Liu, C.-C. et al. (Eds.) (2014). Proceedings of the 22nd International Conference on Computers in Education. Japan: Asia-Pacific Society for Computers in Education

Thinking as a Pleasure: Tactics to Design Digital Educational Games from the Perspective of Board Games

Hercy N.H. CHENG
Collaborative & Innovative Center for Educational Technology, Central China Normal University, China
*hercycheng.tw@gmail.com

Abstract: Board games provide players with not only pleasure but also thinking. More specifically, it is observed that digital games tend to ask players to make quick judgment, demanding less consideration, while board games allow players to think more thoroughly in reasonable time. For this reason, this paper attempts to capture the features of board games, from which most modern digital games originate. When designing digital educational games, designers may consider the features so that players can have both pleasure and opportunities for thinking. Finally, this paper also suggests three design tactics to design digital educational games.

Keywords: Digital educational games, board games, choices

1. Introduction

Salen and Zimmerman (2004) defined a game as a system in which players engaged in an artificial conflict, resulting in a quantifiable outcome. Furthermore, the conflict was purposely produced by game rules with a goal that players attempted to achieve. Crawford (1984) described that conflicts were obstacles preventing players from easily achieving their goals. A puzzle, for instance, provides static and passive conflicts, while games have more dynamic and actively responsive conflicts, which come from the interactions between players and the other entities (e.g. interactive objects, non-player characters, human opponents or collaborators) in the game world.

From the perspective of education, however, a difficult conflict does not guarantee players' learning. As a matter of fact, most digital games adopt immediate conflicts, which may encourage players' fast reactions but hinder their thinking without sufficient time. Such digital games require players' skills of hand-eye coordination (Crawford, 1984), which can be improved by gaming over and over again rather than strategic reflection.

Unlike digital games, although board games lack well-simulated environment, most players still consider board games full of interactivity and interesting conflicts. On the other hand, board games have been widely adopted in classrooms as a part of curriculum (Hinebaugh, 2009), implying the essence of educability. Mayer and Harris (2010) also indicated that the board games might fit the abilities of the 21st century learners defined by American Association of School Librarians (2009). In practice, many recent studies have showed that board games may help students learn in various courses, for instance, mathematics (Ramani, & Siegler, 2008), physics (Smith, & Munro, 2009), health education (Lennon, & Coombs, 2007), and financial accounting (Gamlath, 2007).

Board games, according to their game goals, can be roughly classified into three categories: war games, race games and alignment games (Hinebaugh, 2009). The first one is war games, in which players aim at capturing and/or destroying opponents' units (Woods, 2012). Obviously, *chess* and *go* are both war games; so are some digital games like *Age of Empires*. Just like a war, the conflicts emerge if the units of two parties fight against each other. At this time, survivability becomes the first thing that players should consider. Moreover, players have to figure out how to avoid being attacked effectively and make choices to overcome enemies' defense.

The second category is race games, in which players aim at reaching a destination the fastest, such as *Chinese checkers* and *Chutes and Ladders*[1]. Alternatively, a variation of race games is to score the highest when the game ends. For example, *Monopoly*[2] can be considered as a race game because the player who has the most money in the end wins the game. Most strategy board games adopt such a game type, such as *Puerto Rico*[3] and *Agricola*[4]. These games usually allow players to obtain resources and transform them into scores. Such a transformation mechanism is basically a model of economy (Rollings, & Adams, 2003), facilitating players to consider which actions may provide an efficient way to transforming the least resources into the highest scores.

The third category of board games is alignment games, which require players to make a particular pattern, such as a line of pieces in *tic-tac-toe* or *Gomoku*. Another typical alignment game is *Mahjong*. For winning, players have to collect resources and decide whether the resources are needed or not. If necessary, players have to discard some resources, which involves lots of decisions.

Among the three categories, there is a common characteristic, which is to provide choices so that players may make decisions for their own. With choices, players may start to think which option is better than the others. After making a decision, players are motivated to expect its consequence and attached to the gameplay. In other words, the provision of choices may make players enjoy the thoughtful pleasure of board games

However, media somehow limits the game type. Most digital games are skill-and-action games rather than strategy games because of their aims at massive popularity (Crawford, 1984; Rollings, & Adams, 2003). Although digital games allow players to make decisions immediately, players usually do not have sufficient time to think. On the contrary, lots of board games, especially German games or eurogames (Woods, 2012), are strategy games, taking advantage of turn-based mechanism and allowing players to think more when they make decisions. It turns out that well-designed choices potentially facilitate players to think and have fun at the same time in games.

