

Design and Development a Serious Board Game to Engage Students in Reflecting Daily Eating Habits

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Abstract: The positive impact of game-based learning on enhancing students' motivation was evidenced in numerous empirical studies. Games could provide students with joyful learning environment; however, it does not necessarily lead to students' learning. Therefore, further exploration of how games could enhance learning will contribute to research and practice in game-based learning. This study aims to develop a serious board game, grounded on the philosophy of constructivism, to engage students in reflecting daily eating habits. 14 university students were invited to play the game. Survey as well as interview were conducted to collect their experience in the game. The results indicated that participants were engaged in interacting with the food knowledge and with peers. The results also supported the joyful learning experience, which made learning fun. Recommendation for future research were provided.

Keywords: Game-based Learning, A Serious Board Game Design.

1. INTRODUCTION

Game-based learning makes learning fun, and numerous studies evidenced its effect on enhancing motivation (Charsky & Ressler, 2011). However, playing the games does not necessary lead to knowledge development. A serious game, designed based on learning objective and content, may have learners accomplish a series of missions in a joyful environment. Moving beyond the drill-and-practice game, the serious game, which matches the game mission with learning objectives, enables learners to learn specific knowledge or skills and to evaluate their behavior or decisions based on the feedback provided by the game (Garris, Ahlers, & Driskell, 2002; Kiili, 2005; Mikalef, Giannakos, Chorianopoulos, & Jaccheri, 2012; Nelson, Erlandson, & Denham, 2011; Paraskeva, Mysirlaki, & Papagianni, 2010; Squire, & Steinkuehler, 2005). The above mentioned process helps schema construction and learning transfer (Paraskeva, Mysirlaki, & Papagianni, 2010; Gentile, & Gentile, 2008).

Grounded on the game-based learning literature and cognitive conflict theory, this study aims to design a serious board game to engage students' in reflecting daily eating habits. The game developed will be evaluated by learners' gaming experience and satisfaction with the game.

2. LITERATURE REVIEW

2.2. Game-Based Learning

Game-based learning brings much potential for students learning. First, the basic feature of games,

fun, create a joyful atmosphere and experience for learning if games are integrated in to learning process. Such a joyful experience may enhance students' motivation (Charsky & Ressler, 2011). Specifically, the game may make learning fun and interesting, which may enhance students' intrinsic motivation, while winning the game may bring learners sense of achievement, which further enhances their extrinsic motivation. Second, the drill-and practice games, developed based on behaviorism, provide students with the opportunity to practice specific skills and receive instant feedback. It may help learners develop psychomotor skills (Connolly, Boyle, MacArthur, Hainey & Boyle, 2012). Third, the game mission, in which a series of problems were embedded, requires players to execute diverse strategies to accomplish. The process simulates problem-solving process, and provides an environment for players to learn how to define the mission, analyze resources at hand, propose possible solutions, test and refine their solutions. Such a process may help to develop learners' higher-order thinking (Kim, Park & Baek, 2009).

Despite the above-mentioned benefits of game-based learning, the empirical evidence supporting the impact of games on learning were not consistent. On the one hand, prior studies support that games enhance students' motivation (Karagiorgas & Niemann, 2017). Well-designed games, if integrated into learning process, may bring students flow experience, immersed in the gaming/learning process (Kiili, 2005). On the other hand, various factors may influence whether games could enhance learning. Majority of the games were not designed for learning purposes. If the game adopted for learning are irrelevant to pre-defined learning objectives, students will not gain any new knowledge or skills even they

win the games. Furthermore, for those drill-and-practice game, which are designed for learners to practice, students may or may not enhance their mastery of skills learned in class depending on how students interpret the feedback provided by the game to enhance their gaming performance.

Thus, critical factors influencing the impact of game on learning gains are the relevancy of game mission with the learning objectives and the feedback provided by the game. More importantly, if students' attention are directed to the important concepts, which may or may not be consistent to his or her existing knowledge, students will have opportunity to deeply observe similarity between contents obtained in the game and the knowledge in their brain. If the similarity are found, students could easily assimilate new knowledge into existing knowledge structure. On the contrary, if the content learned in the game conflicts with the students' existing knowledge. They will experience state of disequilibrium, which may increase the intensity of interaction between knowledge and the students. Once they reach the state of equilibrium, they are more likely to expand their schema. Therefore, it brings the need to develop the serious game, which matches the game mission with the learning objectives, to engage students in knowledge construction process.

