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MMOG GAME-BASED COLLABORATIVE LEARNING: AN EXPLORATORY STUDY AND ITS RESEARCH POTENTIAL

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Abstract

This study aims to theoretically explore whether Massively Multiplayer Online Game (MMOG) is an effective collaborative learning platform, empirically examine the occurrence of knowledge creation in MMOG game-play, and conceptually advocate the research potential of MMOG game-based collaborative learning. Although a growing number of researchers have started to use MMOG as a new generation of educational platform, the study for theoretical justification of the occurrence of collaborative learning behavior in MMOG is still under-researched. To bridge this gap, this study integrates MMOG and technology-based collaborative learning streams of research to theoretically explore whether MMOG is an effective learning platform based on Alavi's three attributes of effective technology-mediated collaborative learning environment. In order to examine the occurrence of knowledge creation in the MMOG game-based collaborative learning, we propose definitions of explicit and tacit knowledge in MMOG. Then we conduct an exploratory study using a semi-structural interview approach to collect and analyze qualitative data, in order to support our stipulation of the occurrence of four modes of knowledge conversion in MMOG game-play based on the Nonaka's dynamic theory of organization creation. According to our research findings, this paper advocates the research potential of MMOG game-based collaborative learning in future research.

Keywords: MMOG, Game-based Collaborative Learning

1   INTRODUCTION

This study aims to theoretically explore whether Massively Multiplayer Online Game (MMOG) is an effective collaborative learning environment, empirically examine the occurrence of knowledge creation in MMOG game-play, and conceptually advocate the research potential of MMOG game-based collaborative learning. By definition, *"MMOGs are highly graphical 2- or 3-D videogames played online, allowing individuals, through their self-created digital characters or 'avatars,' to interact not only with the gaming software (the designed environment of the game and the computer-controlled characters within it) but with other players' avatars as well. These virtual worlds are persistent social and material worlds, loosely structured by open-ended (fantasy) narratives, where players are largely free to do as they please – slay ogres, siege castles, barter goods in town, or shake the fruit out of trees"* (Steinkuehler 2004).

From the Information Systems (IS) perspective, MMOG is a hedonic information system which is a new type of computer-mediated communication application with recreational and playful context that is designed to support dynamic social structures (Pena and Hancock 2006). Its design focuses on prolonged use of information systems by including hedonic contents and fancy graphical effects, in contrast to the design of utilitarian information systems that focuses on productive use of information systems for improving the users' task performance (van der Heijiden 2004).

From the technology-mediated collaborative learning prospective, MMOG consists of several unique characteristics (e.g. avatar/virtual identity, co-presence, group identity and transparency) that may trigger collaborative learning behavior in the game context. Recently, a growing number of researchers (e.g. Gee 2004, Childress and Braswell 2006, Mikropoulos 2006) start to introduce the use of MMOG as a new generation of educational platform, allowing players to interact with each other, and learn together through collaborative game-play. However, the study on theoretical justification of the occurrence of collaborative learning behavior in MMOG, is under-researched.

To bridge this gap, the first objective of this study is to put together MMOG and technology-based collaborative learning streams of research to theoretically examine whether MMOG is an effective learning platform by drawing on Alavi's (1994) three attributes of effective technology-mediated collaborative learning environment. The second objective of this study is to bring together MMOG and knowledge creation streams of research to empirically examine the occurrence of knowledge creation in MMOG game-play based on Nonaka's (1994) four modes of knowledge conversion in his dynamic theory of organization knowledge creation. The third objective of this study is to conceptually advocate the research potential of MMOG game-based collaborative learning based on our research findings.

In the next section, we will present our theoretical review of the three effective learning attributes of MMOG game-based collaborative learning environment. Then we will discuss our exploratory study of the occurrence of knowledge creation in a MMOG game-based collaborative learning environment. Lastly, the research potential of MMOG game-based collaborative learning will be presented in the final section.

2   EFFECTIVE LEARNING ATTRIBUTES OF MMOG GAME-BASED COLLABORATIVE LEARNING ENVIRONMENT

From the computer-mediated collaborative learning perspective, Alavi (1994) argues that an effective learning environment consists of three effective learning attributes, namely (1) active engagement in knowledge construction, (2) cooperation, and (3) problem-based learning. With the same token, if we consider MMOG as an effective learning platform, MMOG should consist of these three effective learning attributes. In this section, we will bridge literature of MMOG game-based learning research and Alavi's effective computer-mediated collaborative learning attributes to theoretically examine three effective learning attributes of a MMOG environment.

