Team knowledge with motivation in a successful MMORPG game team: A case study

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ABSTRACT

We studied the content of the team mental model with a case study about a successful online game team. This team was formed by high-ranking managers in a large raid guild to conduct a raid in War of Worldcraft. They were interviewed with a set of 5-W questions developed according to the conceptualizations of team mental model (Levine & Moreland, 1991). Toward the interview protocol, a content analysis was conducted with two-cycle coding method from exploratory to explanatory and a hierarchical framework from code, category, theme, to theory were generated to describe the team mental model. In the first cycle, 17 codes were extracted from participants' own wording for concepts that were shared by whom controlled various gaming characters. These codes are knowledge convergence about the problem at-hand, actors, events, affects and outcomes – what the core gamers have experienced through the collaborative gaming process. In the second cycle, coding was guided by learning theories. Six categories, mingled from 17 codes, showed collective knowledge of co-work process, leaders' works, work under supervision, seeking joint fun, relationship oriented, and balance between extrinsic-intrinsic motivations. From 6 categories, two themes were synthesized: the team (1) performed "joint hard work" for (2) seeking "joint hard fun." The first theme comprised declarative and procedural knowledge representations and we consider it to be the commonality between this game team and ordinary work/learning teams. The second theme was composed of affective and cognitive evaluation components about intrinsic motivation which is in accordance with Self-determination theory (SDT, Deci & Ryan, 2000). In general, "Jointly hard work for hard fun" is the gist content of the team mental model. We found ample evidences that members explicitly recall shared motivational beliefs of team mates and emotional–motivational events in gaming. Based on the results of this study, several implications have been addressed for teachers to enhance students' intrinsic motivation in conducting quality Computer-Supported Collaborative Learning. Future studies are needed to further explore the relationship between the quality of team mental models and team-level performance.

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1. Introduction

A team of MMORPG players is composed of guerrillas, logistical troops, and the main artilleries that assemble the constitution of many action teams (DeChurch & Mesmer-Magnus, 2010; Sundstrom, De Meuse, & Futrell, 1990), such as a military team or a project team (Edmondson, 2003) in high-tech companies. When a game team prepares for raiding, someone needs to lead, organize, and communicate with peers, and the members need to work interdependently to achieve team goals (usually to win at combat during the raid journey). Current online game development involves major human social functions, such as developing interpersonal relations and business transactions, cooperating, organizing manpower, and even learning and training. In addition, the members of an online game team need to invest considerable time to complete tasks. Yee (2006a) reported that, on average, members of online game teams spent more than 20 h per week actively gaming.

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Some researchers regard online games as a third space (Steinkuehler & Williams, 2006) in addition to the first and second spaces of family and work. We observe that many game players do not play in a casual manner; instead, they invest tremendous effort and play games as seriously as working for a paid job. This is especially true for gamers who play MMORPGs. For example, many gamers diligently practice gaming skills (e.g., killing monsters, collecting items, or developing characters) to reach the requirements (ability level) for raids (serial tasks for a group of gamers) and can recite the battle rules. Serious gamers have also been called core gamers by Yee (2006a), suggesting that games are increasingly similar to workplaces. As we observe, some gamers join guilds to make forming groups and raiding easier and more rewarding. They must follow the rules and goals of the guild, such as committing to the call for raiding recruitment and restrictively coordinating with members according to the preset raiding strategies and fixed calendar designated by the raid leader (RL) (Yee, 2006b). In addition, leaders or higher-level gamers enjoyed helping lower level players, giving advice or aiding a difficult quest (Ducheneaut & Moore, 2005; Nardi & Justin, 2006).

Scholars have studied how to build successful teams in modern organizations, but they still lack a good understanding of how to achieve this. Cannon-Bowers and Salas (1990) proposed the concept of a team mental model, which has been particularly influential in contributing insight into the relationship between collective cognition and work team performance (Edwards, Day, Arthur, & Bell, 2006; Marks, Sabella, Burke, & Zaccaro, 2002; Marks, Zaccaro, & Mathieu, 2000; Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000; Rentsch & Klimoski, 2001; Stout, Cannon-Bowers, Salas, & Milanovich, 1999). Team mental models are team members' shared, organized understandings and mental representations about key elements of the team's relevant environment (Klimoski & Mohammed, 1994). As team members interact with each other and gain expertise with joint tasks, they develop team knowledge about the task and the team, which helps them to coordinate effectively. Shared knowledge is important because knowledge is processed in people's minds, and individuals need a certain level of overlap in their individual knowledge bases to coordinate their collective actions.

In this study, we explored the team mental model of a successful War of Worldcraft (WoW) team, a raid team formed by several core gamers who were the founders and officers of a large guild. The reason to invite this expert game team is based on an assumption that the core gamers have rich gaming and teaming experiences and there is a higher chance that team mental model have been formed. Given the complexity of gaming and teaming as well as the lack of empirical research to date, we conducted an interview study, firstly, to explore whether there could be team knowledge distributed among our team members. If gamers in this team did obtain team mental model as it does in sport, military, and company teams, what contents of team mental model would be extracted? Through a descriptive coding (Miles & Huberman, 1994; Saldana, 2009) of interview protocol, we expected to explore basic topics or vivid substances about the game team from the individual members' own wording. As an exploratory study, we did not analysis advanced issues, such as the features (congruence, similarity, or accuracy) of the team mental model as many quantitative studies have done (Mathieu, Heffner, Goodwin, Cannon-Bowers, & Salas, 2005; Smith-Jentsch, Mathieu, & Kraiger, 2005; Webber, Chen, Payne, Marsh, & Zaccaro, 2000). Second, if abundant topics could be identified from the descriptive coding, we might process a two-cycle coding method suggested by Saldana (2009). Based on cognitive and affective models of learning, we expected to explain the descriptive topics emerged from the first coding process for a better understand about what the core gamers have learned (what kind of knowledge they obtained and stored) through the collaborative gaming process. In addition, based on our understanding of work/learning teams, we could compare the similarities and differences between game teams and work/learning teams to interpret the unique features of this game team and the team mental model. The results of this study might have insights or contributions toward team process in computer supported learning environments.

2. Background

2.1. Virtual context of World of Warcraft and game motivation

The MMORPG is a genre of role-playing video games in which very large numbers of players interact with one another within a virtual game world. War of Worldcraft (WoW) is a popular type of MMORPG. The development of players' characters is the primary goal in most MMORPGs. Nearly all MMORPGs feature a character progression system in which players earn experience points for their actions and use those points to increase their characters' "levels," which makes them better at whatever they do.

