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Analysis of Students' Personalities and Gaming Strategies in a Technology-Enhanced Board Game-The Fragrance Channel

Chang-Hsin LIN*, Ju-Ling SHIH

Department of Information and Learning Technology, National University of Tainan, Taiwan

*changhsinlin1206@gmail.com

Abstract: Board game has been popular these years, and increasing technology-enhanced board games were developed to extend its playability and content. This study presents an interdisciplinary instructional game, Fragrance Channel, in the context of the Age of Discovery as the game which encourages students to use their history and geography knowledge as well as logistics to win the strategic game. This study uses game records, observation, and focus group interviews to investigate how players' personality traits and other factors such as game stages, gender, personal conditions, emotional tendencies, and learning styles can influence their gaming behaviors and strategies.

Keywords: technology-enhanced board game, game-based learning, personality, gaming strategies, the Age of Discovery.

1. Introduction

Board game has long history in human civilization. It is played in groups in which players interact with others, either communicates, cooperate, compete, or use strategies to win. It can be played on any surface, with or without cards and objects, and with all kinds of content.

With the wave of Web 2.0 and technological development, many game designers have transformed board games into digital board game (DBG) which uses digital technology and multimedia to simplified game rules and create scenarios that increased the sense of immersion.

In the gaming process, individuals would have different types of thinking, reactions, behaviors, and strategies, which are deeply influenced by their personality traits and many other factors. Personality is one's feeling, thinking, and performance pattern that is general in certain typical patterns but still unique in each individual. In the game, the mental playing space is large and open where players can choose and manipulate in their own way. They interact with others, cope with others, and learn from others.

This study attempts to design an interdisciplinary technology-enhanced board game which would require players to apply their knowledge in history, geography, and math, named Fragrance Channel; and then focus on observing what factors would influence the players behaviors and strategies to win the game, including their personalities.

Two research questions are aimed in this study:

1. How players in different personality traits would use different gaming strategies in Fragrance Channel?
2. Other than personality traits, what other factors would influence the players' gaming strategies?

2. Related work

2.1. Technology-enhanced Board Games

Board games generally refers to games that can be played on the table, do not depend on electronic products and do not need large movements, such as card games, board games, and dice games, etc. People play different types of board games can have different benefits. Research results show that board games have positive influence to players' cognitive, organizing strategies, and thinking abilities (Wilson, Barnes, Aggarwal, Boyle, Hebert, de Leon, & Evans, 2010). When board games were properly integrated in the classroom learning, students' learning achievements have significant improvements through game-based learning (Lin, Huang, Shih, Covaci, & Ghinea, 2017; van der Stege, van Staa, Hilberink, & Visser, 2010).

Board games are normally designed with boards, cards, and objects. With digital technologies, simulated scenarios and extensive game mechanism were much enhanced. Chen, Wu, and Chen (2011) used large touched screen and projections to present digital board game, and used it in formal curriculum in the university. Their results showed significant improvement on students' class participation and learning achievements.

Wallace et al. (2012) also used large touched table to present the card game so the players can interact with the virtual world map and cards. Han, Kim, Jung, and Lee (2012) created a RFID based digital board game platform to play either puzzled board game or chess board game for kindergarten kids. Andrukaniec, Franken, Kirchhof, Kraus, Schöndorff, and Geiger (2013) integrated augmented reality (AR) into traditional board game The Settlers of Catan and developed OUTLIVE. This game is a multiplayer game in which players act as the settlers of Catan, but other actions can only be imagined through AR, such as fighting, hunting, and gathering resources.

With digital technology integrations to board games to increase game effects was defined as complex board by Lin et al. (Lin, Huang, Shih, Covaci, & Ghinea, 2017). With extended gaming experiences, players can have face-to-face interactions with others, but also have virtual content to increase the content and fun. Players can obtain, manage, and digest more knowledge content (Andrukaniec, Franken, Kirchhof, Kraus, Schöndorff & Geiger, 2013; Broll, Vodicka & Boring, 2013).