2.1   Active Engagement in Knowledge Construction

Active engagement in knowledge construction contributes to the personal component of learning

(Kwok and Khalifa 1998). Based on the constructivist belief of learning, active engagement in knowledge construction allows learners to construct new knowledge from their experiences (Alavi 1994). Moving forward to literature of gaming research, Squire's (2005) experience from a single player fighting game aligns with the constructivist believe of active engagement in knowledge construction. Squire (2005) argues that the design of a fighting game confronts a new player first by relatively easy monsters where the player can consolidate and master his/her playing skills by practicing and rehearsing basic moves. After fighting easy monsters at each level, the player will need to fight and defeat a *boss* (i.e. a stronger monster) in order to go forward to the next level. This difficult part of the game by fighting *bosses*, is where the player experiences failures, confronts novel situations and develops new skills. As explained by Squire (2005), sophisticated game practices may look simply like "button mashing", yet, expertise in fighting games arises through a rough progression of (yet also interaction among) four phases: (1) Learning to "read" the game as a semiotic system; (2) Learning, mastering, and understanding the effects of the range of possible moves; (3) Understanding the higher order interactions among these rules and the emergent properties of the game system; and (4) Monitoring continuously and reflecting on goals and sub-goals.

We would like to pick the game *World of Warcraft* (WoW) of *Blizzard Entertainment* (URL: http://www.blizzard.com/) as the example to explain the similarities of arguments between Squire's (2005) learning experience and Alavi's (1994) effective learning attributes in a MMOG context. We use WoW as the example because it is currently the best selling MMOG in the world with over 11.5 million subscribers worldwide (on 23rd December 2008, Blizzard Press Release: http://www.blizzard.com/us/press/081121.html), and also the design of WoW possesses features which support complex social dynamic structures. In WoW, players have to advance their avatar through 60 *levels* of play (or 80 *levels* of play with expansions)[1]. The higher the *level* of the avatar usually means the higher the values of attributes (i.e. *Strength*, *Agility*, *Stamina*, *Intellect* and *Spirit*)[2] of the avatar. *Leveling-up* in MMOG means a player's avatar has already accumulated a certain amount of *experience points* by defeating monsters or by accomplishing tasks, and has consequentially rewarded with an increase of values on various attributes of the avatar.

Similar to the fighting game that Squire (2005) experienced, WoW consists of monsters positioned in different areas. Different monsters positioned in different areas have different appearance and value of attributes. By manipulating the position of these monsters, the game developer can segment high-*level* avatars from low-*level* avatars. By fighting weaker monsters, players can rehearse their basic moves and master their control skills. As aforementioned, accumulation of *experience points* by killing monsters and accomplishing tasks will reward player's avatar with *leveling-up*, together with an increase on the values of various attributes of the player's avatars. As a result, a MMOG player with high-level avatar will usually have a higher chance of winning when he/she fights against stronger monsters in the MMOG environment. If the player's avatar is so weak and cannot pass through areas guarded by stronger monsters, the player can fight weaker monsters first. Then he/she can consolidate and master their skills, accumulate enough *experience points* for *leveling-up*, and even develop new skills before he/she fights against stronger monsters and confronts difficult tasks again.

In sum, MMOG players need to actively engage in learning and practice in order to get forward in their game-play process. Echoed with Kwok and Khalifa (1998), such design of the MMOG game-play process involves learning through individual active engagement in relating new ideas and skills

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[1] The same word "level" in MMOG shares a different meaning from a fighting game as described by Squire (2005); level in a fighting game means the current stage of the player in the game-play process, while *level* (shown in italic on this paper) in a MMOG is a general reflection on the values of attributes for an avatar. Usually higher *level* represents a stronger avatar.

[2] In the setting of World of Warcraft (WoW), players are allowed to create their avatar with a choice from 10 races, 10 classes and 2 genders. The combination of races, classes and gender predefines the starting values of different attributes for the player's newly created avatar. *Strength* is related to the melee attack power and the amount of damage an avatar can block with a shield. *Agility* is related to the attack power when using ranged weapons, armor and the chances of dodging attacks. *Stamina* is related to the health point (HP) of the avatar. Intellect is related to mana point (MP) for the use of magic. Spirit is related to the regeneration rate of HP and MP when the avatar is not fighting.

to what is already known, examining the problem of fighting strong monsters and accomplishing difficult tasks, and eventually creating an integrated whole strategy to increase the chance of winning in the game and obtain fun from the game-play process. Therefore, we stipulate that the attribute of active engagement in knowledge construction does exist in the MMOG environment.

