Iyer, S. et al. (Eds.) (2022). Proceedings of the 30th International Conference on Computers in Education.
Asia-Pacific Society for Computers in Education

Personality Matters? Learning Behavior Analysis of Complex Board Game

Yi-Zhen LIN[a*] & Ju-Ling SHIH[b]
Department of Network Learning Technology, National Central University, Taiwan
*rabbit.abi0219@g.ncu.edu.tw

Abstract: Games can enhance students' learning motivation and performance, but students with different personality traits would have different learning behaviors and emotional responses in the game. In order to dissect the learning effects of games from the perspectives of personality traits, this study developed a complex board game, <Misu'ayaw Tayal>, based on the historical events of Tayal aboriginal tribe which uses interactive multimedia to support and extend learning experiences. A corresponding digital system is developed to document students' gaming behaviors so that the students' learning behaviors and gaming emotions can be analyzed. The goal of this study is not only to investigate the impact of personality traits to gaming, but also to construct an instructional design for historical thinking, as well as to increase students' multiple perspectives to historical events.

Keywords: personality trait, complex board game, learning behaviors, game-based learning, Tayal, AR

1. Introduction

1.1 Research goal

Board games are popular learning tools recently since games can enhance students' motivation and convey knowledge to students (Shih et al., 2017). Nowadays, students learn beyond textbooks, and internalize new knowledge through multimedia, internet, and games. Therefore, board games are gradually applied in various disciplines, such as <Element Enterprise Tycoon> (Chen, 2021) is about chemistry in which students solve problems regarding chemical processes and the use of chemical products; <Anatomy Adventure> (Anyanwu, 2014) is designed to reduce the pressures associated with the study of anatomy; and <Diplomacy> (Mattlin, 2018) is to enhance active learning to international relations. With the advancement of technology, some physical board games were transformed into digital board games or combined with technological elements (e.g. Lin & Shih, 2016). By doing so, the content of the game scenario and game functions can be extended. Nevertheless, students' gaming experiences, game effectiveness, learning behaviors, and gaming emotions depend on various factors, such as players' personality traits (e.g. Ehrler et al., 1999). Specifically, emotion is essential to the structure of personality, and the conflicts and crises accompany the development of personality traits (Keltner, 1996). Thus, personality traits have reciprocal relations with emotions and behaviors. Hence, this study aimed to investigate emotions and behaviors from the perspective of personality traits.

This paper presents a complex board game <Misu'ayaw Tayal> about Tayal historical events integrating interactive multimedia using Quick Response Code (QR code). Twenty elementary school students will be invited to participate the instructional practice. The aim of the study is not only to convey

historical knowledge in order to let students understand what Tayal has experienced in the past but also to make them examine the historical events from multiple perspectives.

1.2 Research question

In this study, students are asked to role-play the historical characters and cooperate with others to solve the problems in each historical event. The research questions for this study include:

1. How student with different personality traits behave differently in <Misu'ayaw Tayal>?
2. How student with different personality traits emotions change in <Misu'ayaw Tayal>?

2. Related Work

2.1 Complex board game

Many previous studies showed that games are an essential and innovative learning tools in the education setting. For example, Eltahir (2021) used Kahoot! as formative game-based assessment tool in the course. They divided the students into two groups, one group learned with traditional strategy and the other group learned with Kahoot!. The results indicated that the group with game-based learning showed high motivation and had better learning performance. Among all kinds of games, board games have gradually emerged in the field of education and become popular. Board games refer to physical games using boards placed on a flat surface without the need to plug in electricity. There are also many kinds of table games, i.e., card games and dice games, that do not involve boards. Board games can be designed to convey and suffice different knowledge fields. Previous studies have shown that board games can positively benefit to enhance active learning (Yoon et al., 2014) and improve learning performance (Cardinot & Fairfield, 2022; Luchi et al., 2019). In addition, some researchers incorporated cooperative learning methods with the board game in the reaction engineering course that provoked students' thoughts and improved their teamwork skills (Azizan et al., 2018).

