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High-level Cooperative Behavior Model of Online Summit Games

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Abstract: In online summit game system (OSGS), a strategic game was designed to incorporate issues and conflicts between countries that allows players to take on roles in the gaming scenario to engage in a high-level cooperation. This study analyzed the intra-group interaction and high-level cooperation process of summit game. The Interaction Process Analysis (IPA) proposed by Bales is used as an analysis tool to analyze high-level cooperation in online summit games. The results show that, the players are very focused in accomplish tasks trying to give ideas, expressing feelings, giving suggestions and strategies. The setting of issues in strategy games strengthened the conflict between countries in each event, which enabled meaningful discussion, negotiation, and problem solving among students, which illustrate the high-level cooperations among group members.

Keywords: Game-Based Learning, High-level Cooperative Behaviors Analysis, Strategic Game

1. Introduction

1.1 Research goal

Cooperative learning is a way of learning together, in a networked environment, without the constraints of time and space. It allows all participants to exchange information and resources with each other anytime and anywhere (O'Malley & Scanlon, 1990). Students can exchange their ideas and what they have learned, learn from each other, help and correct mistakes, learn to think from different points of view, and learn to cooperate and compete. The continuous interaction between individuals and their environment is essential for the development of cognitive understanding (Ben & KedemFriedrich, 2000). Interaction among team members can create new ideas, and interaction is considered a key reason for creating new ideas and maximizing the value of knowledge (Kang, Rhee, & Kang, 2010). Interpersonal trust can be effective in fostering strong interpersonal relationships among team members and in improving team cohesion. Cooperative learning is an experience of cooperative interaction through mutual help, discussion, and argument. Its most important goal is to provide students with the knowledge, concepts, skills, and understanding to become happy and contributing team members (Slavin, 1995). While general cooperation focuses on friendly behaviors among students, high-level cooperation intertwines self-beneficial and altruistic behaviors for both individual and common goals.

In this study, a strategic game was designed to incorporate issues and conflicts between countries that allows players to take on roles in the gaming scenario to engage in a high-level cooperation. In the game, players not only have their own goals to accomplish that can be contradictory to each other, they also have to reach consensus to solve the conflicts between them through negotiations. The game is presented in the online summit game system (OSGS).

1.2 Research questions

In this study, players have different goals in a strategy game because they have their own division of tasks and need to continuously resolve the conflicts emerging from each event in the game. Players should negotiate effectively with their peers, within and across groups, during the conflicts and

eventually achieve a high-level cooperation to achieve the game goal. The research questions for this study is to investigate what the players' high-level cooperation strategies in the online strategic game in the intragroup discussions.

2. Related work: High-level Cooperation

Cooperative learning emphasizes the nature of learning, including personal responsibility, social skills, and teamwork. Group discussions allow team members to share ideas and pass on information, as well as challenge each other, which helps to achieve a higher level of cognitive understanding. Students expand their thinking by discussing with each other in a way that guides them to expand their thinking, allows them to engage in higher level cognitive thinking, and stimulates their multiple learning development. In such an environment, students can collaborate on complex, interesting, and openended tasks that are internalized as part of their independent development (Nijhof & Kommers, 1985).

The knowledge gained from communication and interaction is an important resource for a group's competitive advantage (Alavi & Leidner, 2001), and groups must create new knowledge to maintain an advantage in a rapidly changing environment (Szulanski, 1996). Knowledge is an indispensable resource in interpersonal interactions, and effective interactions make teams more competitive (Argote & Ingram, 2000). Effective interpersonal interactions among team members are highly competitive, but successful interpersonal interactions are difficult to achieve (Argote, Ingram, et al., 2000), and interpersonal trust comes from interpersonal interactions and has a significant impact on interpersonal interactions (Levin & Cross, 2004). Interpersonal interaction is not only a behavior but also a complex interactive process (Nonaka & Takeuchi, 2007). That will involve a large number of social behaviors such as knowledge sharing, interpretation, and integration (Argote & Ingram, 2000), and is an important and effective way to facilitate teams (Yu, et al., 2013). To sum up cooperation are generally friendly, self-interest and altruistic, from the above literatures, the cooperation has three types of cooperation are: (1) active interdependence: work together with team members to complete the task; (2) not alone: when facing complex problems, each person may have his or her own opinion, try to communicate with team members to get a better solution; (3) compromise consensus: Adopt the opinions of both sides and find the points that can work together.

