Gaming Technologies for learning; virtual teams and leadership research in online environments

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Abstract: *Computer-based and Web-based learning have been dramatically decreasing the costs of personnel training. With their increased popularity, virtual worlds and games open up possibilities for simultaneous learning on multiple levels; players may learn from contextual information embedded in the narrative of the game and through the risks, benefits, costs, outcomes, and rewards of alternative strategies that result from fast-paced decision making. Such dynamics also contribute to building relationships and sharing/delegating authority with others, in other words acquiring leadership skills. With its emphasis on leadership skills in virtual teams, this paper introduces main findings of several studies on leadership in multiplayer online environments including commercial online games. These studies main focus was on leadership styles in online environments.*

Keywords: Online games, leadership, online learning, virtual teams, multiplayer online environments.

Introduction

The popularity of massively multiuser online (MMO) environments is increasing rapidly. Membership in *Second Life*™, a persistent multiuser online social world created by Linden Labs in 2003, better explain the uptrend with an increase from 1 million at the end of 2006 to over 10 million in early 2008. According to Vivendi Inc., the first truly global multiplayer online game *World of Warcraft*™ generated close to $1.2 billion in revenue for Blizzard Entertainment® through its more than 10 million subscribers in 2007. These numbers point to the fact that online-networked worlds and games are evolving as digital places to interact with others and they matter socially (Williams, 2006).

Starting from the early 1990s, MMO environments (MMOE) brought together thousands of users either inside a role-playing game (RPG) or a social environment. Designed as open-ended simulations in which the attraction is largely socializing, collaborating, and creating, most of the MMO social worlds are different from traditional multiplayer online games. With the introduction of tools enabling individual development and creation of content, these virtual worlds provide new and unusual ways of interaction to their users/members. These immersive and built-in creative elements represent critical distinction against the massively multiplayer online game (MMOG) genre since such games are played within a developer-controlled constructed space to achieve a win or level-up through goal-oriented gameplay.

Evidently, researchers and educators have taken notice of the expanding MMO environments as virtual worlds, providing social and educational aspects that support mechanisms for learning. Many studies (Stacey 1999, Bouras et al. 2001, Dickey 2005) have highlighted the effects of Internet-based Collaborative Virtual Environments as a useful learning tool in different contexts. According to a USA Today article around sixty educational institutions have initiated a program in *Second Life*, and as stated by Neal (1997), helping them to overcome the barriers of the physical world and advance their capability to provide a social arena for their distance learning/e-learning programs.

Research on 3D Learning Environments and Virtual Worlds

Serious academic attention to games in general, and especially MMO games and social environments was not immediate but grew gradually (Dourish, 1998). Studies into 3D learning environments and multiuser virtual words have identified numerous pedagogical, technical and organizational issues (Clark & Maher, 2003; Jonasson, 2005; Yang & Liu, 2007), and focused on users' perspectives and interactions with them (Prasolova-Førland, 2006). Several books and research articles address to genre specific design of MMO environments and provide an extensive overview of these environments as a medium of learning (Muligan & Patrovsky, 2003; Steinkuehler,2004; Delwiche, 2006).

For most of the previous work in this growing body of research the main research tools have been surveys, questionnaires and interviews. The research lacks "large-scale, longitudinal data about the players' behaviors" and "their interaction with each game environment" (Ducheneaut et al., 2006, p. 282). Only a limited number of studies

observed the social side of MMOEs (Ducheneaut & Moore, 2004; Williams et al., 2006) with emphasis on player interaction and group activity. Prasolova-Forland and Divitini (2003) applied MMOE technologies as a platform to test their potentiality of providing an infrastructure for improving social awareness through usage.

Few studies tackled leadership in MMOEs such as Yee's online "The Daedalus Project" (2003), Nebolsky et al.'s (2003) study of using virtual worlds for leadership training course design, and Williams et al.'s (2006) analysis of Guild Leaders in World of Warcraft™. All these studies were significant in the way they revealed the leadership behavior in MMOEs. What previous studies do not provide is an understanding into the role of user-generated content in a 3D virtual world and how it could support leadership behavior and learning.