Although WoW can be played by a single player, it is more popular to raid – to join forces with 10–40 players to complete a dungeon (solving serial joint tasks). Raids are PvE (person versus environment) task-oriented games in which avatars manipulated by people fight against monsters that are automatically generated by the program. Solving tasks in raids requires multiple gamers with various war functions to collaborate. Ten classes of characters can develop special functions to win war gears and awards in WoW. A class is "the primary adventuring style of a player character, which determines the type of weapons and armor it can use, as well as what abilities, powers, skills, and spells it will gain throughout its adventures" (Wikipedia, 2012). Some characters are good at attacking, whereas others are adept at defense or supplying energy. A player may develop an avatar for a single focused function (such as a damage dealer, tank, or healer) or for multiple combination functions. A tank is a character whose primary function is to bear damage and prevent its peers from being attacked. Tanks are "meat shields" that place themselves between mobs (non-player opponents) and vulnerable team members. While raiding, the main tank keeps the mobs attacking him and only him while the others pick off the mobs. A team needs a main tank because when the team is fighting strong mobs, the healers and damage dealers can often be killed by only a few hits from mobs. A healer is a character whose primary combat purpose is to heal friendly avatars or give them defensive effects. Healers are the second most demanded role for a raid, after tanks. Priests, Druids, Paladins, and Shamans can all serve as healers. Damage dealers are players who are responsible for dealing damage in the team. Their importance should not be neglected because it may take a long time to kill mobs without effective damage dealers. From the above description, a game team in action might coordinate similarly to teams of sports, military, or business who must collaborate to achieve team goal.

Gamers can join gamer-organizations called "guilds." Raid guilds have several characteristics. First, the guild size is usually at least 50–200 gamers, who often have moderate to high skill levels (Ducheneaut & Moore, 2005). Second, founders and core gamers tend to be expert gamers, but gamers of all types can be found in very large raid guilds. Finally, raid guilds usually have detailed operational rules, the most important of which determine the distribution of rewards gained from battles.

Online games motivate a remarkable number of players to ignore other opportunities for leisure and to invest millions of hours collaborating, exploring, and competing against one another in virtual worlds (Przybylski, Rigby, & Ryan, 2010). Why do so many people spend so much time engaged in online games? The immediate and most obvious answer is "because they are fun." If gaming is perceived as pleasurable, it may cultivate hedonic motivation and positive experiences or psychological processes, such as happiness, playfulness, sociability, and satisfaction (Chiang, Lin, Cheng, & Liu, 2011; Chou & Ting, 2003; Vos, van der Meijden, & Denessen, 2011). Several motivational factors have been found to be associated with video gaming. For example, gamers experience positive affect, competence, enhanced self-esteem, and vitality. When they are successful, they give higher value ratings to gaming tasks (Dickey, 2007; Gee, 2003; Ryan, Rigby, & Przybylski, 2006; Wang, Khoo, Liu, & Divaharan, 2008; Warren, Dondlinger, & Divaharan, 2008). In a series of studies assessing psychological need satisfaction (Ryan et al., 2006), video-game players reported increased levels of decision making and autonomy when playing games, supporting Self-Deterministic views of motivation (for a general description of Self Determination Theory, please see Deci & Ryan, 2000). These studies led to the conception that games have a "pull" (attraction) effect for players. Previous research on gaming motivation has mostly focused on the individual level (a person's inner state/perception in relation to gaming). Few studies have addressed motivation at the team level. In this study, we analyze raid members' team mental model. Because motivation is a critical element in gaming and team knowledge (DeChurch & Mesmer-Magnus, 2010; Dickey, 2007; Przybylski et al., 2010), we expected that the content of the team mental model would include intensive information regarding motivation.

2.2. Team mental model and team type

The term "team mental model" is derived from the "mental model" (Craik, 1943) in cognitive psychology, which describes an individual's thoughts and explanations about how something works in real-life situations. Johnson-Laird (1983) defined a mental model as a knowledge structure whereby humans generate descriptions of an object/system's purpose and form, explanations of system functioning and observed system states, and predictions of future system states. These models are constructed by individuals based on their personal life/learning experiences and understanding of the world and provide the mechanism by which new information is filtered and stored. Highly effective operational/project teams (such as army teams in Espevik, Johnsen, Eid, & Thayer, 2006; Lim & Klein, 2006; aircrew teams in Orasanu, 1990; and software developing teams in Espinosa, Slaughter, Kraut, & Herbsleb, 2007) have multiple team mental models of different categories and levels of complexity that enhance effective coordination, problem-solving, and team-level performance (DeChurch & Mesmer-Magnus, 2010; Mohammed, Ferzandi, & Hamilton, 2010).

The team mental model was introduced by Cannon-Bowers and Salas (1990). In a team, team members may share four broad categories of common understanding: the team task, equipment/skills, members, and member interaction (Cannon-Bowers, Salas, & Converse, 1993; Wildman et al., 2012). These categories can be further grouped into two types, task (work and skill) and team (member and interaction), as suggested by Mathieu et al. (2000). The task category indicates that team members hold a common schema of a task along with an understanding of how the environment may influence the task demands. The team category includes a shared understanding regarding team members and how they interact with each other. In our study, raid tasks were provided by a fixed script produced by the game company. Therefore, we decided to limit our attention to the task perspective of the team mental model and solely examine the "team/members" perspective. We followed the team knowledge scheme provided by Levine and Moreland (1991) to develop 5-W interview questions. These questions are the following: Compared with other teams (1) What is the distinctive feature of the team? (What makes your team different from others?) (2) How does the team change? (What has happened to your team in the past? What is it now? What do you expect it will become in the future?) (3) What are the noticeable interaction features (climate) of the team? (4) What is the team norm? (5) How successful is the team? Does the team succeed from any perspective? With references to other teams for an explicit comparison, it is easier to describe gamers' own team.