Therefore, this paper aims to study the feature of board games, choices, which may facilitate both pleasure and learning. The feature may be helpful to design digital educational games. Perhaps digital media may tempt or deceive game designers into overemphasizing fantasy without noticing the real enjoyment and potential educational functions. It is a good idea to explore the possibilities of board games in education.

2. Choices

Sid Meier, the game designer of *Civilization* series, believed that a good game was a series of interesting choices (see Rollings, & Morris, 2000), suggesting the importance of choices in a game. This section will introduce the concept of choices and discuss how choices may facilitate both thinking and pleasure.

2.1 Choices facilitate thinking

An opposite concept of choices is linearity. A game with no choices is merely a story with linear facts (Crawford, 1984). Furthermore, without meaningful choices, the outcome of a game becomes predetermined (Salen, & Zimmerman, 2004). Choices imply the possibility of different results after players invest their efforts, making a game dynamic. When players make choices in a game, they actually explore the relationship between the chosen actions and their results. In terms of computer science, the rules of a game construct a state machine, which describes the aforementioned relationship (Juul, 2005). If all possibilities of choices are considered, a game may be like a tree structure with a

[1] *Chutes and Ladders* originated from an India game, *Snakes and Ladders*, in the 16th century. In the game, on the way to the destination, ladders made players approach the destination while chutes made them away from it.

[2] *Monopoly*, originating from *The Landlord's Game* in 1904, was patented in 1935 by Charles Darrow and published by Parker Brothers.

[3] *Puerto Rico* was designed by Andreas Seyfarth and first published in 2002. The game required players to produce resources, which may be transformed into money and scores.

[4] *Agricola*, a farm-theme board game, was designed by Uwe Rosenberg and published in 2007. Players as farmers use resources to build their own farms, grow crops and keep animals, which may be transformed into scores in the end of a game.

result on every leaf node (Crawford, 1984). In a sense, playing a game is interacting with the state machine as well as exploring the tree of game results (Juul, 2005).

Such a game structure suggests that players should predict the results before choosing an action. Prediction may involve a series of cognitive process: a first and straightforward thought is to evaluate the value of every legal action. In other words, without other consideration, players tend to choose an action that may bring the greatest benefits. In an extreme case, if a game only offer obvious choices, the game has actually no choices at all and thus no challenges for players. For this reason, a game should provide players with choices that need think.

For offering comparable choices, a game can assign different costs to every action. By doing so, players may start to consider the values and their respective costs. An action with high value and high cost is not a necessarily better choice than that with lower value and lower cost. The costs include risks, which are outcomes aware of likely happening (Epstein, 1977; Salen, & Zimmerman, 2004). Risks are usually negative and so inexplicit that players need to deliberate any possible situations before making decisions.

Besides, human opponents provide more factors that should be considered in decision-making. In a competitive multiplayer game, more specifically, players also need to conjecture opponents' actions, which likely influence choices. An experienced player can successfully predict and avoid the harm from opponents' actions. With the consideration of opponents, even obvious choices may change. Especially in a strategy game, players usually need make a long-term plan, consisted of a series of actions. Human opponents with similar abilities may easily interfere a player's plan, resulting in unexpected results. When this happens, the player may need to adjust his/her plan. Therefore, by providing various difficult choices with dilemma, a game may become non-linear and start to facilitate players to think.

2.2 Choices facilitate pleasure

Previous research has shown that the provision of choices will increase the feelings of intrinsic motivation because choices allow people a feeling of autonomy (Ryan, & Deci, 2000). Choices, as a concept against constraint, may free people's mind and satisfy what they need under rules. For this reason, Malone and Lepper (1987) have advocated providing learners with explicit choices may facilitate their perception of control, an individual element of intrinsic motivation. In particular, learners can construct, select and name the features of fantasy to have a personalized learning and playing experience. As a matter of fact, Cordova and Lepper (1996) have showed that, in an education game, learners with choices and personalized fantasy may report obvious pleasure, including higher favor of the game and more willingness to stay after class.