Connolly and Stansfield (2006) examined Information Systems (IS) learning experiences of students with different learning styles in the context of e-Learning and found that students demand more variety with the online interactive materials. Authors also reviewed game-based eLearning technologies and identified a third generation of e-Learning, promoting reflective practice through tools like ePortfolios, blogs, wikis, online communities, and using interactive and engaging technologies such as online visualizations, games, and simulations. E-learning programs can benefit from social and engaging platforms of today's virtual worlds that are built to support multiple users and collaboration among them (Franceschi et al., 2008). Comparably engaging and collaborative in-world dynamics of MMOEs incorporate sophisticated gaming technologies and design elements.

This study explored and evaluated the effectiveness of learning practices in online gaming/virtual environments along with leadership styles and self-efficacy by utilizing a multiplayer online serious game called *infiniteams.* Posing the questions on the correlation between transactional and transformational leadership, team dynamics and leadership learning, the study observed the outcomes of a team building and leadership development exercise in a multiplayer online game environment through experimental research design.

Leadership Styles: Transactional vs. Transformational

In general, academic leadership research addresses leadership qualities and skills under a traditional transactional-transformational typology. Transactional leadership is primarily based on a simple exchange of reward for applied effort between the leader and the followers, but is not likely to generate enthusiasm and commitment to task objectives (Yukl 2005). Transformational leaders develop followers through delegation and empowerment, and they motivate followers to do more than they originally expected to do (London, 2002). According to Bass (1985), one of the earliest theorists to study transformational leadership, effective leaders use a combination of both leadership types. He argues that both types are not mutually exclusive processes. Based on Maslow's hierarchy of needs, Bass (1985) stated that transformational leaders could elevate those around them from a lower to a higher level of need thus increasing follower motivation and performance more than transactional leadership practices.

Transactional leadership seeks to motivate followers by appealing to their own self-interest. In general, transactional leadership encompasses three types of behavior:

1. Contingent Reward – To influence behavior, the leader clarifies the work need to be accomplished. The leader uses rewards or incentives to achieve results when expectations are met.

2. Passive Management by Exception - To influence behavior, the leader uses correction or punishment as a response to unacceptable performance or deviation from the accepted standards.

3. Active Management by Exception - To influence behavior, the leader actively monitors the work performed and uses corrective methods to ensure the work is completed to meet accepted standards.

The universally accepted four transformational leadership behaviors are: idealized influence, individualized consideration, inspirational motivation, and intellectual stimulation (Avolio & Bass, 2004). In recent years, new perspectives emerged to expand this duality arguing that followers should be included in leadership development efforts to prepare them to exercise *shared leadership* (Pearce & Conger, 2003) in certain team-based work context.

Game-based Learning

Games have been developed for education and training purposes for decades (Klabbers, 2001). The advances in multiplayer gaming increased the ability of games to contribute to training simply by allowing users to interact with other users around the globe in real-time. In 2002, the Woodrow Wilson International Center for Scholars in Washington D.C. launched the "Serious Games Initiative" drawing attention to a new genre called "serious games". Serious games refer to application of game technology and game design principles for non-entertainment purposes. With a purpose beyond entertainment, including games for corporate training, games for health, and games for policy and social change, serious games are intended to improve some specific aspects of learning. Players engage serious games with the expectation of improved learning because every serious game has a distinct "focus on specific and intentional learning outcomes to achieve serious, measurable, sustained changes in performance and behavior" (Derryberry, 2007, p. 4). IBM's *innov8* is a good example of serious game designed to teach the fundamentals of business process management and bridge the gap in understanding between business leaders and IT teams in an organization.

Much of the early research on video games has focused on their addictive nature, the impact of video game violence on adolescents, and the effects that hours of sedentary game playing has on physical fitness. Other studies on games and learning focused on direct transfer of skills. These examed how games and simulations can teach skills and impart knowledge (Barab & Duffy 2000, Prensky 2001, Bowman 1982). Advocates of video games for learning contend that games make it possible to "learn bydoing" (Schaffer et al. 2004, Aldrich 2005), they note that doing something as a part of a larger community while immersed in the social context of game's virtual environment is, what Lave and Wenger (1991) describe as "legitimate peripheral participation." MMOEs inherently provide favorable conditions for becoming part of a community, that shares common goals and ways of achieving those goals, thus allowing gradual acquisition of knowledge and skills.