2.2   Cooperation

Cooperation contributes mainly to the social component of learning (Kwok and Khalifa 1998), in which development of knowledge requires cooperation with others in a technology-mediated collaborative learning environment (Alavi 1994). Cooperation can develop understanding by providing social support and reinforcement. This social component in developing understanding through discussion of shared knowledge echoes Pask's (1976) ideas about the important function of conversations in cognitive learning activities.

Unlike legacy electronic games that the number of players is limited by its design and physical space, MMOG allows massively amount of players playing at the same time in the same virtual environment. Instead of fighting against challenging monsters individually like traditional games, some tasks in MMOG require players to solve it collaboratively. Nardi and Harris (2006) conducted a study of collaboration in WoW, and identified several structured ways for players to collaborate in the game-play process.

For example, players in WoW can form *guilds*, which are named long-term groups in MMOG ranged in size from several players to hundreds or thousands of players. *Guild* offers many benefits including free items, opportunities for *parties* and *raids*, access to trade in-game items (i.e. *weapons*, *armors*, *potions*, etc.) through gatherings of *guild* members. Moreover, players of the same *guild*, in general, will help *guildmates* (players belong to the same *guild*) by sharing their knowledge and skills. Specifically, the strategic benefits of the settings of avatars are an example of shared knowledge in the MMOG environment. While grouping with a *paladin* (a class of avatars) at a quest in a cemetery, experienced guildmates will instruct non-experienced play by telling them *paladin* is especially effective against *undead* (a race of monsters) targets. Non-experienced players, in this case, developed knowledge to adjust his/her actions according to the *paladin's* strategic advantages through practice.

In sum, these social component in developing understanding through discussion of shared knowledge will increase the chance of winning, obtaining collaborative victory and perceiving collective enjoyment from the game-play process. Therefore, we stipulate that the attribute of cooperation in knowledge construction does exist in the MMOG environment.

2.3   Problem-Based Learning

Problem-based learning contributes to both personal and social components of understanding (Kwok and Khalifa 1998). Using a problem as the centre of learning illustrates the usefulness of the learned knowledge and skills through a concrete application and motivates learners. Such motivation can lead to a more active engagement of learners and a more focused cooperation between learners in a collaborative learning environment. Also, embedding the knowledge, old and new, from the perspective of a problem leads to a better integration of the knowledge (Alavi 1994).

In WoW, the most critical problem of players is to advance their avatar to the highest level (60 *levels* with the original WoW, or 80 *levels* of play with expansions). This problem can be further divided into smaller problems and categorized them into personal and social perspectives.

The personal perspective of the problem is related to the personal skill of controlling the avatar as well as the knowledge to fight against monsters efficiently. Squire (2005) describes that expert gamers see animations and sounds not just as "pretty graphics", but as strategic signals which give cues to a player (or the group when the task is collaborative) for corresponding actions. As aforementioned in active engagement in knowledge creation, the design of MMOG intentionally positions monsters of different strength to segment high-*level* avatars from low-*level* avatars. For MMOG players to get forward in their game-play process, they may need to accumulate enough *experience points* for *leveling-up* by fighting weaker monsters and trying out their newly developed skills first, before they are capable to defeat stronger monsters.

The social perspective of the problem is related to the guild management skill of educating non-experienced players so that all *guildmates* can benefit individually through collaborative victory. While solving the same problem in MMOG can have more than one method, expert gamers would share their written solutions in forms of guides, walkthroughs and Frequently Asked Questions (FAQ) by heuristics instead of explicit procedural directions (Squire 2005). When a MMOG player encounters a challenging monster or a difficult task which he/she could not solve by himself/herself, he/she may search for suggestions written on MMOG's websites and community forums by other experienced players (Nardi and Harris 2006). In addition, completing tasks in MMOG requires collaborative effort with the goal of achieving collaborative victory that creates a win/win situation for both experienced and non-experienced players. Therefore, based on the strategy to solve problems from the personal and social perspectives that motivates players to engage activity in knowledge construction and cooperate with each other, we stipulate that the attribute of problem-based learning does exist in the MMOG environment.