With the rapid development of technology, more and more technological elements are integrated with board games to extend the context of the game as well as gaming functions so that students can be more immersed in the game scenario and the gaming process. Such technology-enhanced game is defined as complex board game (Lin & Shih, 2021) which allows students to experience a mixed realities gaming environment. For instance, Lin and Shih (2016) designed a complex board game which presented a pop-up map tagged with near field chips (NFC) that triggers extended digital information and gamified interactions through smartphones. Subsequently, Sukernasa, Shih and Surjono (2020) implemented the technology-mediated board game to engage Indonesian learners to learn English vocabulary. Students scanned the QR code at the back of cards to interact with English learning questions. In the same year, Hsu and Lee (2020) integrated AR in a sequential social story situation board game. Such a system consisted of different social situation judgement tasks. Autistic children learned to distinguish decisive priority and to appropriately respond to others in the given situations. The results from this study showed that the game can greatly improve students' motivation and gaming pleasure. Through the integration of technological elements, players can not only immerse themselves in the game environment but also acquire knowledge. Therefore, this study attempts to design a complex board game that combined a physical board game and interactive multimedia using QR codes. The content of the game was related to Tayal and foreign ethnic groups. Students should scan the QR code to obtain information related to historical events.

2.2 Personality traits

As mentioned above, games could effectively enhance students' learning performance as well as learning motivation (Chang et al., 2018; Yeh et al., 2017). In addition to such positive effects, previous studies showed that personality traits could affect students' perception toward various game elements (Denden et al., 2021). Personality traits refer to psychological characteristics, serving as essential predictor of many outcomes (Parks-Leduc et al., 2015). To gain insight into who people are, personality tests have been used

to understand personality traits in various settings, including workplaces and schools. For years, a wide variety of personality tests have been developed. Each personality test has a different classification of personality traits. There are some popular personality tests, such as Big Five personality traits, Myers-Briggs Type Indicator (MBTI), and Eysenck Personality Inventory (EPI). Among them, Eysenck Personality Inventory (EPI) (Eysenck, 1964) was developed in the beginning with only two dimensions, i.e., Extroversion/Introversion and Neuroticism/Stability. These two dimensions have been found to associate with positive and negative emotionality respectively and such differences in these traits are considered to affect emotional and cognitive processing (Kehoe et al., 2012). Since Eysenck Personality is inextricably linked to emotions, it is chosen to be employed in this study as the design foundation to verify whether personality traits influence gaming emotions.

There are three dimensions in the Eysenck personality inventory with N, E, and P values.

- ★ Neuroticism/Stability (N): The value of N stands for emotionality level of individual. People with high N score tend to be emotionally unstable, nervous and irritable while people with low N score tend to be less reactive and calmer.
- ★ Extraversion/Introversion (E): The value of E was determined by observed behavior tendencies (Eysenck, 1968). High score indicates an extroverted personality tendency, including sociable, adventurous, emotional. Low score shows an introverted personality tendency and silent.
- ★ Psychoticism (P): The value of P represents a sensitivity level to psychosis disorder. People with high score tend to be lonely, difficult to adapt the external environment so hard to get along well to others. In contrast, people with low score favor to be mannered, get along well with others, and adapted to the external environment better.

According to Eysenck's personality theory, the two dimensions of Neuroticism and Extraversion forms four personality categories including melancholic, choleric, phlegmatic, and sanguine. Since psychosis disorder is not the educational focus in this study, only two dimensions were used. The four personality categories were employed in the design of the interactive emotional responses in the game system so students' choices in the game can be analyzed accordingly.

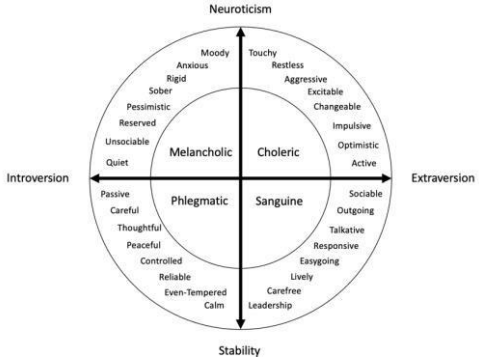

Figure 1. Personality categories of Eysenck's personality theory

3. Game Design

3.1 <Misu'ayaw Tayal>

Misu'ayaw stands for "Go ahead" in the Atayal language. The name implies Tayal's bravery and insistence when they experienced persecution by foreign ethnic groups, they still look forward to the bright future. The precursor of <Misu'ayaw Tayal> was <Mosa Tayal> which is a physical territorial board game with a map board, cards, resource symbols, bargaining chips, and dice. In this study, <Misu'ayaw Tayal> was developed by adding interactive multimedia based on <Mosa Tayal> to make students understand the historical events related to Tayal and foreign ethnic groups. In <Misu'ayaw Tayal>, every historical card comes with a QR code that leads to interactive multimedia of storytelling and action options. Thus, this game not only allows students to play and interact with peers face-to-face in the physical setting but also