Up until recently, the social dimensions of online gaming and social worlds had not been thoroughly explored. Recent studies explored the importance of social awareness for learning communities (Forland & Divitini, 2003), and the importance of interaction in cognition and learning as a social activity (Steinkuehler 2004) within virtual worlds.

The second perspective on the role of games in relation to theories of situated knowledge is how games

create new ways of knowing (Shaffer 2004, 2005). Other researchers (Sweetser & Wyeth 2005, Chen 2006) applied Csikszentmihalyi's (1990) *Flow Theory* to games. Flow theory emphasizes the importance of immersion and fun to motivate repeated plays and spending significant time with the interactive system. "Likewise, the more immersed in the storyline and the more players identify with their role in the game – something that those in the game development industry refer to as "character investment" – the more likely they are to find the game fun and motivating" (Mautone et al., 2006, p. 8).

Games have impact on players' motivation due to their uncertain outcome and the focus on a goal thus providing a sense of challenge for players, which is fed by the opportunities to explore and discover new information and solutions (Bonk & Dennen, 2005). Motivational power of gaming was mentioned by educators in general (Bowman 1982). Yee (2007) studied player motivations in massively multiplayer online roleplaying games (MMORPG) and found that players have a wide array of varied motivations to play and interact with others.

The recent constructivist perspective of instructional design theories assumes that a human being explores reality and constructs a conception of it such that a learning environment should allow students to explore, find regularities, make things and create and test solutions to problems (Savery & Duffy, 1995). In her investigation of a MUD created for kids, *MOOSE Crossing*, Bruckman (1997) demonstrated the benefits of letting users be creators of virtual worlds as the environments that support constructivist learning by allowing for the emergence of knowledge building communities. Bruckman found that the community supports for learning in virtual environment were much more important than the environment itself (Squire 2003). Children in MOOSE Crossing programs benefited both from increased interaction and collaboration with their local classmates.

Cognitive engagement is a necessary condition for learning (Sawyer 2006). Traditional classroom-based methods of learning make individual cognitive interaction more difficult. Unlike most formal training or education, in games there are multiple paths to success (Bonk & Dennen, 2005)**.** Game-based learning produces immediate feedback, active participation and high levels of interactivity, and thus increases the retention of the information supplied (Ricci et al., 1996)**.** Videogames and MMOGs additionally provide the opportunity for exposure to technology. Today's virtual worlds, either social or game-oriented, are becoming more adaptable and intense, making them more appealing as learning platforms.

Methodology

The setting for this study is a leadership development and team building exercise (similar exercises are typically carried-out inside a classroom or an assessment center) using a multiplayer online gaming environment. Based on the general principle that expedient research strategy and methods or techniques must be employed to examine the research questions, a triangulation method will be used in this study. As part of the triangulated approach qualitative and quantitative data will be collected. This involves a quantitative assessment of team success along with in-depth analyses of recorded in-game chat-logs to detect and compare leader functions. Completing the triangulation is the online surveys taken by the participants.

The study employed an experimental design, and the achievement of the research objectives depends on

obtaining information directly from the students about their prior software/gaming experience and leadership behavior. This information was obtained from the participants through online questionnaires. The research design as employs web technologies extensively for administration and implementation purposes.

Participants for this study were undergraduate college students and they formed groups of at least four to play the game called *infiniteams* (developed by TPLD from Scotland). *Infiniteams* is a team-based multiplayer online game with a dedicated Leader role. One of the students in every group was randomly assigned as a leader. Falling under the MMOGs genre, it makes use of avatars to represent the players. The game scenario is based on deserted island survival elements. The experiments were conducted during two consecutive semesters and typical length of a game session was two hours.