A team refers to a specific type of group whose members are collectively accountable for achieving the team's goals. Katzenbach and Smith (1993a) defined a team as "*a small number of people with complementary skills who are committed to a common purpose, performance goals, and approach for which they hold themselves mutually accountable*" (p. 112). Several taxonomies have been suggested to distinguish team types (DeChurch & Mesmer-Magnus, 2010). The features of team tasks are among the key differentiating components. Based on team tasks, three team types exist: decision-making teams, action teams, and project teams (Katzenbach & Smith, 1993a, 1993b; Sundstrom et al., 1990; Sundstrom, McIntyre, Halfhill, & Richards, 2000). Decision-making teams possess high levels of informational interdependence, exchange information, and integrate knowledge, expertise, opinions, and perspectives to solve problems. For example, top management team members exchange ideas and process information with each other to make decisions through communication. Action teams generally possess high levels of behavioral interdependence. In action teams, such as those involving sports, military combat, or medical operations, people perform time-sensitive tasks that require members to coordinate actions and execute physical tasks. The project teams have high levels of both behavioral and informational interdependence. Team members usually come from different units in an organization and can be assigned to sub-teams according to the needs, functions, and activities of a given project. Research and development teams in high-tech companies are often project teams. We expected that our game team might have distributed team knowledge among members because their behavioral integration needs are high.

3. Methodology

3.1. Participants

We approached a highly capable team in a guild after they completed a top-level raid in WoW. In this raid, the gamers were required to have an ability level greater than 70, the highest rank at the time of the interview, and the raid required the participation of 10 members within a given time who jointly tackled all tasks. If they failed to pass one of a series of tasks, they had to remedy the failure within a short period to regain the right to participate in the remaining warfare. This team had 14 members and belonged to a large raid guild. All members were high-ranking managers of the guild and had access to the resources of the guild.

Seven members of this team agreed to participate in the interview. The participants are profiled in Table 1. In particular, we ensured that the participants had developed various avatars for the three main fighting functions to reveal multiple perspectives on the team (Table 2).

Table 1
Profiles of the 7 participants in the interview.

Game ID	Game functions	Gender	Age	Job
Chopper/Maslow: 2nd ID of Chopper	Damage dealer Healer	Male	30–35	High school teacher
Luffy	[b]*Main Tank*	Male	40–45	Computer company owner
Nami	Damage Dealer	Female	Unrevealed	Administrative assistant
Sanji	Tank	Male	30–35	High school teacher
Tom	Tank	Male	30–35	IT engineer
Usopp ([a]*RL*)	Healer	Male	30–35	Cramming school teacher
Zoro	Damage Dealer	Male	30–35	High school teacher

[a] *RL*: raid leader responded for coordination and communication with members.
[b] *Main Tank*: Main tank is the gaming leader in the battles.

3.2. Research procedure

The first author interviewed seven participants with the planned 5-W questions (Table 3), which were developed according to the conceptualizations of Levine and Moreland (1991). Each individual was interviewed twice, for at least 40 min each time. If the participants' comments were not understandable, the interviewer clarified the meaning using further W-questions, such as "What is…?," "How did you (he/she)…?," "When did you (he/she)…?," and "Why did you (he/she)…?" The protocols were transcribed and divided into meaningful statements that were tagged by participant number and statement sequence number.

Though we were opened to select (a) proper coding method(s) to process the interview protocol in the first place, finally we decided that the content analyses were conducted with a two-cycle process (Saldana, 2009, p.149; Wolcott, 1994). The coding process roadmap is illustrated in Fig. 1. The first cycle is exploratory to assist the readers to hear what the authors heard from our core gamers and the "code" is the results of the first-cycle coding. While, the second cycle is explanatory that was guided by learning theories to interpret the contents and the features of the team mental model. The second cycle produced three hierarchical concepts of team mental model with the terms as the "category," "theme," and "theory" suggested by Saldana (2009, p.12).

For the first cycle, a "descriptive coding" method (Miles & Huberman, 1994) was chosen. The interview protocol produced 167 meaningful statements (see Table 3) that were treated as data for content analysis. We used the individual members' own wording to code basic topics from the data and a code could only composed of the statements collected from one of 5-W questions for simplicity. A code was proposed, debated, and decided by the two coders. Because a team mental model is knowledge shared by team members, we decided that for a code to be created, at least half of the participants with various functional characters (tank, healer, and damage dealer) possibly holding various point of views in teamwork, must explicitly said a statement belonging to the code.

The coders selected the statements that were most typical for each code and gradually categorized all relevant statements into codes. Issues were discussed and debated until they were resolved. Third, if one coder asked to revise/remove the initial codes, the first and second stages were repeated. Several iterations were sometimes needed to reach the final consensus. The protocol statements of question 2 (How does the team form and transform?) were randomly selected as the training materials for the two coders. For the remaining four questions, three stages of coding were the same as in the training, except that the authors coded the statements independently and no discussion was allowed. Seventeen codes were extracted (see Table 3) in the descriptive coding process. The inter-rater reliability was calculated separately for codes of five questions (Kappa Coefficients = .919, .872, .713, .939, and .875 respectively, Cohen, 1968) that demonstrated from substantial (.61–.80) to almost perfect (.81–1) consistency between coders (Landis & Koch, 1977).

Because complex essences were indexed within each one of the 5-W questions in the first cycle, we decided to process a second-cycle coding using "pattern coding" method (Saldana, 2009, pp.152–154) to infer emergent configurations or meaningful explanations (see Fig. 1).

Table 2
Three categories of war functions, avatar class and gamer ID in the targeted team.

*Function: A **Tank**-(main or other tank) absorbs damage and prevents others from being attacked.*				
Main function	Supporting functions	Avatar Class	Gamer ID	Ability level
Main Tank	None	Warrior	Luffy	70
Other Tank	Healer & damage dealer	Paladin	[a]Fred	70
Other Tank	Healer & damage dealer	Druid	Sanji	70
Other Tank	Damage dealer	Warrior	Tom	70
*Function: A **Healer** heals and supplies blood to other avatars that are injured in battles.*				
Main function	Supporting functions	Avatar Class	Gamer ID	Ability level
Healer	None	Paladin	Usopp **(RL)**	70
Healer	None	Priest	[a]Wait	70
Healer	None	Priest	Maslow	70
Healer	None	Paladin	[a]John	70
*Function: A **Damage Dealer** attacks and controls the fighting situation.*				
Main function	Supporting functions	Avatar Class	Gamer ID	Ability level
Damage Dealer	Healer	Priest	Chopper	70
Damage Dealer	None	Mage	Nami	70
Damage Dealer	None	Mage	Zoro	70
Damage Dealer	None	Warlock	[a]Anderson	70
Damage Dealer	None	Rogue	[a]Desperado	70
Damage Dealer	None	Rogue	[a]Blaze	70
Damage Dealer	None	Rogue	[a]Grail	70

[a] The gamer did not participate in the interview.