2.2. Professional Dynametric Programs (PDP)

Game-based learning provides players simulated situations to think and make internal connections to their external behaviors. Many studies have evident that the behavioral differences between individuals may be caused by their dissimilar personalities (Hampson & Goldberg, 2006). Personality has been an important indicator to individual differences and all theories have posed different views to it. There are four assessments that are commonly used by science researchers and human resources in industries including Five-factor model of personality (Big Five), Myers Briggs Type Indicator (MBTI), DISC, and Professional Dynametric Programs (PDP).

Among all, Big Five are the most used which identified five personality traits (OCEAN) of individuals that are openness, conscientiousness, extraversion, agreeableness, and neuroticism. However, these five personality traits only describe general traits with measurements. In order to be able to explain why personality would influence players' gaming behaviors and strategies, this study landed the eyes on PDP which would be able to explain how the personality traits would affect individuals' behaviors, reactions to the environment, and predictable behavioral model

PDP started out from DISC personality test which was developed by Dr. Marston in 1920 which is generated from the ancient Greek personality theories. It is a test about human behavioral languages saying that the individuals' personalities were composed by four basic elements namely dominance, influence, steadiness, and compliance (DISC). It explains how individual can adapt to certain work type, and what their possible performance and achievement would be. It can diagnose the individual's management ability and chance to succeed (Cashion & Lynch, 1979).

In order to be more well-rounded and objective, after several decades, Houston, Solomon, and Hubby developed it into Professional Dynametric Programs (PDP) and registered for shared patent between University of South California and University of Colorado (Eastburg, Williamson, Gorsuch,

& Ridley, 1994). PDP has been most widely used around the globe in the human resource departments in the enterprises to manage their employees due to its accuracy. Throughout the years, the system has been used for more than 16 million times by more than 5000 companies, research organizations, and government sectors. It is used to discover people's internal motivation, behaviors, attitudes, and status quos.

PDP Personality Trait Assessment analyzed subjects' reactions to 30 adjectives on five-point Likert Scale to define their personality tendencies. The five types of personalities include Tiger-Driven, Peacock-Expressive, Koala-Amiable, Owl-Analytical, and Chameleon-Comprehensive. Tiger-Driven is the persons who have highly dominating trait. They prefer to adventure, evaluate, and make decisions and are confidence, positive, competitive, and ambitious; The Peacock-Expressive persons are good at interpersonal relationship building. Those persons who are compassionate, optimistic, and sociable have great sympathy, enjoy communicating and like the exposure; The Koala-Amiable persons belong to honest, steady, gentle and kind characteristic. They don't like make trouble with others and work steadily; The Owl-Analytical persons are conservative, down-to-earth and methodical. They pay attention to details and have strong analysis and responsibility; Finally, The Chameleon-Comprehensive persons are fickle, moderate, tough, and good at communication. They are a born negotiator as well as have high resilience.

In game-based learning related studies, studies have proved that personality has close relationships to players' level of immersion and behaviors in online games (Worth & Book, 2014). Personality traits also have positive correlation to gaming motivation and gaming achievements, as well as team cooperation. Players with openness are more immersed in the game while conscientious players avoid role-play games. Neurotic players are less willing to cooperate with team decisions and work more independently in the game (Jeng & Teng, 2008). Therefore, it is known that personality can help us see why the players would have certain behaviors. This study, would take a step further, to diagnose how personality can influence the players' gaming strategies, the actions taken with their natural motives along with their rational thinking that might influence their decisions in games.

3. Game design

Fragrance Channel is a technology-enhanced interdisciplinary board game which contains two major learning contents: spice trading history in the Age of Discovery and math calculation. The context of the game is setup in 16th and 17th century while European countries were launching for the Great Voyage. Countries including United Kingdom, Netherland, Spain, and Portugal colonized Africa and parts of Asia for spice plantation, and use the spices to trade for other goods.

