) [35]. The GAMS is comprised of six subscales of 3-items each – Intrinsic motivation: desire to perform an activity for itself, Integrated regulation: engaging in an activity out of choice that is now a coherent part of the organization of self, Identified regulation: behavior emitted out of choice based on its perceived meaning or its relation to personal goals, Introjected regulation: regulation of behavior through internal pressures like anxiety and guilt which implies partial internalization, External regulation: corresponds to extrinsic motivation, and Amotivation: similar to learned helplessness [35]. Research indicates that the GAMS has adequate levels of validity and reliability [35]. The game characteristics survey contained a 6-point Likert scale from "not important at all" to "very important" for each question and the GAMS contained 7-point Likert scale from "very strongly agree" to "I do not agree at all" for each question.

Research Design
The research design implemented in this study was quasi-experimental. The quasi-independent variables were gender, age partition: 18-25 vs. Over 25, and degree: undergraduate vs. graduate. The dependent variables were apriori (prior) pre-panned comparison of survey characteristic items and GAMS items as well as GAMS subscales excluding the Amotivation Scale which was missing an item when participants completed the GAMS. A priori planned comparisons were made using one-way independent-measures analyses of variance (ANOVAs).

Research Hypotheses
Prior to the study, there were 8 apriori pre-planned comparisons anticipating statistically significant differences, and 4 apriori pre-planned comparisons anticipating no statistically significant differences.

H1: There will be a statistically significant difference by gender on the question "How important to you is physical feedback in a game?" because males and females may respond to physical feedback differently with males more favorable to physical feedback or activities.

H2: There will be a statistically significant difference by gender on the question "How important to you is shooting enemies (targets, etc.) in a game?" because males seem to gravitate more toward aggression or violence than females.

H3: There will be a statistically significant difference by gender on the question "How important to you is character development over time in features such as dexterity, strength, and intelligence?" because character development may be more important to one gender or the other.

H4: There will be a statistically significant difference by gender on the question "How important to you are fantasy settings in a game?" because one gender may spend more time imagining than the other.

H5: There will be a statistically significant difference by gender on the question "How important to you is

different endings (ending options) in a game?" because novelty may be more important to one gender than the other.

H6: There will be a statistically significant difference by age group (18-25 vs. Over 25) on the question "I play computer (video) games because it is an extension of me." since younger participants have grown up with pervasive computer video games.

H7: There will be a statistically significant difference by degree (undergraduate vs. graduate) on the question "I play computer (video) games because it is an integral part of my life." since undergraduates are likely to have more free time than graduate students.

H8: There will be a statistically significant difference by degree (undergraduate vs. graduate) on the question I play computer video games because it is an extension of me." since undergraduates are younger and grew up with computer games.

H9: There will be a statistically significant difference by degree (undergraduate vs. graduate) on the question "How important to you are sophisticated Artificial intelligence (AI) in a game?" because undergraduates rely more on the ability of the game non-player characters to assist and compete.

H10: There will be a statistically significant difference by gender on the question "How important to you is building alliances in a game?" because females appear to be more social and relationship-oriented than males.

H11: There will not be a statistically significant difference by gender, degree, or age group on the question "How important to you are collecting things (e.g. objects, keys, chalices, components) in a game?" because collecting is a universal attribute for gaming participants.

H12: There will not be a statistically significant difference by gender, degree, or age group on the question "How important to you is multiplayer communication in a game?"

H13: There will be a statistically significant difference by gender, age or degree on the GAMS subscales because there were differences by gender, age, and degree on some individual GAMS questions.

Results

We present the results of this study in two categories; i.e. descriptive statistics and the Analysis of H1-H13 Hypotheses.

1) Univariate Analyses for Hypotheses H1 through H12

Female participants scored significantly higher ($M = 4.62$, $SD = .65$) than male participants ($M = 3.44$, $SD = .96$), $F(1, 45) = 16.46$, $p < .001$, $\eta p^2 = .27$ on the question "How important to you is physical feedback in a game?"