Table 3
The structure of the interview questions, definitions and the findings of the team knowledge of a successful WoW raid team (Total statement = 167).

Questions	Definitions	Descriptive codes generated from 1st cycle coding	$N_{\text{Statement}}$ (%) $P_{\text{Person giving statement}}$ (%)
Q1. What is the distinctive **feature** of the team? Statement: 33	Distinctions between the current team and other teams, e.g., those undertook the same and different raids, teams in the same guild and out-of-guild teams.	C1.1 Full-time workers with inflexible game schedule	7(21.21%) 5(71.43%)
		C1.2 Relaxed team requirements with loose regulation and tolerating carelessness	8(24.24%) 6(85.71%)
		C1.3 Having bad luck in gaming	9(27.27%) 4(57.14%)
		C1.4 Criticized as being elite managers who focused mainly on self-profit	9(27.27%) 4(57.14%)
Q2. How does the team **change**? Statement: 25	The remarkable development of the team (its past, current and future state) and apparent transformation landmark.	C2.1 Trust was the basis of the initial team building	12(48%) 5(71.43%)
		C2.2 Many difficulties and challenges occurred in the early raiding stage	8(32%) 4(57.14%)
		C2.3 The aim of fighting in the final raiding stage was to prepare for a new raid	5(20%) 5(71.43%)
Q3. What are the noticeable **interaction** features of the team? Statement: 31	The team interaction features perceived by members, e.g., member's cohesion, satisfaction, and values. Additionally, criticism and the strengths-weaknesses of the team as a whole.	C3.1 Rarely adhered to strict rules	14(45.16%) 6(85.71%)
		C3.2 Valued friendship over fairness	9(29.03%) 5(71.43%)
		C3.3 Pursued a sense of bonding and friendship	8(25.8%) 4(57.14%)
Q4. What is the team **norm**? Statement: 62	Team rules that members recognized and complied with, including explicit and implicit rules (e.g., war equipment assignment, scheduling agreements, negotiations, and crisis responses).	C4.1 Explicit responsibility of the raid leader	8(12.90%) 5(71.43%)
		C4.2 Organizational compensation – support of Main Tank by the guild	12(19.35%) 5(71.43%)
		C4.3 Shared responsibility for player deployment	17(27.42%) 5(71.43%)
		C4.4 Mutual benefit principle of war equipment assignment	14(22.58%) 4(57.14%)
		C4.5 Code of crisis management	11(17.74%) 5(71.43%)
Q5. How **successful** is the team? Statement: 16	Team members' opinion of "success".	C5.1 When they gained first victory, received honor from outsiders, and good feelings emerged from collaborative gaming	7(43.75%) 4(57.14%)
		C5.2 Overcoming many difficulties persistently	9(56.25%) 5(71.43%)

Mingled across the codes extracted from a single data basket in one of the 5-W questions, 6 categories reflecting the patterns of team works and joint pleasure enjoyments were emerged. Among 6 categories, we then theoretically extracted two common "themes" (Saldana, 2009) guided by a cognitive approach of knowledge representation (ACT-R model, Anderson, 1983) and the SDT model of motivation (Self-Determination Theory, Deci & Ryan, 2000). These themes were the core contents of the team mental model that was placed as the most abstract level named as "theory" (Saldana, 2009) in the two-cycle coding process. Field notes written by the interviewer and content analyzers served as information for data triangulation.

4. Results

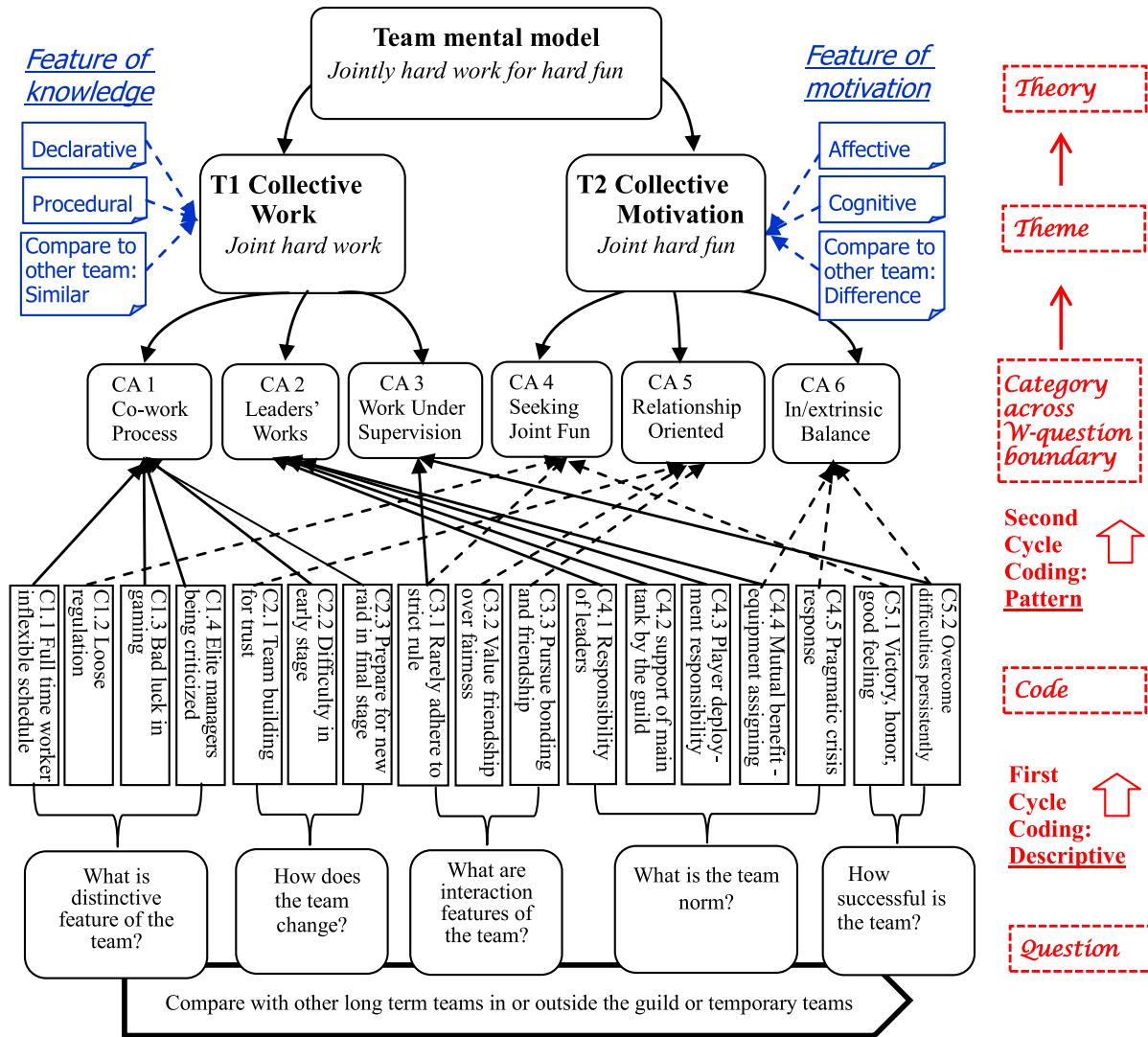### 4.1. Codes generated from the first cycle coding process