To summarize our arguments above, we stipulate that MMOG is an effective collaborative learning platform as it possesses three effective learning attributes suggested by Alavi (1994) from the perspective of computer-mediated collaborative learning, with support from the literature of MMOG game-based learning research.

3 KNOWLEDGE CREATION IN THE MMOG GAME-BASED COLLABORATIVE LEARNING

3.1 Definition of Explicit and Tacit Knowledge in MMOG

With reference to Polanyi's (1966) classification of explicit versus tacit knowledge, this study defines explicit knowledge in MMOG as knowledge that is written in game specific language that is transmittable and sharable among game players, and tacit knowledge in MMOG as knowledge embedded in game specific skills, action strategies and experiences that is difficult to communicate and share amount game players using formal languages. The following table summarizes our definitions:

Types of Knowledge	Definitions
Explicit Knowledge in MMOG	knowledge that is written in game specific language that is transmittable and sharable among game players
Tacit Knowledge in MMOG	knowledge embedded in game specific skills, action strategies and experiences that is difficult to communicate and share amount game players using formal languages

Table 1.   Definition of Explicit and Tacit Knowledge in MMOG

With the assumption that knowledge is created through conversion between explicit knowledge and tacit knowledge, Nonaka (1994) articulates that there are four modes of knowledge conversion taken place in organizational knowledge creation: (1) *Internalization* — from explicit knowledge to tacit knowledge; (2) *Externalization* — from tacit knowledge to explicit knowledge; (3) *Combination* — from explicit knowledge to explicit knowledge; and (4) *Socialization* — from tacit knowledge to tacit knowledge.

Based on Nonaka's theory of organizational knowledge creation, we stipulate that the occurrence of knowledge creation in the MMOG game-based collaborative learning environment can be taken place in four modes of knowledge conversion in the MMOG game-play process.

3.2 An Exploratory Study of Four Modes of Knowledge Conversion in the MMOG Game-Play Process

In order to explore the occurrence of four modes of knowledge conversion in the MMOG game-play process, we conduct an exploratory study using a semi-structural interview approach (Lindlof and Taylor 2002) to collect qualitative data to support our stipulation.

In this study, four experienced players of WoW were invited to join the semi-structural interview. Interviewees were being interviewed individually with an average duration of two hours. Each interviewee was informed that the interview would be taped before the interview began. Each interview section followed the same procedure as follows.

Firstly, the interviewer greeted the interviewee and expressed the purpose of the interview, the expected duration (2 hours) and the interview would be taped. The interviewer would then start a warm up phase by asking warm up questions. These warm up questions included how long the interviewee had been playing WoW, the reasons why he/she liked the game WoW, and other background information related to him/her. This step took around 15 minutes. The interviewer would then ask probing questions and request the interviewee to describe his/her personal learning experience in the four modes of knowledge conversion at the time of playing the game. This step took around 1 hour and 2 minutes on average. Finally, the interviewer asked open-ended questions and request the interviewee to describe all possible factors, e.g. features and designs of a MMOG, which would affect quality of knowledge creation in the MMOG game-play process. This step was around 43 minutes on average.

3.3 Data Analysis and Discussion

Based on our collected interview data, an interviewee described the features of knowledge in MMOG as follows:

"Knowledge in MMOG can be classified into three different aspects. The first aspect is the attributes and available moves of a player's avatar in the MMOG. "Level" is the general reflection on the attributes of avatars in MMOG. Usually the higher level of the avatar means the higher value for the avatar's attributes, and such level can be obtained through accumulation of experience points upon completion of tasks, individually or collaboratively. The second aspect is the skill of the player himself/herself, like the reaction time to press a combination of keys on the keyboard during the fight. Finally, owning a high level avatar does not necessary mean a guaranteed victory."

As commented by another interviewee:

"Some wealthy players simply buy a level-60 avatar from somewhere. However they don't have the skill to control it."

Playing MMOG is closely related to the interaction of the player with the MMOG environment through the control of an avatar. By applying Squire's (2005) experiences on the MMOG context, it is important for a player to understand each and every possible moves of the avatar, and apply these moves strategically in solving the problem given in the MMOG game-play process. In MMOG, there are different settings available for a player to create his/her avatar. The combination of these settings predefines the path towards available skills that a avatar possesses at a certain *level*. With the consideration of different properties of monsters and tasks given to a player, the player needs to know well his/her avatar's strength and weakness when versus monsters of different properties, understand corresponding strategic values of different available moves of his/her avatar, and applies these moves to counter the given problem at the right time.