Female participants scored significantly higher ($M = 4.62$, $SD = .77$) than males ($M = 3.65$, $SD = 1.12$), $F(1, 45) = 8.12$, $p < .007$, $\eta p^2 = .15$ on the question "How important to you is shooting enemies, (targets, etc.) in a game?"

Female participants scored significantly higher ($M = 4.92$, $SD = .49$) than male participants ($M = 4.24$, $SD = 1.05$), $F(1, 45) = 5.13$, $p < .03$, $\eta p^2 = .10$ on the question "How important to you is character development over time in features such as dexterity, strength, and intelligence?"

Female participants scored significantly higher ($M = 4.54$, $SD = .78$) than males ($M = 3.79$, $SD = 1.00$), $F(1, 45) = 5.75$, $p < .02$, $\eta p^2 = .02$ on the question "How important to you are fantasy settings in a game?"

Female participants scored significantly higher ($M = 4.46$, $SD = .78$) than male participants ($M = 3.29$, $SD = 1.19$), $F(1, 45) = 10.62$, $p < .002$, $\eta p^2 = .19$ on the question "How important to you is different endings (ending options) in a game?"

The 18-25 age group ($M = 5.18$, $SD = 1.27$) scored significantly higher than the Over 25 age group ($M = 4.20$, $SD = 1.79$), $F(1, 45) = 4.86$, $p < .03$, $\eta p^2 = .01$ on the question "I play computer (video) games because it is an extension of me."

Undergraduates scored significantly higher ($M = 5.27$, $SD = 1.18$) than graduate students ($M = 5.27$, $SD = 3.57$), $F(1, 45) = 5.47$, $p < .024$, $\eta p^2 = .11$ on the question "I play computer (video) because it is an integral part of my life."

Undergraduates scored significantly higher ($M = 5.27$, $SD = 1.18$) than graduate students ($M = 3.57$, $SD = 1.79$), $F(1, 45) = 14.89$, $p < .001$, $\eta p^2 = .25$ on the question "I play computer (video) games because it is an extension of me."

There was no statistically significant difference by degree on the question "How important to you are sophisticated Artificial Intelligence (AI) in a game?", $F(1,45) = .22$, $p = .64$.

There was no statistically significant difference by gender on the question "How important to you is building alliances in a game?", $F(1, 45) = 1.94$, $p = .17$.

There was no statistically significant difference by gender [$F(1, 45) = 4.0$, $p = .052$)], degree [($F\ 1, 45) = .27$, $p = .60$], or age group [($F1, 45) = 1.87$, $p = .18$] on the question "How important to you are collecting things (e.g. objects, keys, chalices, components) in a game?"

There was no statistically significant difference by gender [$F(1, 45) = .14$, $p = .70$], or degree [$F(1, 45) = 2.90$, $p = .09$], but there was a statistically significant difference by age group with the 18- 25 age group scoring higher ($M = 4.48$, $SD = .75$) than the Over 25 age group ($M = 3.75$, $SD = 1.21$) on the question "How important to you is multiplayer communication in a game?"

2) Multivariate Analysis for Hypothesis H13

There was no statistically significant difference by gender or age, but there was a statistically significant difference by degree on the five subscales of the GAMS, $F(5, 36) = 2.71$, $p = .03$, $\eta p^2 = .27$. Undergraduate participants scored significantly higher ($M = 13.90$, $SD = 4.16$) than graduate participants ($M = 9.64$, $SD = 4.97$) on the Integrated regulation GAMS subscale, $F(1, 45) = 13.41$, $p < .001$, $\eta p^2 = .25$. Undergraduates also scored significantly higher ($M = 13.82$, $SD = 3.82$) than graduates ($M = 10.93$, $SD = 3.93$) on the Identified regulation GAMS subscale, $F(1, 45) = 7.45$, $p < .009$, $\eta p^2 = .16$. Lastly, undergraduates scored significantly higher ($M = 9.57$, $SD = 4.01$) than graduates ($M = 8.36$, $SD = 4.07$) on the Introjected regulation GAMS subscale, $F(1, 45) = 5.19$, $p < .028$, $\eta p^2 = .11$.