The previous paragraph concluded that choices influenced pleasure. Interestingly, research also found that pleasure may influence choices. More specifically, Mellers, Schwartz, and McGraw (1999) showed that choices were associated with anticipated pleasure. In other words, people tend to select an option with greater pleasure they perceived. Furthermore, Mellers and McGraw (2001) also identified an outcome effect that anticipated pleasure rose with the increase of anticipated outcome. These results suggested that people may make decisions based on the higher anticipated outcome as well as pleasure.

Although it seemed that the aforementioned research upheld as more choices as possible, some studies also revealed the negative consequences of too many choices. For example, Iyengar and Lepper (2000) showed that people with extensive choices (up to 30 choices in this case) reported less satisfaction than those with limited choices (6 choices in this case). Furthermore, when those people made a decision with too many choices, they felt both pleasure and frustration at the same time. This phenomenon was termed as "choice overload" or "paradox of choice" later by Schwartz (2005).

The possible reasons were that too many choices brought large-scale comparisons as well as the regret of the second best options (see Scheibehenne, Greifeneder, & Todd, 2010). Comparison the anticipated outcome of the chosen options with possibly positive outcomes of an un-chosen option may result in regret, yet if the outcome of an un-chosen option was negative, such a comparison would be pleasure (Mellers, & McGraw, 2001). Therefore, it should be more careful to design choices in a game-based learning environment, as Malone and Lepper (1987) suggested.

3. Design Tactics to Facilitate Thinking and Pleasure

From the perspective of board games, this section enumerates three design tactics to facilitate both thinking and pleasure of learners in a game-based learning environment. The three tactics are introduced in order of complexity.

3.1 Tactic 1: Choices

As a basic design tactic, choices, referring to selecting one option from several ones by definition, are widely adopted in board games. Board games usually allow players to choose one action in their own turn. A recent board game *Love Letter*[5] requires players to play a card from two cards in their hands. Although the action is very simple, players may focus on deducing which is the best option with a little chance. Because the game brings so much fun, the game received best card game, best family board game, best innovative board game, and best party game awards in 2013.

For enhancing strategic thinking, board games usually limit the amount of resources. Another board game *Puerto Rico*, for example, requires players to choose one from six actions in order to obtain limited buildings, plantations, workers, and spaces for selling. The player may execute the chosen action first with a privilege (*e.g.* to pay 1 dollar less or to get 1 resource more, depending on the chosen action); the rest of players execute the same actions in order without the privilege. Without sufficient resources, even simple selection may become seriously careful and tactical.

However, without choices, insufficient resources do not necessarily lead to strategic thinking. For example, *Monopoly* is a well-known family board game without sufficient resources and choices. In the game, a player plays as a landlord, aiming at buying properties to make a fortune. In one's turn, one has to roll a dice, which may randomly determine one's moves from 1 to 6. If one stays at an unoccupied property, one may buy it as one's own asset; however, if one stays at an opponent's property, one has to pay the rent. Although the game provides limited properties, players' actions are essentially determined by randomness (no choices), making the game linear and non-strategic.

In order to facilitate players to think and have real pleasure, the game should empower players to decide their actions. A good example is a digital educational game, Joyce, designed to incorporate educational quizzes in *Monopoly* (Chang, Yang, Yu, & Chan, 2003). Although the general game rule of Joyce was based on *Monopoly*, the designers modified the rule of moves for enabling players to choose their moves. More specifically, when players collect two random numbers by rolling dices, they were allowed to move with three choices: (a) the sum of the two numbers, (b) the larger one minus the smaller one, or (c) the smaller one minus the larger one (*i.e.* moving backward). Instead of moving randomly or freely, such a choice may force players to figure out optimal solutions, to take responsibility and to enjoy any possibilities of a non-linear game.

3.2 Tactic 2: Combination

Combination refers to mixing several parts for creating an assigned pattern according to the game rule. Some board games adopt the design of combination even if one action is chosen at a time. *Mahjong* is a typical example to demonstrate the combination tactic in a single action. In the game, players are required to draw a tile and then to choose a tile to discard from seventeen titles in hands in their own turn until anyone makes a legal combination of hands and wins the game. Although the action is simple, the action is actually a difficult decision to discard the most useless tile for increasing his/her probability of making a legal combination as well as decreasing the others' probabilities.