On the game map (Figure 1), there are signs for four countries with their corresponding flags with color identifications. On the map, ports were tagged with corresponding one or above colonial states; and with or without spice productions. Some countries have more colonies than others. Whichever country's ship is one space close to ports owned by other countries will be attacked and lose movement points, spices, or weapons. The ocean is the space where ships can sail freely.

Every game has four players. Every player has one mobile device with NFC detection function through which player can interact with the game map to confirm location, retrieve card information, and checks other players' gaming states. There are four kinds of cards: task cards, country cards, equipment cards, and action cards.

Each player has his own randomly selected task (Figure 2), whoever completes the task first wins. Each task would contain spices (total of 13 spice quantities) that can be commonly retrieved and that are owned by specific country which can only be obtained by either exchange or attack.

Every country has different power (Figure 3), such as UK has more attack power, Netherland has more action points, Spain has more cargo capacity, and Portugal has more colonies.

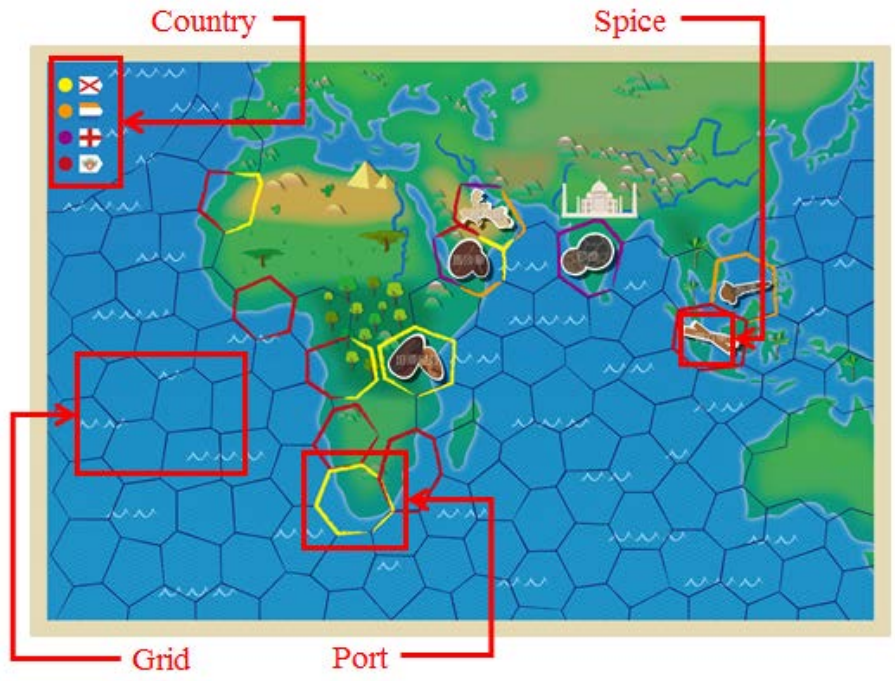

Figure 1. Fragrance Channel Game Map

Figure 2. Spice Tasks

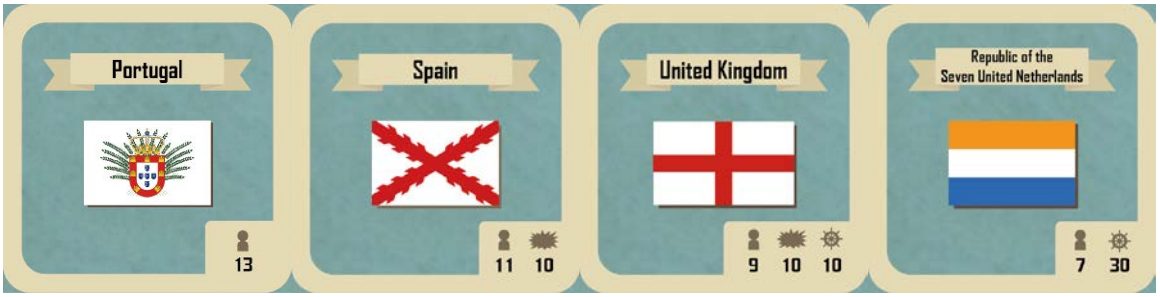

Figure 3. Country cards and the parameters of country power