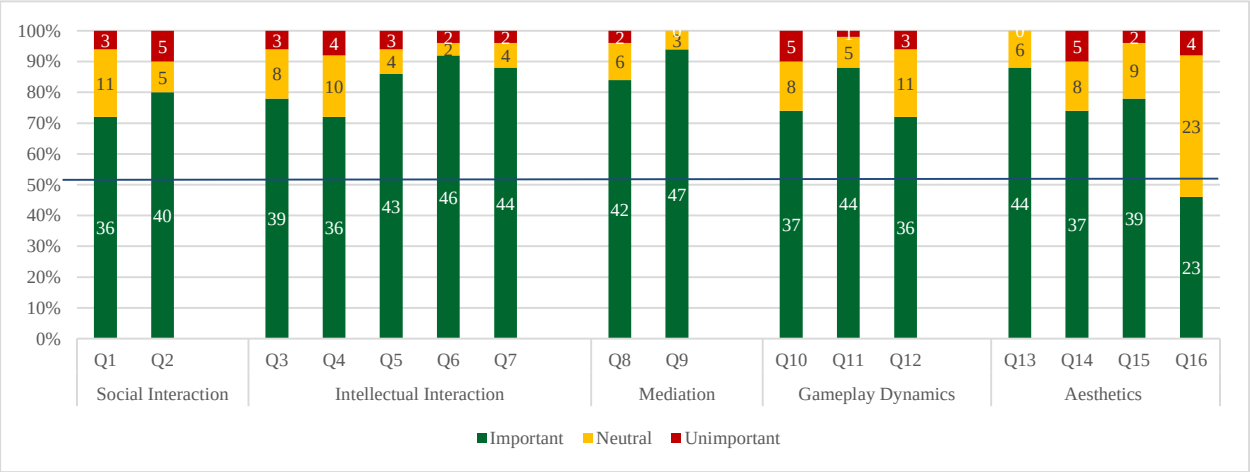


Fig. 2. Game Characteristics and Inventory questions. These questions are categorized into Social Interaction, Education Interaction, Functionality, Gameplay and Aesthetics.

Table 1. Game characteristics questions relevant to our study

No.	Question
Q1	How important to you is multiplayer communication in a game?
Q2	How important to you is multiplayer option in a game?
Q3	How important to you is solving puzzles in a game?
Q4	How important to you is fulfilling a quest in a game?
Q5	How important to you is skill development in a game?
Q6	How important to you are skill levels in a game?
Q7	How important to you is character development over time in features such as dexterity, strength, and intelligence in a game?
Q8	How important to you is it that a game is based on a story?
Q9	How important to you is rapid absorption in a game?
Q10	How important to you is collecting things in a game?
Q11	How important to you is sophisticated AI in game?
Q12	How important to you is rapid advancement of player in a game?
Q13	How important to you are sound and graphics settings in a game?
Q14	How important to you is the ability of the player to customize the actual physical properties of a character in a game?
Q15	How important to you are high quality realistic graphics in a game?
Q16	How important to you are cartoon-style graphics in a game?

3) Descriptive Statistics

Fig. 2 presents the descriptive statistics from a number of significant questions taken from game characteristics survey. The questions are categorized into Social Interaction (Q.1-2), Intellectual Interaction (Q. 3-7), Mediation (Q. 8-9), Gameplay Dynamics (Q. 10-12), and Aesthetics (Q. 13-16) and shown in Table 1.

We combined the "Extremely Important" and "Somewhat Important" answers as Important, the "Somewhat Unimportant" and "No Important at All" answers as Unimportant, and the "Neutral" and "I don't know" answers as Neutral for clarity (Fig. 2).

5. DISCUSSION

In this study we investigated apriori pre-planned comparisons on several features of gameplay and their perceived importance by several groups of participants. Results supported our anticipated outcomes for H3-H13 hypotheses. This will be quite beneficial for the developers of game content targeting the studied population groups in helping them craft the game content to cater to the target population's satisfaction and needs.