Based on these three views of the features of knowledge in MMOG, we further discuss the four knowledge conversions between tacit and explicit knowledge in the MMOG game-play process by analyzing our collected interview data.

3.3.1 Externalization

Externalization is the knowledge conversion from tacit knowledge to explicit knowledge (Nonaka 1994). Experienced players tend to share their knowledge to the *newbies*[3] (a term used by experienced

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[3] *Newbie/newb* and *noob/n00b* shares different meaning. *Newbies* are those who are new to the game and are very beginner of it, and they are willing to learn and fix their errors to move out from this beginner stage. *Noobs*, on the other hand, know little and have no will to learn any more. *Noobs* expect people to do the work for them and expect to get praised about it.

players to describe non-experienced, junior and low-*level* players who are willing to learn) in community forums, and who seek for opportunities to cooperate and team up in the MMOG. In particular, experienced players will share their knowledge and experience with *newbies* of the same *guild*, as mentioned by our interviewee:

"Usually higher-level players are those who enjoy the game, and enthusiastic to make his guild running smoothly. They will usually share their experience with new guild members and hope such enjoyment to the game can be transferred to the newbies."

This sharing of transferred explicit knowledge can be occurred through the interactions between players and writings on the blog and community forum. In other words, tacit of knowledge of an experienced player can be transferred and become explicit knowledge, in forms of verbal conversation or in-game chat, and written experience in blogs and forums, which are accessible and communicable to other players. Therefore, we stipulate that knowledge externalization does occur in the MMOG game-play process.

3.3.2 Combination

Combination is the knowledge conversion from explicit knowledge to explicit knowledge (Nonaka 1994). In the setting of MMOG, the game-play process can be triggered by competition between communities of players. As aforementioned, a group of players can receive and share rewards upon fighting against monsters and completion of a collaborative task together, in terms *leveling-up* with increases on various values of attributes of their avatars as a form of collaborative victory. Players of MMOG interact with in-group members in a variety of meaningful ways to share knowledge and skills so as to increase their capital and the chance of winning in those competitions and share collaborative victory. Gee (2003) refers to these communities of players as affinity groups:

"People in an affinity group can recognize others as more or less 'insiders to the group'. They may not see people face-to-face, but when they interact with someone on the internet or read something about the domain, they can recognize certain ways of thinking, acting, interacting valuing and believing as well as the typical sorts of social practices associated with a given semiotic domain."

Based on Gee's (2003) argument above, we can describe knowledge combination in the MMOG game-play process from two different perspectives: private and public.

From the private perspective of knowledge combination in the MMOG game-play process, an interviewee articulated his view as follows:

"During a raid, each player will have his/her own responsibility. If I cannot handle my role correctly, the whole raid will fail. That's why before each raid, we will have a thorough discussion where we elaborate our ideas and suggestions of fight, combine and consolidate our suggestions, finalize the assigned responsibilities of everyone, and try to carry out the raid as planned. The outcome of the fight will be documented as an experience for future reference."

Another interviewee had a similar view of knowledge combination:

"Guild masters and experienced players of the guild will document down their game-play experiences, respond to other players' queries, and write down some FAQ and walkthroughs with the purpose that newbies can read and try out the methods themselves. Some guilds actually have their own discussion boards to organize and combine all these game-play experiences, FAQ and walkthroughs together."

Similar to Nardi and Harris's (2006) argument, if individual players fail to cooperate in a collaborative task, the whole task will fail. With this drive, each player requires to play a unique role in a collaborative task which cannot be mistaken. For this extrinsic motive of collaborative victory, groups of experienced players would like to share their knowledge to in-group members as a form of private mode of knowledge combination in form of private blogs and forums. As mentioned by an interviewee, online community forums and in-game chat are the major means to communicate with each other for the discussion of their strategies to fight prior to the mission. During the discussion process, each player externalizes his/her explicit ideas and suggestions of the task, and their

suggestions will be combined and consolidated. Finally, a commonly accepted strategy will eventually come out.

From the public perspective of knowledge combination in the MMOG game-play process, combination can be like a sharing of knowledge to unknown others. While some MMOG players focus on the extrinsic rewards of collaborative victory, some players may be keen on intrinsic rewards and the fun part of the game-play process. This intrinsic motive of experienced players may drive them to share their experiences and fighting tips with others using their own blogs and reply to discussions in public forums.