Equipment cards include ship hull, oar, sail, and weapon (Figure 4), each influence the ship power such as Propulsion Power, Cargo Capacity, Arm Force, Firing Distance, and Sailing Duration. For example, the size of ship hull would increase cargo capacity and sailing force that would extend the turnaround time; better sails can accelerate the speed; and higher rank of weapon have higher arm force. With these variables, players are placed in the conditions in which they need to apply different

strategies in the game. However, the total of action points and cargo capacity is limited to 20. All ships are equipped with basic weapon, bow and arrow. If more powerful weapons are wanted, the player can use his spice to trade for it and upgrade the ship.

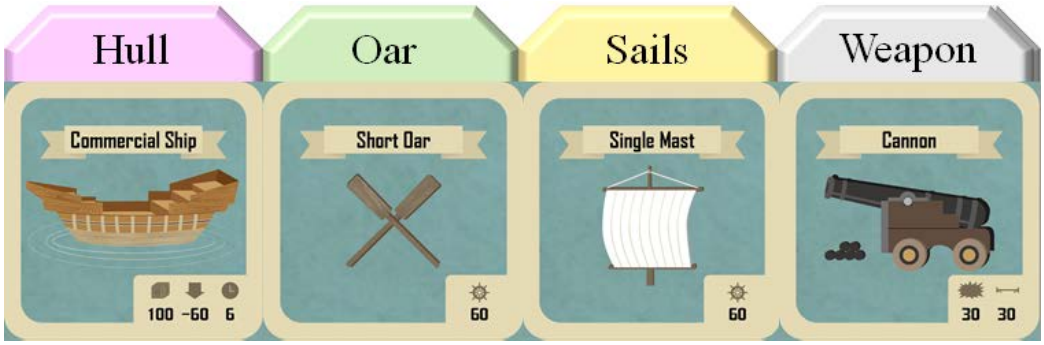

Figure 4. Equipment cards for ships

In every turn, players can use their action points to do actions, such as move, inbound, outbound, trade for spices, repair ships, upgrade weapons, attack, and progress report (Figure 5).

Figure 5. Action cards for the game

On the mobile device, the main screen show the status of all four countries; after clicked on the specific country, details of the ship powers will show. Students need to calculate how and where to sail their ships so that they can properly use their action points to do what they want to do. With their winning strategies, the students should calculate how many spices they should buy and in what way they can obtain or trade more, or use them to upgrade their ships. To sum up, the game has heavy demands to the students to use their math and logistics as well as strategies to win the game.