facilitates students to think about the positions they take toward various events, and see historical events in different light as a game character. To complete the game, students have to communicate, negotiate, and coordinate with others to resolve the intergroup conflicts.

There are five roles in <Misu'ayaw Tayal> including Han Chinese, Japan/Qing Dynasty, Tayal 1, Tayal 2, and Tayal 3. Students choose roles to play. The winning conditions include the increase of total resource values, and reach consensus to all the conflicts generated in the historical events by all the ethnic groups together. The results are defined by participants including the teacher/game master.

3.2 Game design

To enhance students' understanding of the historical events and to increase the interaction and enjoyment of the game, every role in the game comes with different sizes of population, level of civilization, amount of fortune, resources, and power of defense at the beginning (Figure 2). All the ethnic groups should expand their territories to progress the game. Five historical events are presented in the respective round in the game (Figure 3), namely the migration of the Tayal tribe, the civil unrest, Msbtunuxd Incident, the period of Japanese occupation, and the Bnqcip Incident. All historical events involve conflicts between different ethnic groups that require them to negotiate and reach consensus to the final conflict resolution. Take the third event Msbtunuxd Incident as an example, after Liu Ming-Chuan implemented Mountain Development and Aborigines Pacifying Policy, Qing Dynasty and Han Chinese started to plunder the camphor recourses from the Tayal tribes. Because of the strong force attacks, Tayal 2 surrendered while Tayal 1 and Tayal 3 struggled to resist. The situation is quite tensed so they have to decide whether to negotiate with Qing Dynasty and Han Chinese or to foster wars to protect their resources. Decisions can be made by the students during the game.

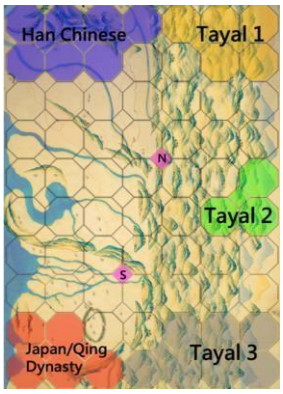

Figure 2. Map of the game

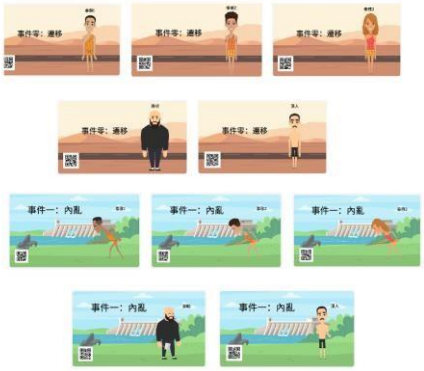

Figure 3. Historical event card of the five ethnic groups

3.3 <Misu'ayaw Tayal> Game System

All historical events are presented by the interactive media in the game system. Unity, a cross-platform game engine, is used for the development. Android is used as the main publishing platform in this study.