Therefore, we stipulate that knowledge combination (private and public) does occur in the MMOG game-play process.

3.3.3 Internalization

Internalization is the knowledge conversion from explicit knowledge to tacit knowledge (Nonaka 1994). As one of our interviewee said:

"All of us begin with zero knowledge on this game MMOG. At the beginning stage, each of us will need to do research by ourselves."

Based on the responses of the interviewees, we found that learning usually starts with a tutorial session in the MMOG. The tutorial session is like an introductory lesson for a new player to learn how to play a specific MMOG. In the tutorial session, a player reads the instructions and guides (explicit knowledge of MMOG) developed by the MMOG developer, and practices on his/her own, with the purpose of consolidating and mastering the skills to control his/her avatar. In other words, the process of consolidating explicit knowledge (instructions and guides in the tutorial session) through reading and practice will help MMOG players transform this explicit knowledge into their own game specific skills, action strategies and experiences (tacit knowledge of MMOG).

In addition, when we ask our interviewee the source of their game-play resources, the following respond is provided:

"If you type "World of Warcraft" in Google, there are thousands of results in which we can find some blogs showing you some fighting tips. Some of the experienced game players have blogs to share their own game-play experiences to the public. Also, by going through the discussion records of community forums, we can learn through the solutions of how other players went through the same problem."

Echoed with the research of Nardi and Harris (2006) and Squire (2005), user manuals, online FAQ, records of discussions, and blogs of experienced players contain a rich amount of explicit knowledge of MMOG for MMOG players. By reading this explicit knowledge of MMOG, players could internalize this explicit knowledge through practice, and transform them into their own tacit knowledge for their mastery and even developing new skills to accumulate *experience points* for *leveling-up*. Therefore, we stipulate that knowledge internalization does occur in the MMOG game-play process.

3.3.4 Socialization

Socialization is the knowledge conversion from tacit knowledge to tacit knowledge (Nonaka 1994, Kwok et al. 2002). In other word, learners can learn through observing and imitating others, without direct interaction or communication using formal languages. Regarding socialization, an interviewee told us his personal story:

"I had once saved another player in World of Warcraft, who was surrounded by several monsters and it seemed like he was going to die. Then I casted a spell of fireball and cleared those monsters surrounding him. This player then asked me, 'hey, that spell is powerful, what is it?' I replied, 'It is difficult for me to tell you how to handle that task. Just follow me and I will show you again how to do."

In MMOG, players can see each other during the time of travelling around the virtual space or fighting with other players in the same *quest*. A player is able to observe and imitate others, in order to learn how others are playing the game, in addition to learn through internalization, which

emphasizes that a player can learn through reading explicit knowledge (e.g. written walkthroughs and guides in blogs and forums, listening to advices and suggestions in in-game chats, etc.) using game specific languages. However, if a MMOG player cannot figure out the strategy to fight against a challenging monster or handle a difficult task even after an intensive search of explicit knowledge (e.g. written instructions, guides or experienced players' experience sharing in blogs and forums) online, the player may choose to construct their own knowledge through observing and imitating other experienced players through socialization. Therefore, we stipulate that knowledge socialization does occur in the MMOG game-play process.

To summarize, we integrate MMOG and knowledge creation streams of research to stipulate that the occurrence of knowledge creation in the MMOG game-play process can be taken place in the MMOG game-based collaborative learning environment. Our findings of the exploratory study using a semi-structural interview approach support our stipulation of the occurrence of four modes of knowledge conversion in the MMOG game-play process.

4 RESEARCH POTENTIAL OF MMOG GAME-BASED COLLABORATIVE LEARNING

In this study, we stipulate that a MMOG game-based collaborative learning environment possesses three effective learning attributes, with support from the literature of MMOG game-based learning research. Also, our findings of the exploratory study support our stipulations of the occurrence of knowledge creation in the MMOG game-based collaborative learning. However, numerous research challenges remain in this area of collaborative knowledge creation in MMOG. Therefore in this section, we will present the research potential of MMOG game-based collaborative learning and limitation of this study.

4.1 Research is needed on "what" drives motivation to knowledge creation in MMOG

The first type of research potential focuses on the independent variables e.g. motivational drivers, which lead players to create knowledge in the MMOG game-play process. Active engagement in knowledge creation is an important attribute of an effective learning environment (Alavi 1994). Developing methods and interventions that can motivate a player to engage in MMOG game-based learning tasks is an important research topic that may provide significant impacts to the educational industry.