The interview protocol produced 167 meaningful statements that were treated as data for content analysis. Codes (C1.1–C5.2) are presented in Table 3 according to the sequence of the 5-W questions. The number (percentage) of the statement assigned to one of the codes and the number of person who offered the statement are listed in the right column of Table 3. A code is described and followed by the typical statement(s) we selected.

Question 1. What is the distinctive feature of the team?
Explicitly Compared with other long-term teams inside/outside the guild and temporal teams (teams that are established temporarily for a short-term goal, most of whom do not join any guild), the members regarded the raid team as a team formed by full-time workers with an inflexible gaming schedule (code1.1, C1.1 in Table 3), having relaxed team requirements with loose regulation and tolerating carelessness (C1.2), having bad luck in gaming (C1.3), and being criticized by other gamers in their guild as elite managers who focused mainly on self-profit (C1.4).
Code 1.1. A team formed by full-time workers with an inflexible gaming schedule (7 statements, 21% statements collected from question 1)
Most often, WoW gamers are college students. This team was different in that all team members were adults with full-time jobs who were unable to play the game during work shifts. Raiding implies a responsibility to keep up with a preset schedule and the goals

Fig. 1. Two-cycle coding process is shown in the right-hand side and the results in the left-hand side. The first cycle coding was for descriptive purpose in which 17 codes were extracted from the interview protocol collected with 5-W questions. In the second coding cycle, we searched for particular patterns among 17 codes across questions. Six categories were emerged as meaningful units and then were grouped as two core themes of the team mental model: "gaming requires joint hard work" and "there is collective gaming pulls to seek for joint hard fun." In general, "Jointly hard work for hard fun" is the theoretical highlight of the team mental model shared by the gamers in the studied team.

of the team. Full-time workers need to balance many life obligations with raiding. Hence, when some members could not participate in a raid, the major responsibility of the raid leader (RL) was to find substitutions.

We are not that free because we all have full-time jobs. Our raiding progress was therefore rather slow. Sometimes it was just hard to have all of us go raiding. When we found some partners couldn't join in one day and another couldn't raid tomorrow either, we then realized that it must hold this week. (W-06-03)

Code 1.2. A team having relaxed team requirements with loose regulation and tolerating carelessness in raiding coordination (8 statements, 24%)
    Compared with other raid teams, the members felt that their team was more concerned about enjoyment during raiding and was less demanding of players' gaming functions, progress, and equipment. Team management was loose, and careless operation or coordination was often tolerated. The members preferred fun over winning combats rapidly or collecting treasure/equipment, which is the main goal of most raid teams.

Our team would make fun, relaxing…, but other teams would care more about raiding progress, gathering more treasures, award distribution. (L-10-03)

Code 1.3. Having bad luck in gaming (9 statements, 27%)
    The team felt that they were extremely unlucky. Many times, they obtained unwanted rewards from their battle accomplishments. To obtain the necessary equipment and treasure, they sometimes had to return to a completed task and refight the same battle. For

the team, the fun of gaming was found in hard work. They felt that fun and enjoyment were not equivalent to easy tasks.

When a certain expected or needed reward did not come out, we had to come back fighting again to see if it would appear or not. (C-12-03)

Code 1.4. They were criticized by other gamers in their guild as elite managers who focused mainly on self-profit (9 statements, 27%)
Because our participants had achieved very high ability levels and were acknowledged as leaders in the guild, other gamers in the guild complained that this privileged team exclusively comprised leaders; thus, they considered this team self-focused profit takers. The members were accused of using the public resources of the guild to serve their purposes. As expert gamers, they had undertaken the responsibility to run the guild in a fair manner.

There were many opinions opposing us…. This actually resulted in the fall and break-up of the guild. Because we were leaders, yet we seemed less concerned about guild gamers. We took many resources, while at that time there were still more than 50 players actively participating in the guild who also needed the resources. (G-05-05)

Question 2. How does the team change?

Reflecting on the team's transformation, the members stated three common developmental characteristics of the team (compared with other game teams) and were coded as: trust was the basis of the initial team building (C2.1); many difficulties and challenges occurred in the early raiding stage (C2.2); and the aim of fighting in the final stage of a previous raid was to prepare for a new raid (C2.3).
Code 2.1. Trust as the basis of the initial team building (12 statements, 48% statements collected from question 2)
Previously, most players in the guild had participated in a raid requiring 40 players; therefore, most of the participants had previously gamed with the others. At the formation of the current raid team, the members intended to invite familiar and trusted ones from among the guild gamers who were qualified to participate in the most advanced raid (at the time of the interview, level 70 was required, which was the highest level at the beginning of their fighting). Many of the participants in this study had real contacts (extending their virtual relationships into physical contacts) or had developed previous social relationships (such as friends, roommates, or customers) to game together. In contrast, members in other "temporal teams" are not acquaintances or friends.

In the beginning of raiding in Karazhan, we looked for familiar and trustworthy friends because we hadn't reached the higher level yet. …In most teams, members could be any gamer who wants to get in (C-02-01).

Code 2.2. Many difficulties and challenges occurred in the early raiding stage (8 statements, 32%)
The purpose of the team was to confront a new raid. It was quite challenging, even for them, and they were excited to initiate a series of challenging tasks. During the series of battles, they failed many times due to their lack of experience and luck as well as poor teamwork. It took the team three to four hours per day and several days each week to accomplish the serial missions. The initial stage of the new raid involved joint hard work.