There were two hypotheses (H1 and H2) with results contrary to our expectations for pre-planned comparisons. We had anticipated that males would score significantly higher on the questions of "How important to you is physical feedback in a game?" and "How important to you is shooting enemies (targets, etc.) in a game?" than female participants. However, female participants scored significantly higher than male participants on both of these questions. We can attribute these results to either the limitation of our current data explained below, to the reversal of gender roles in role-playing virtual environments, or to an unknown factor which needs more investigation and study.

As shown in the descriptive statistics of our study on game inventory questions (Table 1 and Fig. 2) all five categories of Gameplay, Aesthetics, Mediation, Social Interaction, and Intellectual Interaction are perceived as important features of a game if it were to be viewed favorably by the target population. This will be quite important in developing game content for applications in education as maintaining the interest of the target population could be essential in the success of the delivery of educational content.

Limitation

A limitation of the study was an unequal number of male (72%) and female (28%) participants. As such, some of the findings in our preliminary data, such as those evaluated for H1 and H2 hypotheses may change as we increase the size of our sample size and the scope of the project.

6. CONCLUSIONS AND FUTURE WORK

This paper presented our preliminary data and results of a study which investigates gameplay factors that impact immersion and satisfaction perception of video/computer

games on a target student population. Our goal is to identify contributing features in drawing students to participate in the gameplay and to establish guidelines in effectively developing gamified educational content.

A significant future direction for our research is to study the contents of the participants' interaction within the game with other players as well as the Non Player Characters (NPCs). We will be specifically performing interaction process analysis as well as comparing socioemotional with task-oriented communications, quantitatively. Furthermore, we will plan to perform ethnography and discourse analysis to investigate the development of communities and cultures in game, qualitatively, to establish guidelines for development of successful gamified educational contents.

7. REFERENCES

[1] Entertainment Software Rating Board (2014). Video game industry statistics. Available at http://www.esrb.org/about/video-game-industry-statistics.jsp

[2] Ritterfeld, U., Cody, M., & Vorderer, P. (Eds.). (2009). *Serious games: Mechanisms and effects*. New York, NY: Routledge.

[3] Holmevik, J., & Haynes, C. (2010). Gaming across the curriculum. *Currents in Electronic Literacy, 11*

[4] Gee, J. P. (2004). *What video games have to teach us about learning and literacy*. New York, NY: Palgrave Macmillan, p. 26.

[5] Bartle, R. (1996). Hearts, Clubs, Diamonds, Spades: Players Who Suit MUDs, Available at *http://mud.co.uk/richard/hcds.htm*

[6] Yee, N. (2006). Motivations for Play in Online Games. *CyberPsychology and Behavior*, 9, 772-775.

[7] Vygotsky, L. S. (1978). *Mind in society* (M. Cole, Trans.). Cambridge, MA: Harvard University Press, p. 88.

[8] Petronio, S. (2002). Communication privacy management theory. In L. A. Baxter & D. O. Braithwaite (Eds.), *Explaining communications: Multiple perspectives* (pp. 309-322). Thousand Oaks, CA: Sage.

[9] Petty, R. E., & Cacioppo, J. T. (1986). *Communication and persuasion: Central and peripheral routes to attitude change*. New York, NY: Springer-Verlag.

[10] Sherif, C., Sherif, M., & Nebergall, R. (1965). *Attitude and attitude change: The social judgment-involvement approach*. Philadelphia, PA: W. B. Saunders.

[11] Ward, M. Sr. (2010). Avatars and Sojourners: Explaining the Acculturation of Newcomers to Multiplayer Online Game as Cross-cultural Adaptations, *Journal of Intercultural Communication*, 23.