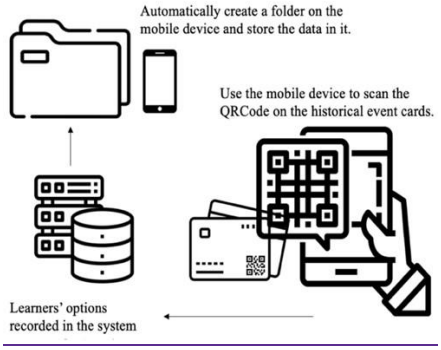

Figure 4. System architecture

Figure 5. Animation and decision-making choices

Two major functions were developed for <Misu'ayaw Tayal>: showcase the historical event animations, and interactive decision-making choices. As shown in Figure 4 and 5, during the gaming process, students scan the QR codes on the historical event cards and the corresponding historical event animations will be played on the mobile devices. The scenes, effects, and roles of the animations were created by Animaker and imported into Unity to make students more immersed in the game scenario. Besides, each animation is different according to the roles. Decision making choices were given at the end of each event animation. Every option to the question is an emotional response prescribed based on Eysenck personality theory, corresponding to the four personality categories of melancholic, choleric, phlegmatic, and sanguine respectively. Students choose the option that best fits their emotions and choices in the situation. For example, the question in the first event The migration of Tayal is "What should we do? Our land is not enough". The four choices are "Don't worry, there will be a way."
(sanguine), "We're done." (melancholic), "I know. It's quite annoying." (choleric), and "It's not serious at all." (phlegmatic). Choices made throughout the game would lead to certain affects or outcomes in the later events, such as deduction to resources in the physical game. For instance, students who made repetitive emotional options of sanguine will gain an additional resource, while repetitive emotional options of choleric will lead to loss of resources. All emotional options selected by the students are recorded. At the end of the system, a folder is automatically created in the device to store the data in.

4. Research Design

4.1 Research process

This study will be conducted in an elementary school in Taiwan with 20 students. All the students will be divided into four groups with five students in one group. As shown in Figure 6, the research started with a questionnaire with 12 questions to collect students' personal information and their gaming experiences playing board games. Then the students will be asked to take the Eysenck Personality Inventory (EPI) to identify their personality traits. The complex board game will take about 60 minutes. During the gaming process, the students experience 5 historical events and play toward their own goals. After the game, they will take a game satisfaction survey that consisted of different aspects. Such survey will be employed to collect students' feedbacks to the game.

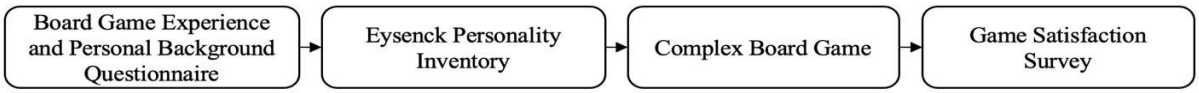

Figure 6. Research process

For EPI, every chosen answer to a question would add in a point to the related scale of the corresponding dimension. The T score (T=50+10*(X-M)/SD) was converted according to the total score in each dimension. Students with different personality traits will be divided into groups in the most heterogeneous way so the students can interact with peers with different personality traits.

4.2 Research tools

To answer research questions, research tools are employed in this study.

★ Board Game Experience and Personal Background Questionnaire: The questionnaire comprises two parts. The first part is to collect the basic information of students, including age, gender, favorite subject, etc. The second part is to investigate students' game preferences and experience. ★ Eysenck Personality Inventory: It is employed to identify the personality traits of each student.

There are two scales in the inventory, Extroversion/Introversion(E) and Neuroticism/Stability(N).

- ★ Learning Behaviors Observation Sheet: It is conducted to document students' gaming behaviors. All gaming behaviors will be coded and analyzed to know the influence of personality traits.
- ★ Database record: It is used to record students' decision-making choices related to emotional responses while facing problems in the historical events.
- ★ Game Satisfaction Survey: The survey aims to measure students' game satisfaction in seven dimensions, namely aesthetics, availability, enjoyment, freedom, game process and learning.

5. Conclusion

Nowadays, genres of board games have become more diversified especially with the advancement of technology. Gradually, many board games have been applied to embed knowledge. With the board game <Misu'ayaw Tayal>, historical thinking can be naturally stimulated. By integrating technological elements into physical board games, students are able to learn about historical events while having fun. During the process of having conflicts and making cooperation, students learn how to negotiate with others and to solve problems. However, personality traits are one of the human factors that influence students' behaviors during the game. Individual differences would influence decision making, emotions and perspectives, as well as gaming strategies and behaviors. This study focused on the examination of the behavioral differences and emotional changes of the students from the perspective of personality traits. The results of this study will help future researchers to develop more inclusive educational game designs and give the history education a new look.

Acknowledgements

This study is supported in part by the National Science and Technology Council (previously known as Ministry of Science and Technology) of Taiwan, under MOST 108-2511-H-008 -016 -MY4.