The goal of the evaluation is to measure the effectiveness of multiplayer online environments on leadership development and learning based on *peer-ratings* and *performance* criteria. To measure the leadership qualities of the participants an online Multifactor Leadership Questionnaire (MLQ) was developed. The MLQ, based on the Full Range Leadership Model developed by Bernard Bass and Bruce Avolio (1991, 1997) assesses transactional and transformational leadership behavior. Every participant also took a pretest before the start of the game session. This is a preliminary survey called "Prior software experience questionnaire". Its main focus is to measure prior videogame experience, familiarity with online social technologies, and participants' attitudes toward both technologies. This survey also included leadership related items based on motivation to lead (Chan and Drasgow, 2001) and leadership self-efficacy (Murphy, 1992).

Final Post Test -made out of optional open-ended questions, to address general issues and participants' evaluation of the whole experience is used at the end of each session. For each survey described above, separate versions, one for Leader and one for the followers, were applied. Some of the questions from our measures include:

- Did the group or team accomplish the goal?
- How did the leader perform according to the followers' ratings?
- Did the team as a whole learn from the online game experience?

Every team's game performance was observed by using a score sheet. A game observer was available for each session to keep track of the points earned by the team. Finally, the in-game chat log data for each game session was retrieved from the game servers of TPLD. Next section introduces the findings of the study, and because of space limitations all the results cannot be presented.

Findings

Total sample size for this study was 48 (male, N=26 and female, N=22). As a result of random assignment of leaders, male students led only four teams whereas female students were the leaders for seven teams. Only a few teams were all male or all-female teams. Based on the total sample size, fifty-four percent (54%) of the participants were male and the remaining forty-six percent (46%) were female. Based on age data collected from the participants the age range was from 18 to 22. Out of 46 valid responses, majority of the participants, 17 or (37%), are 20 years old followed by 14 students at the age of 19 representing just above 30% of the sample.

A total of 13 game experiment sessions were conducted. Two sessions were incomplete because of

technical problems with the game servers located overseas, reducing the total of completed sessions to 11. Four out of eleven teams had 5 members, the remaining seven were teams of four.

Table 1 shows the means and standard deviations for team mission scores in two game level plays. Maximum of 5 points can be scored in every session. In Table 1, mean value for the first level (crafting) score is higher than second level (creation) score. A statistically significant correlation exists between crafting score and creation score of the teams (.854).

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Team's crafting score	3.36	11	1.75	.53
	Team's creation score	2.86	11	1.64	.49

Table 1. Descriptive Statistics for Team Performance.

To determine participants' gaming experience a composite measure was formulated by using the data from Pretest survey. New composite measure was based on the responses to familiarity with games, hardware and software. Then a total score for each participant is calculated by adding up his/her "Gamer", "Hardware" and "Software" experience scores. This total score is called "Total Gaming" score that reflects individual gaming experience of each participant. Mean statistics for "Total Gaming" composite measure is presented in Table 2. The sample population had only one observation each for 22 years old female and 18 years old male participants. There was no male participant at the age of 22.

	Age									
	18		19		20		21		22	
	M	F	M	F	M	F	M	F	M	F
Total Gaming Score Mean	70	67.3	76.57	66	72.6	66.25	86.5	65	-	55
N	1	3	7	3	11	4	2	7	-	1
Missing	0	0	3	1	1	1	0	1	-	0

Table 2. Mean Statistics for Total Gaming Score.

Based on their responses from the Post-test survey, see Table 3, half of the participants thought that online gaming experiment was a useful exercise and forty nine percent reported to have learned something about leadership because of it.

	N	Mean	Standard Deviation	Rating < 4 (%)	Rating > 4 (%)
This software taught me something about leadership	47	4.15	1.44	28	49
Overall, this was a useful exercise	46	4.33	1.23	13	50
The *infiniteams* software is a good training tool	46	4.02	1.37	34	44

Table 3. Summary of Results for Questions 8,12, & 22.

To have a better understanding of what was learned it is necessary to refer to the comments made by the participants. Following comments for questions 8 and 12 are presented after minor editing:

Q8: This software taught me something about leadership.