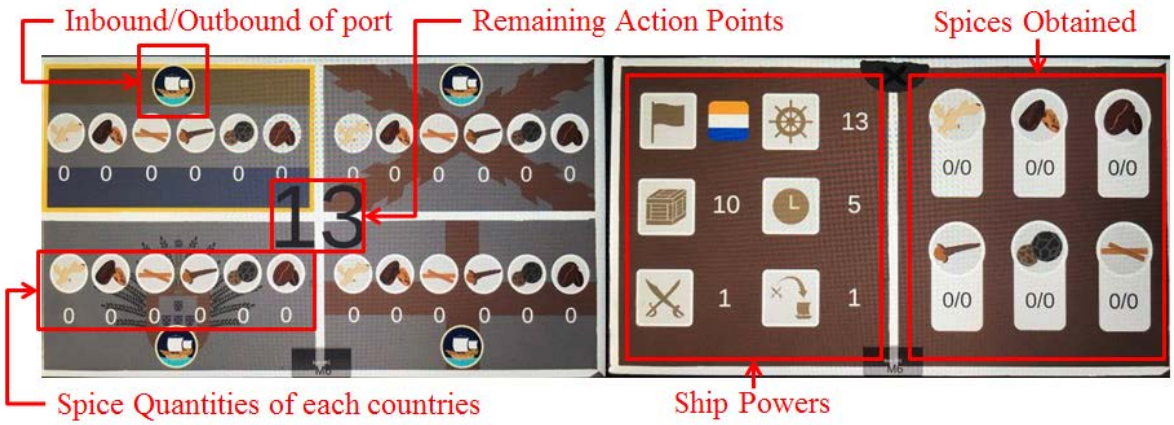

Figure 6. Game Interface on the Mobile Devices

4. Research design

4.1. Research process

This study presents the technology-enhanced board game Fragrance Channel which integrates physical board game, mobile phone, digital system, history, geography, and math to allow students to use what they have learned in the classrooms in the interaction of game. In order to know what kind of people can benefit the most from the game, and what kind of interactions they would have, a cross-analysis of students' personality, group dynamics, and gaming strategies were analyzed.

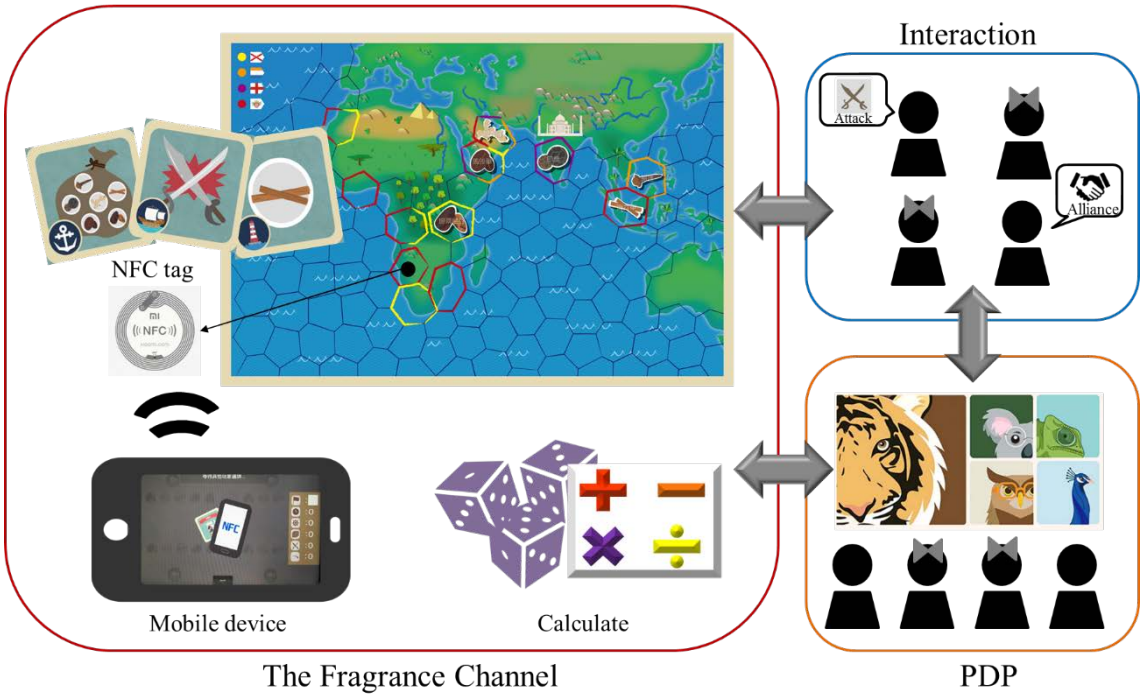

Figure 7. Research structure

The research process is a Figure 8. Before the experiment, all players took PDP personality trait test, and then the first and second round of board game followed by the focus group interview to review gaming strategies and retrieve feedbacks.