References

Anyanwu, E. G. (2014). Anatomy adventure: A board game for enhancing understanding of anatomy. *Anatomical sciences education*, *7*(2), 153-160.

Azizan, M., Mellon, N., Ramli, R., & Yusup, S. (2018). Improving teamwork skills and enhancing deep learning via development of board game using cooperative learning method in Reaction Engineering course. *Education for Chemical Engineers*, *22*, 1-13.

Cardinot, A., & Fairfield, J. A. (2022). Game-based learning to engage students with physics and astronomy using a board game. In *Research Anthology on Developments in Gamification and Game-Based Learning* (pp. 785-801): IGI Global.

Chang, C.-C., Warden, C. A., Liang, C., & Lin, G.-Y. (2018). Effects of digital game-based learning on achievement, flow and overall cognitive load. *Australasian Journal of Educational Technology*, *34*(4). 155-167

Denden, M., Tlili, A., Essalmi, F., Jemni, M., Chen, N.-S., & Burgos, D. (2021). Effects of gender and personality differences on students' perception of game design elements in educational gamification. *International Journal of Human-Computer Studies*, *154*, 102674.

Eltahir, M., Alsalhi, N. R., Al-Qatawneh, S., AlQudah, H. A., & Jaradat, M. (2021). The impact of game-based learning (GBL) on students' motivation, engagement and academic performance on an Arabic language grammar course in higher education. *Education and Information Technologies*, *26*(3), 3251-3278.

Eysenck, H. J. (1968). Eysenck personality inventory manual. *San Diego: Educational and Industrial Testing Service*. *90*, 185-214

Eysenck, H. J. (1964). The measurement of personality: A new inventory. *Journal of the Indian Academy of Applied Psychology*. *1*(1), 1-11

Hsu, H.-T., & Lee, I.-J. (2020). Using augmented reality technology with serial learning framework to develop a serial social story situation board game system for children with autism to improve social situation understanding and social reciprocity skills. *International Conference on Human-Computer Interaction* (pp. 3-18). Springer, Cham

Kehoe, E. G., Toomey, J. M., Balsters, J. H., & Bokde, A. L. (2012). Personality modulates the effects of emotional arousal and valence on brain activation. *Social cognitive and affective neuroscience*, *7*(7), 858-870.

Lin, C.-H., & Shih, J.-L. (2021). The Development and Evaluations of Complex Table Game for History Culture. *International Journal on Digital Learning Technology*. (In press)

Lin, C.-H., & Shih, J.-L. (2016). *The Investigation of Learning Effectiveness Using a Mobile-based Complex Puzzle Game: Mast Dream.* Paper presented at the 10th European Conference on Games Based Learning: ECGBL 2016. 373-380

Luchi, K. C. G., Cardozo, L. T., & Marcondes, F. K. (2019). Increased learning by using board game on muscular system physiology compared with guided study. *Advances in physiology education*, *43*(2), 149-154.

Mattlin, M. (2018). Adapting the DIPLOMACY board game concept for 21st century international relations teaching. *Simulation & Gaming*, *49*(6), 735-750.

Parks-Leduc, L., Feldman, G., & Bardi, A. (2015). Personality traits and personal values: A meta-analysis. *Personality and Social Psychology Review*, *19*(1), 3-29.

Shih, J.-L., Huang, S.-H., Lin, C.-H., & Tseng, C.-C. (2017). STEAMing the Ships for the Great Voyage: Design and Evaluation of a Technology integrated Maker Game. *IxD&A*, *34*, 61-87.

Sukenasa, N. P. P. P., Shih, J.-L., & Surjono, H. D. (2020). Using Technology-Mediated Board Game on Young Learners. *Script Journal: Journal of Linguistics and English Teaching*, *5*(2), 136-148.

Yeh, Y.-T., Hung, H.-T., & Hsu, Y.-J. (2017). *Digital game-based learning for improving students' academic achievement, learning motivation, and willingness to communicate in an english course.* Paper presented at the 2017 6th IIAI International Congress on Advanced Applied Informatics (IIAI-AAI), 560-563

Yoon, B., Rodriguez, L., Faselis, C. J., & Liappis, A. P. (2014). Using a board game to reinforce learning. *The Journal of Continuing Education in Nursing*, *45*(3), 110-111.