Cooperation focuses on friendly behaviors among players, in which self-interested and altruistic behaviors are intertwined for a common goal. In this study, the strategy game incorporates issues, creates conflicts between countries, and allows players to divide roles. Because of the conflict between countries, players have their own goals to accomplish and a consensus to solve the conflict, they can express their views and opinions through negotiation, and then achieve the goal of solving the task through learning and consensus to achieve high-level cooperation.

This study uses Bales' Interaction Process Analysis (IPA) to classify the content of players' ingroup textual communication in the internal affairs session of the game. Bales' definition of a group has nothing to do with the size of the group, but with the fact that any group member in the group has a clear enough impression or perception of each of the other members so that some reactions can be made to each person at the time or in subsequent questionings, even if it is just recalling the presence of another person (Bales, 1950). IPA focuses on the interpretation and classification of observed behaviors. The observer must infer the intent and meaning of the observable actions. It is an analytical tool for group interaction that is widely used in research, especially for analyzing problem-solving processes. If group members' behavioral patterns are mostly focused on positive reflections, it can be seen that group members are generous in praising group members; and if behavioral patterns are focused on attempting to answer and connoting problem, it can be seen that group interaction is strong, and the above behaviors are more positive for intergroup cooperation. Bales interaction process analysis was originally developed for face-to-face communication, but it has been used in computer mediated research as well (Maloney-Krichmar & Preece, 2005).

3. Online Summit Game Design

Online Summit Game System (OSGS) uses WAMP (Windows-Apache-MySQL-PHP) architecture as a web server framework. WAMP is a group of free software names that run dynamic web sites or servers at the same time. Sublime Text is used as the program editor. The front-end consists of three major elements: HTML for web scaffolding, CSS for web design layout, and JavaScript for presenting web

dynamics, which is the programming and language for the game interface style and function design, while the back-end consists of PHP and MySQL for storing and reading game data files through multiple data tables.

The game mechanism in this study is based on the maker game for the Great Voyage <Fragrance Channel> developed by Shih, Huang, Lin, and Tseng (2017), which uses the 17th century spice trade in the Great Voyage time as the game scenario. Two gaming objectives include the total assets of each country increases, and all crises presented in the game are resolved with consensus. The rise of the national assets requires spice trading to earn income; and the conflict resolution requires intragroup action strategies and intergroup negotiations.

Account passwords are created for every role of each country in OSGS. Players role-play as captain, diplomat, trader, or internal affairs officer in the five countries, namely England, France, Portugal, Spain, and Netherland. The roles in the game are randomly assigned to the players to draw randomly so they do not know who is beyond the system in the game. Before the game, the teacher introduces the background of the game and guides players through the context.

This game is divided into several phases (Figure 1). Phase one is the opening scene with territorial competition through auctions, "Preemption". Since the initial wealth and manpower of each country are different, each country has to occupy colonies in phase one to plant spices to earn income. Then the game enters phase two in which three historical crises are presented and needed to be solved all at the same time. The three crises were designed to inter-related to each other whereas the resolution of one crisis might affect the decision of the other two. The first crisis is "Scurvy", wherein a mysterious sailor's disease appear and cure needed to be found to prevent sailors' death. The second crisis is "The Treaty of Tordesillas" which divided the newly discovered land outside of Europe between Spainish and Portuguese Empires. In the history, the lands to the east would belong to Portugal and the lands to the west to Castile which had caused colonies of the European countries whereas other European countries might choose to ignore the treaty. The third crisis is "The Hundredyear Hatred" in which a military conflict fought between France and England occur. However, the long-standing confrontation between England and France was thought to be committed by France but turned out to involve Netherlands' conspiracy in the game (designed to increase gamified involvement of all countries). In all crises, there were secret information to some of the countries that increase the negotiation tension between them.

In phase two, players have to find treatments to the crises in three rounds. Each round goes through four stages. First stage is internal affairs. Each country has to make the strategic plans for the crisis resolution, prepare for the declarations, and make the inventory. Second stage is diplomacy. This time is for international negotiations to make new rules and reach consensus on treating the crisis. The challenge is for each country is to accomplish their own goals but at the same time to comply for common benefits. The third stage is declaration. The captain will make declarations on behalf of each country annoucing their final decisions to crisis treatments and posting their stands to the international conflicts. The fourth stage is settlement. The pope will evaluate the international conditions based on declarations and make settlement to crisis resolution outcomes.