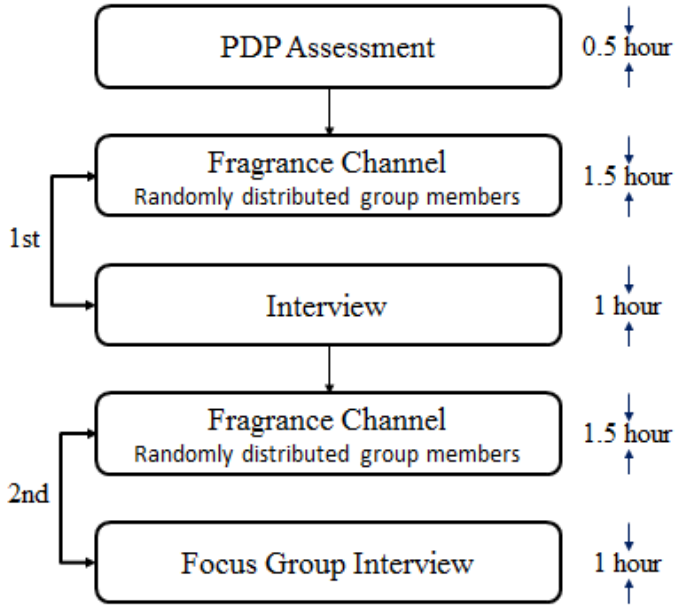

Figure 8. Research process

This instructional game experiment invited 16 secondary school students to participate. They are 12 boys and 4 girls, aged 13 to 15; randomly distributed into groups of 4. They all have more than three years experiences playing digital games and board games so they should be familiar with the basic gaming concepts.

After the PDP tests, there are 1 tiger/chameleon; 4 peacocks; 2 koalas; 1 koala/chameleon; 3 owls, 5 chameleons. All members were randomly distributed into groups; and redistribution was done before the second round the game.

4.2. Research tools

PDP Personality Trait Assessment has total of 30 questions with 5-point Likert-Type Scale, in which 5 to be strongly agree, 4 to be agree, 3 to be neutral, 2 to be disagree, and 1 to be strongly disagree. Question items that contribute to the personality traits were as follows (Table 1).

Table 1. PDP Personality Trait Types and Question Items

Personality Trait Types	Question Items
Tiger (Dominance)	Questions: 5, 10, 14, 18, 24, 30
Peacock (Extroversion)	Questions: 3, 6, 13, 20, 22, 29
Koala (Pace/Patience)	Questions: 2, 8, 15, 17, 25, 28
Owl (Conformity)	Questions: 1, 7, 11, 16, 21, 26
Chameleon (1/2 Sigma)	Questions: 4, 9, 12, 19, 23, 27

Focus Group Interview questions include:

1. How did you setup the parameters of your ship? What is your choice of cargo capacity and sail force? Why?
2. What did you do in the gaming process? Why?

3. How did you interact with the other three players? Why?
4. What did you do to complete the task before others do?
5. If there is next time, what would you do for change?

5. Result analysis

5.1. PDP Influence Gaming Strategies

Players with specific PDP personality traits would show certain gaming strategies and behavior patterns.

Tigers: They are leaders and should be more dominant in group interactions. In this instructional experiment, there is no student who is with this trait.

Peacocks: They are active, outgoing, talkative, and would brighten up the group atmosphere. Peacocks with prosocial tendencies would use more peaceful gaming strategies. They tend to give suggestions others to complete their tasks step by steps. On the other hand, peacocks with aggressive tendencies would lead the groups to use more conflict strategies. They would encourage others to make alliance, weaken targeted players, and compete to win.

Koalas: They are conservative and rigid. Once they had decided a strategy, they would not easily change their minds. They do not like to attack others, and be attacked. They are passive players in terms of initiating battles. They tend to be prosocial and keep game atmosphere to be more peaceful.

Owls: They are with delicate minds, and would follow the game rules and calculate in detail about movement distance and predict locations. They would think about their next step when it is other's turn, and would protect them by getting inbound to ports or quickly sailed back to the starting points to complete the task. They tend to play safe, would maximize the effects of action points.