At first, we knew nothing about this raid. We had poor teamwork and strategies, which resulted in many game-overs. We had to start fighting again and again. (P-02-01)

Code 2.3. The aim of fighting in the final raiding stage was to prepare for a new raid (5 statements, 20%)
After overcoming many difficult missions, the team developed effective raiding and coordinating strategies. The battles then became routine and less challenging. The members fought only to upgrade their levels and collect equipment in preparation for their next new raids or for other guild raid teams. At the later stages of this raid, the members were confident in final success but continued to work hard to store supplies for future battles.

Gradually, the purpose of our battles in the raid changed. It was to obtain certain rewards for the preparation of the future raids, not a must-do task for the current raiding. (C-13-03)

Question 3. What are the noticeable interaction features (climate) in the team?

For this team, three team member interaction features (climate) were acknowledged by most of the members: the team rarely adhered to strict rules (C3.1), valued friendship over fairness (C3.2) and pursued a sense of cohesion and a good relationship (C3.3).
Code 3.1. Rarely adhered to strict rules (14 statements, 45% statements collected from question 3)
Participants felt that for most other raiding teams, teamwork was very much like work at a pay job. They reported that raid teams are frequently managed in a highly structured manner with strict rules to ensure fairness among members and success in gaming. However, the members of this team tended to pursue pleasure and were reluctant to follow strict rules. They were administrative leaders of the guild who were familiar with and knowledgeable about the rules of gaming and team management. However, in this particular team, rules were not seen as a priority.

I don't want to always talk about fairness as in other teams; instead, I care more about the humane atmosphere in our team. (L-06-03)

Code 3.2. Valued friendship over fairness (9 statements, 29%)
For other teams, fairness is a central issue in team management. To encourage members having individual goals to pursuit collective goals, they need to know that they would be treated fairly. For example, gamers may need specific equipment to fight certain battles with the aim of attaining higher levels for their characters. All team members place great attention on the award assignment mechanism. Fairness is critical; otherwise, guild or team members may complain, conflict, or break up. This team differed because most of the members had been comrades and friends for a long time, so they valued friendship over fairness.

It is easier to work with fewer people…easier to address things…there will not be a dispute over fairness because relationship is more important than fairness. (P-06-03)

Code 3.3. Pursued a sense of bonding and friendship (8 statements, 26%)
In addition to gaming together in the virtual world, most of the members attended physical gatherings occasionally. Some players on this team developed closer relationships through gaming. For others, the purpose of raiding was to accompany and bond with their friends.

People like Chopper come to my company to have meals. Gradually, I think we gamed for a sense of bonding. If we gathered only for winning the game, our team would not last for long. (G-06-07)

As time has gone by, the game has become like a tie or bridge between us. We say hello to one another over the Internet, even on the days we do not play. (G-02-03)

Question 4. What is the team norm?

Members mentioned five principles as their norms: explicit responsibilities of the raid leader (C4.1), organizational compensation (support of the main tank by the guild) (C4.2), shared responsibility for player deployment (C4.3), the mutual benefit principle of war equipment assignment (C4.4), and the pragmatic principle of crisis response (C4.5).

Code 4.1. The responsibilities of the leaders were explicitly (8 statements, 13% statements collected from question 4)
All of the participants addressed some aspects of the raid leader's (RL) and the main tank's leadership and influences. The main tank is the head of the missions. S/he must survey WoW blogs, watch gaming videos of other competitive teams to plan a set of actions/ strategies beforehand and be a person whom team members trust during battle actions. The RL is the administrative coordinator and it is the responsibility of the RL to negotiate with team members about gaming schedule, player deployment as well as distributing rewards and equipment.

What if we only have eight players but lack another two today? Ask the RL! It is the RL's business to address all types of scheduling, communicative, and coordination problems. (C-19-06) (C-20-02)

Code 4.2. There was organizational compensation – support of the main tank by the guild (12 statements, 19%)
A tank may be hurt badly on a mission but cannot be easily replaced. It is not easy to sustain a main tank. Consequently, a guild tradition exists that in a team of more than 10 players, the damage expenses of a main tank are reimbursed by the guild. Because of this financial support, no matter how tired a main tank might be, it must lead the mission according to the preset schedule. This expectation shows that the guild is run very structurally.

I (Luffy) force myself to go on a mission anyway, regardless of my tiredness. Without a main tank, it is impossible for a team to go on a mission. Because my avatar is supported by the guild, I have a responsibility to assist others. (G-08-04)

Code 4.3. Shared responsibility for player deployment (17 statements, 27%)
According to the gaming requirements and previous history of failure and success, the RL arranged the player deployment to form a weekly gaming schedule. Finding a substitute for an absent player is a critical issue that must be formally discussed among team members.

You must be careful to choose a substitute from a number of players because if the substitute makes a mistake, the performance of a team would be weakened. Oftentimes, we would all die. (M-03-05)

Code 4.4. The mutual benefit principle of war equipment arrangement (14 statements, 23%)
The guild maintains a record of every player's key performance indicator (KPI) history to sustain accountability. The higher a player's score, the more and better equipment the player obtain. The reward is assigned based on the raider's contribution. By contrast, on this team, equipment was distributed according to individual needs, not performance.

Those who were well equipped would give the rewards to other members in need. The upgrade of all members' war equipment in our team could improve the team's overall fighting power. (L-15-02)

Code 4.5. The pragmatic principle of crisis response (11 statements, 18%)

At the beginning of a new mission, poor teamwork by the team resulted in often failure or a game-over. When a series of failures or intolerable mistakes occurred, the members became impatient or blamed one another. Because of repetitive failures, the team experienced inner crises. However, these crises remained under control. Through harsh conversation, the members were able to examine the reasons for failure and to find alternatives and strategies that enabled them to win.

Even though we were friends, we had crises of accusation. Blaming or criticizing others was an emotional outlet but could also be viewed as a way to find out the problems, to see if someone hadn't done his work. (L-06-07)

Question 5. How successful is the team? Does the team succeed from any perspective?

For these team members, there were two types of success in the game: when they gained first victory, received honor from outsiders and good feelings emerged from collaborative gaming (C5.1); and when they found they could overcome many difficulties (C5.2).

Code 5.1. Success means when they gained first victory, received honor from outsiders and good feelings emerged from collaborative gaming (7 statements, 44% from question 5)

The team members defined their success according to the following three conditions: the first defeat of a challenging monster, the honor produced by the uniqueness or excellence of the equipment worn by their avatars compared with that worn by their fellow gamers in the guild or outsiders, and genuine good feelings produced by good teamwork.