Thinking about combination is never easy for players, because it involves enumerating all possibilities. In other words, combination demands the ability to recognize, specify, and generalize patterns. In *Mahjong*, players first have to classify the tile types and sort the tiles of the same type physically or mentally. Then, as the rule of legal combination requires, they need to group every three tiles of the same or successive figures into a pattern. Experienced players can create several grouping ways on purpose in order to increase their own wining probabilities. Sometimes players need to give up one of the grouping ways because these ways are mutually exclusive.

[5] *Love Letter* is a card game, designed by Seiji Kanai and published in 2012.

On the other hand, combination can also be considered as a complex set of choices, requiring players to make several decisions at the same time. A popular poker game, *Big Two*, uses this tactic. Players in their turn have to decide to play single card, pairs, triples, or five-card hands. In a sense, the action can be decomposed as multiple decisions on whether they play each card or not. Alternatively, it can also be considered as decisions on how many and which types of cards should be played. In either way, players have to evaluate all conditions of the combination and their consequence.

The tactic of combination can also be adopted in educational games, such as *Numbers League*[6], a mathematical card game. In this game, players take the role of superhero leagues, whose goals are to capture aliens. More specifically, each alien has a certain number (*e.g.* from 3 to 26 in the easiest mode) while the value of each superhero is the sum of the numbers on their heads, bodies, and legs. If a superhero is equipped with a weapon (*e.g.* +5, -10, or ×4), the player may decide to use it or not. In order to capture an alien, the player has to specify he/she use which one or more superheroes and whether the heroes use their weapons. For doing so, the players have to consider as many combinations of arithmetic expressions as they can. For example, if a player has a superhero of 4 with a weapon +10 and another superhero of 8 with a weapon -5, he/she could capture aliens of number 3, 4, 7, 8, 12, 14, 17 and 22 in all combination of his/her superheroes with/without their weapons.

3.3 Tactic 3: Creation

In a spectrum of choices, from controlled to free actions, creation is perhaps the most implicit but imaginative way to making decisions. It is true that creation involves a plenty of choices. In drawing, for example, people actually have to decide the theme, perspective, tools, colors and so forth. Besides drawing, creation can be a writing, a song, a dance, or an artifact. Although real world enables people to produce creations at will, a game never allows players to create works totally freely. Instead, it provides rules to constrain players' creation to a certain extent.

There are many board games about creation. *DIXIT*[7] is one of them and popular. This game is consisted of a deck of cards with undefined pictures, so that every player may interpret these cards in their own way. In one player's turn, he/she plays the role of a question poser, who need to secretly select a card in hand and to give it a subjective meaning. The meaning can be a word, a phrase, a sentence, a story, a song, or even on a motion. According to the meaning, the other players also have to secretly select a card in their own hands as a distracter. After revealing all selected cards, the players except the question poser score if they can correctly choose which card belongs to the question poser. More interestingly, the question poser cannot score if all of the other players choose the correct or wrong cards. This scoring rule facilitates the question poser to pose a moderately ambiguous question, not too straightforward or too difficult to guess.

Without doubts, DIXIT may facilitate players' creativity and imagination. Besides understanding the relation between the meaning and the correct card, the pleasure of playing *DIXIT* is devising an ambiguous meaning. The aforementioned scoring rule for question posers may transform the creativity of the question poser into a simple choice. As a matter of fact, such a rule is also used in several board games of creativity, such as *Barbarossa*[8] and *Ask Anything*[9]. While the former requires players to create clay artifacts, the latter requires them to pose yes/no questions.

Not very many digital games take advantage of human's creativity as a part of games. A mobile app game, *Draw Something*, which was downloaded extensively two years ago, allowed every two players to guess each other's drawing. With the connectivity of network, this game may link friends or people across the world regardless of the constraint of time and space. However, although the painter may draw a picture creatively, the guesser actually solves a puzzle according to the hint of the picture the painter made. For the guesser, the conflict of the game is passive, making the game too linear. A possible solution is to provide some choices for guessers.

---

[6] *Numbers League*, designed by Ben Crenshaw and Chris Pallace, was published by Bent Castle Workshops in 2007.

[7] *DIXIT* was designed by Jean-Louis Roubira and published in 2008.

[8] *Barbarossa* was designed by Klaus Teuber and published in 1988.

[9] *Ask Anything* was designed by C. C. Hung and published by TwoPlus Games in 2013.