To understand the motivational drivers of knowledge creation in MMOG from the psychological perspectives, several conceptual perspectives have been proposed in previous studies to understand human motivation, including Deci and Ryan's (1985) self-determination theory, and Ford's (1992) goal theory, etc. Using these perspectives, one posits that behavior can be extrinsically and intrinsically motivated (Herzberg et al. 1993). Applying the logics of motivational theories to the design of MMOG, the future investigation of individuals' desires of intrinsic and extrinsic rewards (driving by the unique characteristics of MMOG and different kinds of reward settings, and their effects on players' desire to play and create knowledge) is warranted for extending our theoretical understanding of gamers' behavior. Answers from the search of "what" drives motivation to knowledge creation will help educators to adjust minor game and task settings in the MMOG environment which can facilitate the optimum knowledge creation outcome.

On the other hand, if we look at MMOG as a type of hedonic information systems, gamers' selection of a certain MMOG can be seen as an IS adoption process. From the information systems perspective, Unified Theory of Acceptance and Use of Technology (UTAUT, Venkatesh et al. 2003) provides an unified view of system adoption by drawing upon well-established and scattered IS theories. Core constructs of UTAUT, including *Performance Expectancy*, *Effort Expectancy*, *Social Influence* and *Facilitating Conditions*, may gives insights for us to investigate the causes of gaming behavior from the IS perspective. In addition, in contrast to traditional beliefs that male teenagers are the dominating population of gamers, Yee (2006) found that most players of MMOG are in fact adults, disproportionately male but with a wide variety of occupations and demographic characteristics. Many families forgo watching TV dramas and quest together in WoW (Bainbridge 2007). Suggested by the model of UTAUT, *Gender*, *Age*, *Experience* and *Voluntariness of Use*, can be applied to the

MMOG environment and study whether gender differences, age differences and experiences from other MMOG will affect one' knowledge creation behavior. Answers from the search of "what" drives motivation to knowledge creation will help game developers to include elements which can possibility trigger active engagement in knowledge creation. Program developers may also adopt these unique characteristics of MMOG creatively on utilitarian information system in the future to encourage stickiness and productivity.

4.2   Research is needed on "how" collaborative learning occurs in MMOG

The second type of research potential focuses on the research methodology for investigating the process of knowledge creation in the MMOG game-based collaborative learning. This study seeks for preliminary understanding of knowledge creation through interviews with MMOG players, multiple "snap-shots" from interviewees' memory allows us to explore explanations of the knowledge conversion between explicit and tacit knowledge based on the Nonaka's (1994) dynamic theory of organization knowledge creation.

In addition to interviews with MMOG players, other well-established research methodology can also help us to collect relevant data for analysis. For example, a survey methodology can be employed in which new questionnaires can be designed and created. Distribution of survey can be done directly in the MMOG environment to ensure the returned surveys are from players who actually participate in such MMOG. In addition, for the possibility of having common-method bias, researcher can also make use of the "transparency" characteristic of MMOG to retrieve values of attributes of player's avatars, like the amount of played hours, amount of *experience point* and current *level*, and compare these objective figures with the data collect through survey.

On the other hand, participation in a MMOG is an ongoing process. Interviewees of this study told us training an avatar from *level*-zero to the highest *level* requires no less than two months of sleepless participation. Therefore in contrast to interview and survey method which retrieve mainly "snap-shots" of data, observation can be another research methodology to be used to analyze the on-going game-play process of MMOG players. To retrieve these longitudinal data for analysis, one possible research methodology for future research is to work with *guild masters* and game developers of MMOG. The researcher can act as an observer and retrieve continuous communication log, amount of online time, players' action and attributes of all the *guild* members. Content analysis of the interactions between in-game events, players' action and discourse will allow us to have statistical analysis on the knowledge conversion in the MMOG game-play process, and helps educators to administrate, facilitate, or even manipulate the learning processes by looking for signals of knowledge creation during the game-play process in multiple time frames.