Chameleons: They tend to go with the flow, and would change their strategies as the game progresses. They are goal-oriented, and want to complete game tasks as their priority. They like to like to take aggressive actions such as attack, or persuade others to attack the same target to strengthen his advantages. He may or may not betray his alliance to achieve his goal.

5.2. Other Factors Influence Gaming Behaviors

Game stages: It is found that when unfamiliar players were placed in one group, they were more self-contained, and less interaction would happen. In the middle of the game, when one player fired attack, the group interactions start, and more actions and strategies such as making alliance, persuasion, making commands, and seducing.

Gender issues: In the game, boys tend to attack more than girls, and girls tend to use more prosocial strategies and obtain spices by trading instead of initiating battles. From the interviews, girls in this age would tend to remain in one strategy without being influenced or intervened by others' opinions or game progress.

Personal conditions: In this experiment, two students were with special conditions and needs and had very special gaming strategies that are different from others. The first one is physical challenged. He chose Spain which has more colonies and ports. He made inbound to a port in every turn from the beginning to the end of the game so that he wouldn't be attacked by others. He is subconsciously protecting himself all the time which may due to his personal life experience. The second student is with ADHD. He chose Netherland which has higher sailing force in nature. He also setup the ship movements to the highest parameter so that he can sail in very high speed and to the farthest location. He didn't want to have any contact with others so they would not have any chance to fire attack. With this experience, when he couldn't choose Netherland in his second round of game, he couldn't move faster than others, he gave up the game and did not want to play. In the middle of the game, he realized that his country, Portugal, has many colonies and can get away from other by getting inbound to ports, he kept his ship away from the other players. Throughout the game, he kept begging for pities and use emotional strategies to protect himself. However, since he had a fame of

poor social interactions and tended to say bad things or used bad body languages to provoke others, other players would make alliance to attack him. Therefore, he felt upset and gave up the game.

Emotional tendencies: Emotional directed players liked to play games in peaceful way, so they were easily influenced by aggressive players. When the atmosphere of the game is filled with attacks, they tend to change their goals or give up. It is better to place them with prosocial players to play games.

Learning styles: Players were generally either goal-oriented or attack-oriented. Although 90% of the players aimed to complete their tasks, others would fire attacks just to increase the fun of the game. Players with more gaming experiences would ask for making alliances or persuading others to change their original strategies regardless whether they would keep their promises in or after they achieve their own goals. Once they betrayed their alliances, the other players would attack him reversely as punishments.

6. Conclusion

It is interesting to see from the game experiment how players with different PDP personality traits would do things in generally categorized patterns, but with different strategies due to other factors. Internal personality traits that an individual born with would not only affect how they think, but also what they do. When players were into different game stages, they would use higher level gaming strategies in the game, such as making alliance, persuasion, making commands to others, and seducing others to do certain actions.

Comparing to the first round of the game, players were more immersed in the second round, have more emotional reactions, and have more interactions. Players with special personal conditions would show behaviors that are corresponding to their real life behaviors. If they are regarded as the vulnerable groups in the real life, they are more protective and defensive in the game. Also, players who are prone to emotional changes are better to play with prosocial players so that their gaming experience would be better.

Quercia, Kosinski, Stillwell and Crowcroft (2011) had stated that the individuals' personality traits would influence their reactions to their environment, behaviors they do, preferences they have, and strategies they take. Other than external behaviors, the traits also influence their internal interests, value, emotions, and attitudes (Hampson & Goldberg, 2006).

From the experiment, it is found that the interrelationships between personality traits and gaming strategies would also influence group dynamic, and vice versa. A framework for analyzing the gaming process, diagnosing how individuals with various personality traits would be influenced by each other would be an important and valuable contribution so that game designers as well as instructors would know how to place students in groups to enhance group dynamics, increase learning effectiveness, and encourage thinking that require more logical, critical, as well as creative thinking.

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