4. Concluding Remarks

In order to design digital educational games, this paper attempts to study the design tactic of board games owing to their potential for facilitating both thinking and pleasure. Historically, digital games originate from board games, and thus they may share the same core about thoughtful pleasure. Unlike digital games, which have additional fantasy, board games have pure design of game rules, worthy of thorough investigation.

This paper preliminarily identifies players' choices in games as the route to both thinking and pleasure. Based on this argument, this paper also proposes three tactics to design digital educational games. Furthermore, when the aforementioned design tactics are applied to a digital educational game, computing power should not restrict the game play. Rather, in terms of Crawford's definition of games (1984), computers ought to reflect the representation of reality or fantasy, to reinforce the interactions between human and computers or among players regardless of time and space, to enrich the conflict in any forms of exciting challenges, as well as to ensure the safety cognitively, emotionally and socially.

References

American Association of School Librarians (2009). *Standards for the 21st-Century Learner in Action*. Chicago, IL: American Library Association

Chang, L. J., Yang, J. C., Yu, F. Y. & Chan, T. W. (2003). Development and Evaluation of Multiple Competitive Activities in a Synchronous Quiz Game System. *International Journal of Innovations in Education and Training, 40*(1), 16-26.

Cordova, D. I., & Lepper, M. R. (1996). Intrinsic motivation and the process of learning: Beneficial effects of contextualization, personalization, and choice. *Journal of Educational Psychology, 88*(4), 715-730.

Crawford, C. (1984). *The Art of Computer Game Design*. New York: McGraw-Hill.

Epstein, R. (1977). *The Theory of Gambling and Statistical Logic*. San Diego: Academic Press.

Gamlath, L. S. (2007). Outcomes and observations of an extended accounting board game. *Developments in Business Simulations & Experiential Exercises, 34*, 132-137.

Hinebaugh, J. P. (2009). *A Board Game Education*. Lanham, MD: Rowman & Littlefield Education.

Iyengar, S. S., & Lepper, M. R. (2000). When choice is demotivating: Can one desire too much of a good thing? *Journal of Personality and Social Psychology, 79*(6), 995-1006.

Juul, J. (2005) *Half-Real: Video Games between Real Rules and Fictional Worlds*. Cambridge, MA: MIT Press.

Lennon, J. L., & Coombs, D. W. (2007). The utility of a board game for dengue haemorrhagic fever health education. *Health Education, 107*(3), 290-306.

Malone, T. W., & Lepper, M. R. (1987). Making learning fun: A taxonomy of intrinsic motivations for learning. In R. E. Snow, & M. J. Farr (Eds.), *Aptitude, Learning and Instruction III: Conative and affective process analyses* (pp. 223-253). Hilsdale, NJ: Erlbaum.

Mayer, B., & Harris, C. (2010). *Libraries Got Game: Aligned Learning Through Modern Board Games*. Chicago, IL: American Library Association

Mellers, B. A., Schwartz, A., & Ritov, I. (1999). Emotion-based choice. *Journal of Experimental Psychology: General*, 128, 332-345.

Mellers, B. A., & McGraw, A. P. (2001). Anticipated emotions as guides to choice. *Current Directions in Psychological Science, 10*(6), 210-214.

Ramani, G. B., & Siegler, R. S. (2008). Promoting broad and stable improvements in low-income children's numerical knowledge through playing number board games. *Child Development, 79*(2), 375-394.

Rollings, A., & Adams, E. (2003). *Andrew Rollings and Ernest Adams on Game Design*. Indianapolis, IN: New Riders Games.

Rollings, A., & Morris, D. (2000). *Game Architecture and Design*. Scottsdale, AZ: Coriolis.

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions, *Contemporary Educational Psychology, 25*(1), 54-67.

Salen, K., & Zimmerman, E. (2004). *Rules of Play: Game Design Fundamentals*. Cambridge, Massachusetts: MIT Press.

Scheibehenne, B., Greifeneder, R., & Todd, P. M. (2010). Can there ever be too many options? A meta-analytic review of choice overload. *Journal of Consumer Research, 37*, 409-425.

Schwartz, B. (2005). *The paradox of choice: Why more is less*. New York: Harper Perennial.

Smith, R. D., & Munro, E. (2009). Educational card games. *Physics Education, 44*(5), 479-483.

Woods, S. (2012). *Eurogames: The Design, Culture and Play of Modern European Board Games*. Jefferson, NC: McFarland & Company, Inc.