4.3   Research is needed on "what" knowledge is created in MMOG and "how" to evaluate

The third type of research potential focuses on the dependent variables which are used to investigate the knowledge generated in post-system adoption stage. While the first and second research potential focuses on the motivational factors and the emergence of collaborative learning respectively, this research potential focuses on the content of knowledge being created. From the educator's perspectives, evaluation of learning outcome is necessary if MMOG is being used intentionally for educational purposes. More importantly, the game-play process of MMOG is different from traditional games due to the online multiplayer nature. MMOG players can interact with each other online using avatars as their representation. Therefore, the knowledge creation process is no longer merely personal, but it also involves the social component of knowledge creation.

According to Polanyi (1966), knowledge can be classified into explicit and tacit knowledge. Evaluation of tacit and explicit knowledge may require different methods. The design of MMOG is transparent regarding tacit knowledge created through the game-play process. Although we cannot assess the tacit knowledge of a player, MMOG provides objective figures (e.g. the amount of played hours, numbers of kills, numbers of death, changes on *experience points* and *level*, etc.) as reflections of tacit knowledge for us to evaluate the performance of a MMOG player. Regarding the method to assess explicit knowledge, MMOG players can, as aforementioned, externalize their explicit knowledge in MMOG using game specific language, in forms of verbal conversation or in-game chat,

and written experience in blogs and forums, etc., which is accessible and communicable to other players.

To the educators, understanding the outcome of knowledge creation is important as it directly affects the selection and the use of MMOG as a learning tool given different intended learning outcomes. Results of research on "what" knowledge is created in MMOG will provide significant answers for addressing whether knowledge created in MMOG can be transferred successfully back to the real world. For example, the research on examining the emergence of leadership as a learning outcome through the MMOG game-play process over time is under-researched so far, and its future research is warranted. The results of this MMOG research on leadership are expected to have deep and long term impact for our understanding of the use of MMOG for developing leadership skills of a player, who can make use of this acquired leadership skills in the real world, with real people, and for a real job.

4.4   Research is needed on "how" to balance MMOG involvement and addiction

This research potential focuses on the social impacts of the use of MMOG for educational purposes. From the perspective of educators, it may be a paradox to make use of MMOG in educational context.

From the behaviorist beliefs of learning, rewarding certain behavior will encourage continuation of such behavior. In the setting of MMOG, earning *experience points* for *levelling-up* upon completion of tasks individually and collaboratively, random dropping of items and in-game currency by defeating monsters, can be viewed as rewards to individuals as a kind of flow experience (Csikszentmihalyi 1994). From the economical perspective, game developers and educators may share a conflicting interest. For game developers, MMOG players pay monthly subscriptions fee in order to continue their participation in the MMOG environment, more profit can be generated if more players "subscribe" for the MMOG. In order to keep game players, game developers develop expansions to the original game by adding more features and extending maximum *level* of avatars. Using WoW as an example, the maximum *level* of the original WoW is *level* 60. The first expansion *Burning Crusade* has a limit of *level* 70, while the latest expansion *Wrath of the Lich King* has a limit of *level* 80. New area and quests are available for players to further explore the virtual world of MMOG, causing a continuation of knowledge creation process, even for the well-experienced players in the original settings.

To the educators, it is the most ideal case if a player is voluntary to actively engage in the learning and knowledge creation process. This kind of deep learning may be difficult to achieve in an ordinary classroom setting. However, in the context of MMOG, most of the players are voluntary and actively engage in such learning and knowledge creation process. But a paradox is created with the potential causes of threats like addictiveness. Our current theory seems unable to provide answers of this problem and suggest appropriate strategies to balance players' addiction in a recreational task, rather than in a learning task. Future research is warranted searching for a balanced involvement of knowledge creation in MMOG and addiction based on the unique design characteristics of specific hedonic information systems, like MMOG.

5   CONCLUSION

Based on MMOG game-based learning literatures, this study stipulates that MMOG is an effective collaborative learning environment, which possesses three effective learning attributes suggested by Alavi (1994). Based on Polanyi's (1966) classification of explicit versus tacit knowledge, we propose definitions of explicit and tacit knowledge in MMOG. Moreover, this study integrates MMOG and knowledge creation streams of research to stipulate that the knowledge creation can be taken place in the MMOG game-based collaborative learning environment. Findings of our exploratory study using a semi-structural interview approach support our stipulation of the occurrence of Nonaka's (1994) four modes of knowledge conversion in the MMOG game-play process. Based on our findings, we propose four major directions of future research, and hope this proposed MMOG research potential will generate insights for educators, researchers and game developers who intend to closely examine the use MMOG as a new generation of educational platform.

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