It was the happiest moment to finally knock down the monster, which might have taken us a month to defeat it. (G-10-01)

It was the honor. That is, having unique but rare equipment gave me a sense of superiority. (G-06-03)

Rewards were secondary to the good feelings. It was the excitement that made it worthy of the time spent raiding. (F-07-03)

Code 5.2. Success comes when they overcame many difficulties (9 statements, 56%)

The difficulties experienced in the battles of a top-rank new raid inspired the members to overcome them. Quarreling about mobs and monsters that have not been defeated for over a month and finding solutions to problems made the process enjoyable. Again, the members commented that gaming was a way to seek "hard fun." Fun and enjoyment are valuable because they are not easy to gain.

It was so exciting and wonderful to defeat mobs successfully after countless failures. We tried too many times. At the final battle, we should have died but won and were alive. It was a great experience. (P-02-04)

4.2. Category, theme, and theory generated from the second cycle coding process

4.2.1. Category

Because abundant topics were identified from the first cycle coding, we decided to undertake a second cycle coding. Firstly, 6 "categories" (CA1-CA6) were extracted when the codes across 5W-questions were connected to infer meaningful configurations (see Fig. 1).

Three categories reflect the patterns of team works: CA1 "co-work process" was formed combining five codes [C1.1, C1.3, C1.4, C2.2, C2.3], CA2 "leaders' works" combining four codes [C4.1, C4.2, C4.3, C4.4], and CA3 "work under supervision" combining 2 codes [C3.1, C5.2]. While, another three categories demonstrate patterns of joint enjoyments: CA4 "seeking joint fun" combining 3 codes [C1.2, C3.1, C5.1], CA5 "relationship oriented" combining 3 codes [C2.1, C3.2, C3.3] and "balance between intrinsic and extrinsic motivation" also combining 3 codes [C4.4, C4.5, C5.2] (see Fig. 1).

4.2.2. Theme and theory

Based on our focus on the differences and similarities between the game team and work/learning teams as well as guided by cognitive and affective learning theories, we suggest 6 categories could be theoretically segregated into two "themes." Theme 1 (T1) was derived from categories CA1 to CA3 addressing the work aspect – our participants agreed on the general notion that "gaming requires joint hard work." We regard this as the similarity between this game team and other ordinary work/learning teams. Theme 1 appears to include both declarative and procedural knowledge. Examples of declarative knowledge include facts about the virtual world environments, battle events, and members' backgrounds, personalities, and gaming habits. Examples of procedural components include how to navigate characters in the virtual world, kill mobs with a certain type of weapon, jointly complete a combat with the forces of the tank, healer, and damage dealer, and distribute raiding rewards.

Theme 2 (T2) was derived from categories CA4 to CA6 manifesting the motivational aspect – the participants stated that "there is a collective gaming pull to seek for joint hard fun." We suggest that this is the difference between this team and work/learning teams. Theme 2 shows two basic motivational features: affective and cognitive evaluations. Examples of the affective component include positive emotions (such as fun, enjoyment, contentment, pride, or excitement) and negative emotions (such as anger, sadness, boredom, or distress) perceived

in successful or frustrated gaming events. Examples of cognitive evaluations include setting goals for battles and interactions as well as determining the value of rewards, achievement, and bonding.

Finally, three levels of patterns were emerged from the lowest to highest levels, category, theme, and theory. Two themes were synthesized into so called "the team mental model" that was placed at the most abstract level, namely "theory" (see Fig. 1). The contents of the team mental model for our participants showed "Jointly hard work for hard fun."

5. Conclusions and discussion

This study aimed to explore the content of the team mental model in a successful WoW raid team. Five-W questions (Levine & Moreland, 1991), focused on team interaction and integration, were used to interview seven expert raiders. The interview protocol produced 167 meaningful statements that were treated as data for content analysis. The content analysis was conducted with two cycle method (Miles & Huberman, 1994; Saldana, 2009) from exploratory to explanatory. The first cycle coding used descriptive coding method (Saldana, 2009; Wolcott, 1994) to extract the participants' own wording. Because 17 codes composed of 5–17 statements across 4–6 participants holding various gaming characters (tank, healer and damage dealer), we regard that knowledge convergence were emerged about gamers' direct experiences, such as the problem at hand, actors/characters, events, joint affects and group outcomes – what the core gamers together have experienced through the collaborative gaming process. The descriptive codes showed our team appeared to share a common view of what was happening, what was likely to happen next, and why it was happening, in accordance with the findings of previous team mental model studies (Cannon-Bowers et al., 1993). We suggest that the shared knowledge allows team members to perceive the tasks and describe information in a similar manner, to share expectations concerning team functions, and to develop similar explanations for a gaming situation (Cannon & Edmondson, 2001; Kleinman & Serfaty, 1989; Mohammed & Dumville, 2001). Although we decided to elicit only team-related knowledge, the task work aspect was still a notable component of the team mental model. This result is in accordance with findings collected from working and learning teams (Cannon-Bowers et al., 1993; DeChurch & Mesmer-Magnus, 2010).

The second cycle used pattern coding method (Miles & Huberman, 1994; Saldana, 2009) to produce three hierarchical levels of team mental model, namely the "category," "theme," and "theory." Because the authors focused on the differences and similarities between the game team and work/learning teams and intended to interpret the findings of first cycle coding with cognitive and affective learning theories, the synthesis in the second cycle is theory directed. Six categories, mingled from 17 codes across question boundary, showing collective knowledge of co-work process, leaders' works, work under supervision, seeking joint fun, relationship oriented, and balance between extrinsic and intrinsic motivations. From these categories, two themes were immediate synthesized: the team (1) performed "joint hard work" for (2) seeking "joint hard fun." In general, the expert gamers' team mental model had two core themes, one about collective work and the other about collective motivation.