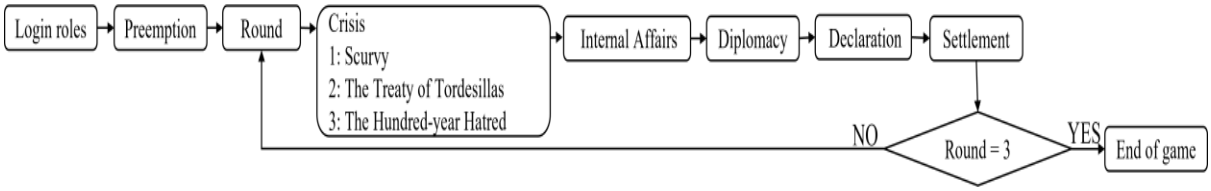

Figure 1. Game flow

Placing different issues in the game allows players to present their individual views and positions to the issues which is a good opportunity for players to learn teamwork, communication, coordination, and independent thinking, as well as to establish good value system. In this study, the background of the 17th century maritime era was used as the game scenario that comprises the knowledge of geography, history, and various disciplines including health issues. With the game mechanism, the players were guided to take the initiatives, cooperate as a team, and solve the situational problems in the game, which is very important for reaching the high-level cooperation among the group.

4. Research design

4.1 Research Framework

Fifteen graduate players majoring in educational technology and network information in Taiwan was invited to participate in this study. There were 7 males and 8 females who were randomly divided into groups of three to form a country.

This study was to analyze the high-level cooperation in the summit game from the textual interactions documented in OSGS. The overall course time was two and half hours. The research process of this study is as Figure 2. Before the game starts, the rules of the game and the operation of the system are explained. The gaming processes are documented in OSGS. After the game, students are guided to reflect on the game and fill out the game system feedback questionnaire.

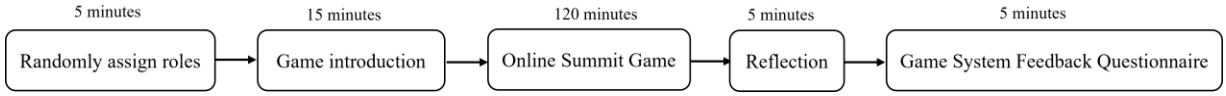

Figure 2. Research process

4.2 Research Tools

This study analyzes the records of players' high-level cooperation strategies in the online strategic game in the intragroup discussions. All dialogues are coded sentence by sentence. Interaction Process Analysis (IPA) proposed by Bales (1950) is chosen to be the coding scheme. Bales interaction analysis divide categorize interactions into three major domains (positive socioemotional domain, negative socioemotional domain, and neutral task domain) containing twelve categories. The questions task domains is a set of questions describing the activity. The attempted answers task domain is a set of activities trying to answer. The positive socioemotional domain contains several different positive responses, and negative socioemotional domain contains a set of negative responses opposite to positive socioemotional domain. The middle region of the system. The attempted answers task domain and the questions task domains are considered as task problem areas, while positive socioemotional domain and negative socioemotional domain are considered as social-emotional problem areas. The idealized interaction process is an interplay between the task and socioemotional behavior domains. When the focus is on the task, the social and emotional relationships of group members may become more tense, and conversely task completion is less effective when the group's activities are focused on social-emotional activities. (Table 1).

Table 1. *Bales' Interaction Process Analysis*

Domains	Categories	In Game example sentences
Socio-motional Area: Positive	Shows solidarity, reward	Go Captain, you are great!
	Shows tension releases, jokes	It's okay, I don't feel any loss.
	Shows acceptance, Agrees	Agree Have enough money.
Task Area: Attempted Answers	Gives suggestions: Cue others to initiate	Find out which country has the antidote.
	Gives opinions: Expression of feelings Gives information	I leave it to you. Don't let me down. Netherland ants to trade with Spain
Task Area: Questions	Asks for information	What is the conclusion
	Asks for opinions: Expression of feelings	Want to be cheated by him?
	Asks for suggestions: Cue others to initiate	Which port to grab
Socio-motional Area: Negative	Shows rejection, Disagree	Why is it not solved?
	Shows tension, Asks for help	
	Shows unfriendly, defends	

5. Results: Intragroup - High Level Interactive Behavior Analysis

Players' high-level cooperation behaviors are categorized and analyzed with IPA (Table 2).