2.3. Design of a Serious Game

Moving beyond selecting an existing game, this study will design a serious board game based on cognitive conflict theory. According to the literature in the area of game/board game design, well-designed mechanics of a game include goals, rules, procedures, path leading to goals etc (Kiili, 2005; Mayer & Johnson, 2010; Raybourn, 2007; Schell, 2008). First, goals and missions of the serious game should be consistent with learning objectives. Goals statement should be easily understood by the players and challenging. Second, rules should be fair and consistent. Third, the scores players gain in the game should reflect their knowledge or skills which are stated in learning objectives. Fourth, players should be provided with information to self-explore and test their strategies. Fifth, difficulty of the game should be increased with players' performance. Fifth, feedback provided by the game should be responsive and instant, and helps to players' optimal performance. Sixth, competition and collaboration among the players for the board game are necessary. At times, one player's action may serve as the instant feedback providers for the other players.

3. RESEARCH METHOD

3.1. Research Design

The design-based research (DBR) method were conducted using qualitative research approach. First, fourteen university students were invited to participate in a two-hour board game. The process was video-taped and their experience and satisfaction with the game design were collected via one questionnaire developed by the authors. The five point likert scale questionnaire include 25 items to measure five dimensions: Goal(1), Related to balanced diet(7), Rule(2), Mechanism(10) and Joyfulness (5).

3.2. Design Principles of the Serious SGQ Board Game

The design principles of the proposed serious game, are described as followed:

First, the goals of the game which include both mastery goal orientation and performance goal orientation may promote students to develop or master specific contents during the game (Clark & Martinez-Garza, 2012). The goal of the game is that learners have to monitor and evaluate their eating habits according to the principle of balanced diet.

Second, the given game tasks should simulate the application of the learned content so that players could explore and practice specific knowledge by executing the games tasks (Kinzie & Joseph, 2008). Specifically, the players in the game need to select the food for their meals, observe the ingredients contained in the food and judge to which type of food the ingredient belongs.

Third, they could reflect the appropriateness of their actions or decisions by observing the instant feedback (Mikalef, Giannakos, Chorianopoulos & Jaccheri, 2012). The instant feedback will be provided by other players, the mechanism of the game and the scoring board given to each player.

Fourth, the challenge embedded in the game could engage students in a flow state and may increase their concentration and persistence in facing the challenge. The challenge built in the game prompts them to observing the new learned food nutrition information from the game, which may or may not conflict with their existing knowledge. The above-mentioned gaming process may contribute to students' schema development (Collins & Halverson, 2010; Klopfer & Squire, 2008; Papastergiou, 2009; Paraskeva, Mysirlaki & Papagianni, 2010).

Fifth, the game flow should motivate players to reflect their eating habits according to the balance diet principle. Most important of all, the game flow should pr

ompt the players to interact with each other, clarifying any misconception about the food nutrition information

4. RESULTS AND DISCUSSION

4.1. The Food Master Serious Board Game

The serious board game called Food Master is developed with printed cards and web-based system. The Food Master is designed to engage students in reflecting their daily eating habits. The game starts with a scenario, which simulates player's life and required the players to select the food for breakfast, lunch, afternoon-tea and dinner from the restaurants. Specifically, the goal for the players is to earn the highest scores by reaching the status of balanced diet.

At the beginning of the game, each player select the first meal (i.e. Breakfast) from the lists of the restaurant from the web-based system (See Fig 1). The system will show the ingredients of the food they selected (See Fig2).



Fig.1. The Interface of the Web-based System



Fig.2. The Ingredients of the Selected Food

The player takes the ingredient cards from the card box (see Fig 3). The middle of the card present the ingredient with the list of the Nutrients. Those ingredient with Phytochemicals, which may help prevent cancer, were marked in red Hexagon (see middle image of Fig 3). Those ingredient, which might affect health, were marked in black (see right image of Fig 3). Such a design tries to catch players' attention reflecting whether the food they select is good or bad to their health.