- *Its hard to lead online, too much lag time to type.*
- *There is no subtle leadership in online forums -- at least not when there is a clock running like it was in this game. I'm used to seeing body motions and using tone of voice to understand some of what my leader is asking. It showed that virtual teams may need more decisive and/or explicit leaders than in-person teams.*
- *Even when people are panicking, you can try to stay calm and be encouraging.*
- *Being a leader is hard.*
- *I usually think I am a good leader, but because I couldn't use the technology I was unable to lead in a successful way, not due to leadership but no skills in the program.*

Q12: Overall, this was a useful exercise.

- *It made me realize how inept I am at video games. It was very fun, and I learned afterward that people knew who I was because of how I was talking to them, which I found very interesting.*
- *I feel that more prep on the "gamer" side was very necessary.*
- *It was fun and helped us build teamwork.*

A multiple regression analysis was conducted to evaluate how well self-rated leadership attributes predicted team performance. The predictors (independent variables) consisted of team's average leadership self-efficacy (LSE) score, and all four MLQ self-ratings of leaders from first and second level. The criterion (dependent) variable was team performance or total score of both levels.

Mean and standard deviation statistics for leader ratings are already presented in Table 6. Team's average LSE score mean was (50.3622) with standard deviation of (3.7465) and total team score had mean value of (6.2273) along with the standard deviation value of (3.2662). The following analysis of variance in Table 4 revealed that the

linear combination of self ratings on leadership behavior to team performance was significant, $F(5,3) = 37.436$, $p < .01$.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	83.999	5	16.800	37.436	.007(a)
	Residual	1.346	3	.449		
	Total	85.345	8			

a. Predictors: (Constant), Team's average LSE, LCreate_Tform, LCraft_Tact, LCraft_Tform, LCreate_Tact
b. Dependent Variable: Total team score

Table 4. ANOVA for Leadership attributes and Team Performance

Then the F test results are used to test the significance of the regression model as a whole. Pairwise deletion method is used for this regression analysis because of the small sample size. Correlation coefficient for the model indicated high relationship $R^2 = 0.984$ (Table 4). The adjusted R^2 identifies a more refined result for the regression equation by taking into account the sample size and the number of independent variables, and the adjusted R^2 for this model was (0.958).

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change statistics			
					Sig, F Change	R Square Change	F Change	df2
1	.992	.984	.958	.66990	.944	44.902	4	.005

Predictors: (Constant), Team's average LSE, LCreate_Tform, LCraft_Tact, LCraft_Tform, LCreate_Tact

Table 5. Regression Model Summary

Both low F and high R^2 values established statistically significant effect of independent variables on the dependent variables so our answer to the research question – self-rated of leadership behavior can predict team performance in a multiplayer online environment – is affirmative.

Discussion and Concluding Remarks

This study was designed to explore leadership development and learning in multiplayer online environments. Multiplayer gaming experiments exposed undergraduate students to a virtual mission requiring leadership as well as team building skills. The online gaming experiments were successful in the sense it enabled researcher to capture reactions and interactions of participants in online game environments.

The quantitative analysis of this study examined transactional and transformational leadership behavior in multiuser online environments through an industry standard, Multifactor Leadership Questionnaire (MLQ) test. Results of the empirical analysis demonstrated that transactional and transformational leadership behaviors are

correlated in a multiplayer gaming environment. These results confirmed earlier research that concluded the relationship between transactional leadership and transformational leadership are not mutually exclusive but closely related (Avolio & Bass, 2004; Podsakof & MacKenzie, 1996). With the sample size of 48, and 11 leaders, a (.90) correlation was found between leaders' self-rated transactional behavior and transformational leadership behavior in two game levels (crafting and creation).

The analysis yielded promising results for another research question of this study. Leaders' self-evaluation of transactional and transformational leadership behavior along with leadership self-efficacy score was predictive of team performance in both game levels. According to Yukl (2005) leaders who posses self-efficacy for leading may create a more transformational environment that instills a strong sense of confidence in the followers. Therefore, self-efficacy is an important transformational leadership behavior allowing followers to independently meet tasks and goals in different conditions. Empirical tests determined that leader self-rating of transformational leadership behavior in the creation environment was correlated (Pearson $r= 0.628$ with $p<.05$) with team performance.