Table 2. *High-level cooperation behavior categories*

Domains	Categories	England	France	Portugal	Spain	Netherland
Sociomotional Area: Positive	Shows solidarity, reward	2	9	1	1	11
	Shows tension releases, jokes	2	10	4	4	2
	Shows acceptance, Agrees	20	12	20	9	19
Task Area: Attempted Answers	Gives suggestions: Cue others to initiate	8	7	11	6	10
	Gives opinions: Expression of feelings	15	29	30	46	33
	Gives information	21	36	54	59	51
Task Area: Questions	Asks for information	18	26	17	15	18
	Asks for opinions: Expression of feelings	15	11	10	6	13
	Asks for suggestions: Cue others to initiate	8	21	11	12	6
Sociomotional Area: Negative	Shows rejection, Disagree	2	0	0	0	0
	Shows tension, Asks for help	0	0	0	0	0
	Shows unfriendly, defends 0	0	0	0	0	
	Total	111	161	158	158	163

The total number of sentences in the dialogues is the lowest compared to other countries since England is the only country that does not need to solve crisis one "Scurvy". In the game, England has lemon on their ship since the beginning, so they do not have to negotiate with other countries to resolve the crisis. Other than that, England's interaction focused on attempting to answer and connoting questions. Conversations between group members include queries to the captain if tradings should be planned.

Similarly, France has large ratios of dialogues on attempted answer and questions. Behaviors in the positive social-motional area occurred 31 times in France, including (giving praise, making jokes, laughing, and agreeing). It was observed that the group members did not hesitate to praise others and gave positive feedback showing their solidarity. The dialogue was mainly in the form of questions and answers, ranging from asking about possible actions to expressions of personal opinions and feelings. The captain quested the members their thoughts and make the plans together which leads to a smoother game.

Portuguese interactions were mostly in socio-motional area and attempted answers. Total of 95 sentences were in the attempted answer including (giving suggestions, ideas, and information). They wanted to go to England to sell information and obtain the antidote by selling spices and discussed about tax exemptions with France. The Portuguese group as a whole would actively give their own ideas and opinions and would express their views on what they saw and how they might solve the crisis. Their group proceeds the game well.

Spanish group also has high ratio of attempted answers and questions. Total of 111 sentences were in the attempted answer category including (giving suggestions, ideas, and information). Group members offered several negotiation, lying and allying strategies with other countries. The whole group actively give their own ideas and opinions which lead to clear decisions and reach consensus for the country development.

Netherlands group also has high ratio of attempted answers and the questions. Total of 94 sentences were attempted answer behaviors including (giving suggestions, ideas, and information). Since in one of the crisis they are the hidden enemy, the whole group followed the captains' order to pretend to be innocent and frame the French. The whole group actively give their own ideas and

opinions and express their observations and possible resolutions to the crisis, so they progress the game well. In addition, the Netherlands has relatively weak initial funding, so the team are actively discussing strategies to increase assets and reach game goals.

6. Conclusion

This study analyzed the high-level cooperation of intragroup interactions with OSGS. The results show the players are very focused in accomplish tasks trying to give ideas, expressing feelings, giving suggestions and strategies. The contribution of this study is that it can guide players to achieve high-level cooperation through summit games. High-level cooperation is different from general cooperation in which players have their own roles and tasks to accomplish, at the same time to reach consensus for conflict resolutions. In this study, the setting of issues in strategy games strengthened the conflict between countries in each event, which enabled meaningful discussion, negotiation, and problem solving among students, which illustrate the high-level cooperation among group members. The design of effective summit game require three necessary elements: (1) the issues that involve all parties, and each has different positions; (2) the conflict can be solve with cooperation and competitions through negotiations; (3) tensions between individual goals and common goals should be presented so high level cooperation would happen In addition, sufficient time should be given for intragroup and intergroup negotiations so that the understanding to the issues, perspective-taking, expression of ideas, mutual trust, and mutual assistances can be enhanced to achieve to a higher level.

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