For the first core theme in expert gamers' mental model, it appears that raiding involved hard work, practice, and coordination. The results are in accordance with findings regarding the task work aspect of the team mental model in previous studies of simulative and real military teams as well as air control tower teams (Lim & Klein, 2006; Marks et al., 2002; Mathieu, Rapp, Maynard, & Mangos, 2010). Gaming requires hard work is further stressed by that the duties of leaders (RL and main tank) were demanding. This finding echoes the results of serial studies about MMORPGs (Ducheneaut & Moore, 2005; Ducheneaut, Yee, Nickell, & Moore, 2006a, 2006b, 2007) and leadership in the mental model literature (Burke, Fiore, & Salas, 2004). The first theme displays cognitive features of knowledge stored in these experts' long term memory. It appears to include both declarative and procedural knowledge which was introduced by Anderson in ACT-R model (Adaptive Control of Thought – Rational, Anderson, 1983; Anderson, Fincham, Qin, and Stocco, 2008). Examples of declarative knowledge and procedural components were analyzed in the result section. This result is accord with the notion made by previous team mental model studies (Klimoski & Mohammed, 1994; Lim & Klein, 2006; Mohammed & Dumville, 2001) that team mental models include both shared representations of preexisting declarative and procedural knowledge.

The second core theme in expert gamers' mental model demonstrates remarkable level of motivation to play through paying tremendous efforts. Our result confirmed the conclusions on gaming motivation presented by Przybylski et al. (2010) and an empirical study by Ryan et al. (2006) that gaming fun or enjoyment does not mean that the tasks must be easy. Although our expert gamers faced many difficulties and invested a great deal of effort and time, their goal was to enjoy "hard fun." They were similar to the sports heroes who work very hard at improving their sports skills or the successful businessmen who enjoy working hard at making deals. Because they gained increasing competence and aimed for an autonomous state of seeking fun and positive feelings, we suggest that this type of motivation corresponds to the "competence" and "autonomy" factors of intrinsic motivation defined in Self-Determination Theory (SDT, Deci & Ryan, 2000; Ryan & Deci, 2000) as natural psychological needs during human growth. Other examples revealing collective motivation of our expert gamers include equipment arrangement was based on each player's individual needs rather than performance. This principle was very different from the principles of other game teams and work/learning teams; however, Ducheneaut et al. (2006a) has observed the social dynamics of online gaming teams and suggested that trust is the basic component required for high-quality interactions in effective game teams. Our result showed that high level of intrinsic motivational was a critical component in the content of team mental model, while in contrast, previous team mental model researchers emphasize more on pure cognitive process and functions of team mental model (Cannon-Bowers & Salas, 2001). Because this study focused on the teamwork/interaction aspect of team mental model, not on the task aspect, we found ample evidences that members shared motivational beliefs of team mates and motivational events in gaming. Though the conceptualization of motivational aspect in team mental model has been addressed in the definition level by Cannon-Bowers and Salas (2001), it has seldom been empirically studied up to date. Studies of social cognition (e.g., Levine & Pizarro, 2004; Wilson, Meyers, & Gilbert, 2003) have proved that individuals remember previous emotional or motivational episodes when they cued by strong positive and negative feelings. Memory for the emotions evoked by past events regulates individuals' ongoing behaviors and future plans (Levine, Lench, & Safer, 2009). Therefore, we suggest future study could unfold this issue of team mental model based on the current development of social cognition.

This game team's uniqueness may be attributed to the members' strong intrinsic motivation for team actions and a balance between intrinsic and extrinsic motivation. For many teams in working and learning settings, a vital factor of intrinsic motivation, autonomy, is limited or even prohibited. For example, teachers must set up semester goals of a course and weekly goals of classes, monitor students' progress, and evaluate whether goals have been achieved; in this teacher-leading context, students' autonomy is easily neglected. Many

classroom teams and teams in computer-supported collaborative learning (CSCL) often passively follow teachers' instruction rather than actively engage their minds and efforts (Jones & Issroff, 2005; Wang & Lin, 2007), making a remarkable contrast with our game team.

The results of current study could contribute to form effective teams and to encourage engagement in CSCL. Most CSCL teams are not formed based on personal volition (e.g., Wang, Lin, & Sun, 2007) and the tasks are assigned externally. Our results imply that teacher must carefully design collaborative tasks and activities to enhance students' sense of autonomy and competency as well as positive emotions. Project-based learning with inquiry principle allowing more personal choice of project theme and working method are potential strategies that teacher can try. Positive emotions are valuable treasures that might be obtained even in struggling learning process if quality or humorous project leaders as well as the empowerment from teachers are in presence. Most school curricula and hence CSCL tasks lack the concept of "hard fun," not because what is learned in school is inherently not fun but because designing "hard fun" instructional materials and activities requires flexibility, student control, and a willingness to avoid "instilling" students with only one correct concept in one correct manner. Due to a lack of autonomy and interest, many workers or students exhibit "amotivation" (lacking the intention to perform a behavior or lacking motivation, Deci & Ryan, 1991) or "negative motivation" (avoidance of learning/working, Chiang, Yeh, Lin, & Hwang, 2011; Elliot & Church, 1997). If a work/learning team fails, it bears a substantial resource loss (e.g., money, time, or the life of members). Therefore, a real team must work carefully. However, the online game team expressed that they have the opportunity to repeatedly tackle the same combat tasks. "Game-over" was not a stop sign for them; instead, it might be the beginning of a repeated operation process and even team development. These repeated processes allow continuing practice when all members have perished in the previous round. Because gaming allows repeated failures, it may provide a unique simulation space for teams to practice the skills of communication, cooperation, leadership, and many other team coordination functions. The world may be virtual, but its social interaction is real. Group games could be a practice space to build communication and cooperation skills.

This study has several limitations. First, The characteristics of our targeted game team seemed more similar to both action and project teams than to decision-making teams following team taxonomy of DeChurch and Mesmer-Magnus (2010). On the one hand, team members in gaming battles face similar situations as those faced in military combat or sports, and they need to possess high levels of behavioral interdependence. On the other hand, the members have various gaming roles, functions, and strengths and work together to accomplish raid tasks. The results found in this study could be generalized to the project teams and action teams. Second, this study is in nature a case study, we invited only one team with several expert gamers. It would be interesting to invite less successful teams and/or gamers with less experiences or skills for the comparison of team mental model. With larger sample size, investigation using questionnaire can be conducted. The current findings can be used to construct a questionnaire (for example, a statement such as "Is pleasure more prominent than performance in your team?") which can be administered to invited team members. Third, although we did not study how does a learning team's mental model develops and how it relates to a team's learning performance, it would be a major issue in learning science when introduce team mental model from organizational psychology filed (Van den Bossche, Gijselaers, Segers, Woltjer, & Kirschner, 2011). We suggest that future studies should be conducted to further explore the characteristics of team mental models and the relationship between the quality of a team mental model and team-level performance for CSCL or classroom teams.

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