Fig.3. The Ingredient cards

Then the player is asked to judge to which type of ingredient the ingredient belongs and put it into corresponding area of the map of the board game (See Fig4). Additional rule that the two cards are connected with at least one Nutrient is created to draw players' attention to the Nutrient contained in the ingredient (See Fig5).



Fig.4. The Map of the Board Game

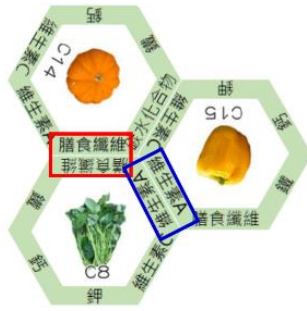


Fig.5. The Rule of Connecting Cards

The above mentioned process is called one-meal round. Each player takes turn to select the first meal and then move to another round to select the second meal until four meals round were done. The DAY 1 game, which includes four-meal rounds, asks players to select the food they had in yesterday. The DAY2 game, which includes another four-meal rounds, asks the players to select food to accomplish the given mission. After DAY1 and DAY2 games were done, players calculated the scores according to their scoring board they used throughout the game (See Figure 6). The scoring board is designed as an observation tool for the player to monitor their selection of food based on the principle of balanced diet.

	1	2	3	4	5	6	7	8	9	10
Grains	●	●	●	●	●	●	●	●	●	●
Meat & Beans	●	●	●	●	●	●	●	●	●	●
Vegetables	●	●	●	●	●	●	●	●	●	●
Fruits	●	●	●	●	●	●	●	●	●	●
Milk	●	●	●	●	●	●	●	●	●	●
Oils	●	●	●	●	●	●	●	●	●	●
Nuts	●	●	●	●	●	●	●	●	●	●

Fig.6. Scoring Board

The formula of the final scores validated by nutritionist is listed in Table 1. If ingredient cards collected satisfied the criteria, the player earn the corresponding score. The bonus score is designed for the ingredient cards with red Hexagon, which indicates better for health. The bonus scores = $3 \times \text{No. of ingredient cards with red Hexagon} + 10 \times (\text{No. of ingredient cards with red Hexagon} / 5)$. Then all the scores earned were summed up to be the final scores.

Table 1. Scoring Scheme

Criteria		Score
The amount of Grains	≥ 3	10
The amount of Meat & Beans	≥ 6	10
The amount of Vegetables	≥ 6	10
The amount of Fruits	≥ 2	10
The amount of Milk	≥ 3	10
The amount of Oils	≥ 6	5
The amount of Nuts	≥ 2	5
Bonus		
Sum		

4.2. The Learners' Satisfaction with the Food Master Board Game

As shown in Table 1, the participants were satisfied with the game with the mean score at 4.21. First, they were very clear about the game and highly agreed that the game engaged them in learning balance diet ($M=4.01$). Second, they agreed that the rules are fair and consistent throughout the game. Third, they agreed that the game mechanism and the instant feedback promoted them to interact with the food knowledge, to interact with the peers and to think deeply about the strategy of selecting food. Fourth, they enjoyed the game and enjoyed playing with the peers. Last, they like the art design of the board game very much, including the map, ingredient cards and so on.

Table 2. Scoring Scheme

Dimensions	Means
Goal	4.5
Related to balanced diet	4.01
Rule	4.21
Mechanism	4.08
Joyfulness	4.26
Sum	4.21

5. CONCLUSIONS

A serious board game about food nutrition was developed in this study. The results indicated that participants are satisfied with the game. The game prompted them to uncover the food nutrition knowledge which is conflicted with their existing knowledge. Furthermore, they reflected their eating habits based on the balance diet and healthy

principles. The results also supported the joyful learning experience.

To the extent of the authors' knowledge, this is the first serious board game designed centering on food nutrition and cognitive conflict theory. It may contribute to the potential of game on raising cognitive conflict, which may lead to schema reconstruction. The findings are based on the qualitative and descriptive data collected from a small-group. Future research is suggested to use quantitative measure or increase the numbers of the participants to extend the generalizability of the current findings.

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