More specifically, the correlation coefficient (R^2) of the tested regression model indicated that over ninety eight percent (98.4%) of the variance of team performance was contributed to its linear relationship with the transactional and transformational leadership attributes and leadership self-efficacy scores (Table 4). The confirmed linkages between leadership attributes and team performance in the multiuser online games are comparable to prior research that demonstrated consistent correlations between transactional leadership behaviors and leadership effectiveness (Bass, Avolio, Jung, & Benson, 2003; Judge & Piccolo, 2004). Equally positive findings supported direct transformational leadership-team performance linkages ((Balthazard et al., 2002; Kahai et al., 2000). Another study by Sosik, Kahai and Avolio (1998) also provided support for the linkages between transformational leadership and group creativity in a GDSS (Group Decision Support System) context. Moreover, in laboratory experiments, Hoyt et al. (2003) observed that leaders with high leadership self-efficacy strengthened group members' individual and team performance by means of increasing their collective efficacy.

Leading virtual teams is not an easy task. As proposed by Bell and Kozlowski (2002) "the ability of virtual team leaders to perform key leadership functions is limited by the distribution of team members across space and the consequent lack of face-to-face contact" (p. 27). Keep in mind that team leaders were chosen randomly and most did not have any former experience as a virtual team leader. Let's take a look at one of the Post-test comment suggests a display of leadership style consistent with the characteristics of transformational behavior:

- *Even when people are panicking, you can try to stay calm and be encouraging.*

Apparently, some of the leaders were also using the in-game chat to openly express their confusion and more often their disconnect from the flow of the game. Most common statement recorded by the game chat log was "I don't know what I am doing". Not so surprisingly, some followers shared the same state of mind with their leader. They showed signs of disorientation on the island during the gameplay, which is then followed by health problems for their avatars resulting in multiple "caging" incidents (temporary disqualification from the game). Post-test comments mirror the challenging experience:

- *We enjoyed working together but it was hard because no one kn[e]w what they were doing, especially the leader.*
- *We had a lot of difficulty, my people could hardly stay alive!*

Despite the difficulties some participants experienced in adapting to the game mechanics and mission objectives overall reaction to the game was quite favorable, such as:

- *It was interesting and fun, but sometimes I'd get frustrated and I wish that my person would move faster.*
- *It was fun and helped us build teamwork.*
- *I don't know about 'useful'... it was fun... I guess but I didn't learn much.... like I didn't even know what the goal was... or what we had to make... etc...*
- *It was fun to chat online, and try to complete the mission.*
- *It really makes you want to [do] well as team and you are having fun doing it.*

The main IS-related contribution of this study is that it combines the experience of online gaming and learning with the study of virtual leadership in MMOE. Attempts to provide empirical as well as social analysis of leadership in online environments and multiplayer games constitutes a recent topic for leadership research. Conclusions from a Harvard Business Review article by Reeves, Malone and O'Driscoll (2008) asserted that leadership in multiplayer online games happens fast, it encourages risk taking, it promotes temporary rather than permanent leadership roles, and there are numerous opportunities for leadership practice. Their most important conclusion, however, was that some properties of games make leadership easier, such as virtual game economies, hypertransparency of game metrics and media rich communication features in games. Such notions of "gamifying" the work environment to enhance the quality of leadership were intriguing for the authors. Consequently, they took sides with the expert gamers on their research suggesting that it is not the leaders but rather it is the game that needs to be changed for better leadership.

Likewise, this researcher embarked on this study believing leaders can do better when they are allowed to change, modify and add to the online environment they operate. Therefore every leader can take advantage of virtual environment technologies that make content generation possible. Creating own content helps leaders to develop new ways to lead in the virtual environment where they interact with the virtual team. This infusion of newly created content works as a gateway for a leader to better adapt and response to challenges of dynamic environments, altering leader's leadership behavior that are transformational in nature.

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