[12] Juul, J. (2003) The game, the player, the world: Looking for a heart of gameness. *Level Up Conference Proceedings*. Utrecht, Netherlands: DiGRA & University of Utrecht. Available at http://www.digra.org/dl/db/05163.50560.pdf

[13] Liebman, M. (2010). Four ways to teach with video games. *Currents in Electronic Literacy, 11*.

[14] Hesford, W. S., & Brueggemann, B. (2007). *Rhetorical visions: Reading and writing in a visual Culture*. Upper Saddle River, NJ: Prentice Hall.

[15] Alexander, J. (2009). Gaming, student literacies, and the composition classroom: Some possibilities for transformation. *College Composition and Communication, 61,* 35-63.

[16] Sardone, N., Devlin-Scherer, R. (2010). Teacher Candidate Responses to Digital Games: 21st-Century Skills Development, *Journal of Research on Technology in Education*, 42(4).

[17] Chow, A., Woodford, K. and Maes, J. (2010). Deal or No Deal: using games to improve student learning, retention and decision-making, *International Journal of Mathematical Education in Science and Technology*.

[18] Kaufman, D., Sauve, L., and Renaud, L. (2011). Enhancing Learning Through an online secondary school educational game, *Journal of Educational Computing Research*, 44(4), pp. 409-428.

[19] Teoh, J. (2012). Pre-service teachers in second life: potentials of simulations, *Journal of Educational Computing Research*, 40(4), pp. 415-441.

[20] Silva, K., Correia, A. P., and Pardo Ballester, C. (2010). A faculty mentoring experience: Learning together in Second Life. In I. Gibson et al. (Eds.), *Proceedings of International Conference on Society for Information Technology & Teacher Education*, pp. 1312-1317

[21] OpenSimulator. (2014). Available at http://www.opensimulator.org/

[22] Open Cobalt (2014). Available at http://www.opencobalt.org

[23] Kaneva ™ (2014). Available at http://www.kaneva.com

[24] Open Wonderland (2014). Available at http://www.openequalfree.org

[25] Hummel, H., Houcke, J., Nadolski, R., Hiele, T., Kurvers, H. and Lohr, A. (2011). Scripted collaboration in serious gaming for complex learning: Effects of multiple perspectives when acquiring water management skills, *British Journal of Educational Technology*, 42, pp. 1029–1041.

[26] Westera, W., Nadolski, R. J., Hummel, H. G. K. & Wopereis, I. (2008). Serious games for higher education: a framework for reducing design complexity. *Journal of Computer Assisted Learning*, 24(50), pp. 420–432.

[27] Zyda, M. (2007). Creating a science of games. *Communications of the ACM*, 50(7), pp. 27–29.

[28] Brown, A., Tavakkoli, A., Loffredo, D. and Ehsan, H. (2014). "Interactive Level Design for iOS Assignment Delivery: A Case Study", *Journal of Systemics, Cybernetics and Informatics*, 12(1), pp. 27-38.

[29] Apperley, T. (2006). "Genre and game studies: Toward a critical approach to video game genres", *Simulation & Gaming*, 37(1), pp. 6-23.

[30] Gergory, J. (2009). *Game Engine Architecture*, Natick, MA: AK Peters, ISBN: 978-1-56881-413-1.

[31] Lord Of The Rings Online (2014). *Turbine Inc. and Warner Bros. Entertainment Inc.* Available at http://www.lotro.com

[32] LOTRO-Wiki (2014). Available at: http://lotro-wiki.com/index.php

[33] Wood, T. A., Griffiths, M. D., Chappell, D., and Davies, M. (2004). The structural characteristics of video games: A psycho-structural analysis. *CyberPsychology & Behavior*, 7(1), pp. 1-10.

[34] Yee, N., Duchenaut, L., & Nelson, L. (2012). Online Gaming Motivations Scale: *Development and validation*. Palo Alto Research Center, Palo Alto, CA, pp. 1-5.

[35] Lafreniere, M. K., Verner-Filion, J., and Vallerand, R. J. (2012). Development and validation of the Gaming Motivation Scale (GAMS). *Personality and Individual Differences*, 53, pp. 827-831.