Game Design Literacy as a Problem-Solving Disposition

Beaumie Kim, University of Calgary, beaumie.kim@ucalgary.ca
Reyhaneh Bastani, University of Calgary, reyhaneh.bastani@ucalgary.ca

Abstract: In this paper, we argue that developing game design literacy supports learners' disciplinary engagement as well as skills needed in different situations in life, especially problem-solving and decision-making. Designing games for both their own learning and others' play challenges learners to develop a disciplinary understanding while transforming their ideas into communicative, coherent, and playable games. We define game design literacy and present our findings on how learners identified and solved problems in designing games.

Learners' creative expressions, i.e., designing personally meaningful artifacts, have been advocated in various learning settings for many decades (Dewey, 1934). On the other hand, it is difficult to engage learners in design activities that offer the continuity beyond their personal meanings, conceptual understanding, or identity development. Scholarship of constructionist gaming (i.e., creating games in the classroom) has offered in-depth perspectives on how learners could develop coding skills and academic understanding through designing digital games, and started to investigate learners' collaboration and identity development in this process (Kafai & Burke, 2015). When we call something a game, it has a system of rules, symbols, and models. Game design requires a deep sense of this system (Gee, 2008). When a game is played, its system is enacted and evolves as players become part of it. We argue that game design literacy involves this anticipation of players beyond the designers' personal meanings. In this paper, we describe how students identified and solved problems as they designed board/card games for educational goals, in anticipation of players' actions. We define game design literacy as problem-solving dispositions, and present our findings from a western Canadian middle school.

Game design literacy

Sheridan and Rowsell (2010) sought to theorize "design literacies" by studying designers of varying disciplines. Building on these efforts, we are investigating how the process of designing games can indicate learners' problem-solving dispositions. When learners engage in a participatory design, they identify what is worthy of knowing in their design, develop and redefine the group and class norms within the socio-cultural context, and express their identities through discourse and artifacts (Kim, Tan, & Bielaczyc, 2015). Game design can have a very special place in education: it requires incorporating different modes of knowledge and skills to create a system for players to participate in it through play (Zimmerman, 2013). It is not only about the designers' personal meanings, but also about the future players' creation of new meanings. To become game design literate, one needs to understand and create a complex set of meanings for a specific system, to symbolically represent the components of the system, and to structure the play based on the rules (Gee, 2008). Game design, however, entails not only one's understanding of how the system operates, but also one's anticipation of how it might be transformed when played (Zimmerman, 2013). Specific meanings, therefore, are both designed and emerged as players participate in the gameplay. Within the task of game design, we argue that there are varying levels of design tasks that emerge as problems for designers to solve. We suggest that game design literacy, which calls for learners understanding and anticipation of systems, design, and play, indicates complex problem-solving dispositions that Sheridan and Rowsell (2010) observed from professionals.

Research design and findings

We worked with two Grade 8 teachers (Math/Science and Humanities) and a learning specialist to design and implement the board/card game design approach, addressing the learning outcomes from Grade 8 Programs of Study: Mechanical Systems, Origins of a Western Worldview (Renaissance Europe), Number Sense (Rates, Ratio, Proportions), and Communication/Presentation Skills. The teachers asked the students to develop games that would be fun to play but also integrate curriculum. A board game designer visited the class twice to introduce board/card game designs and to give feedback when the groups had early prototypes. They finished their projects on the school's celebration of learning day. We took an ethnographic approach to observe and document this process, including video-recordings and collecting their game design artifacts, and conducted interviews with the teachers and the students. Two researchers individually noted the kinds of problems and solutions that the students identified while designing games, and discussed them for consensus. We observed that many students looked for information beyond the topic knowledge, and engaged in problem-solving and decision-making processes. Their engagement in this process showed relevance to the complexity of students'

games, which ranged from board-based trivia games to sophisticated role-playing or strategy games. We briefly summarize the groups' identified problems and the solutions, using examples from two groups.

Incorporating learning content. Some groups took the task of incorporating multiple disciplines in their games as their important problem to solve. For example, the goal of Renaissance: Rebirth (R:R) game was to build ships and houses (i.e., using simple machines) within the context of Renaissance. Players needed to visit universities, trading posts, and shops to gain knowledge and purchase goods and resources, within the context of applying Da Vinci's early concept of hydraulics. After creating the game context of Renaissance and bringing ideas from Mechanical Systems, one of the group members suggested incorporating Number Sense (rates and ratio) in their point and trading system. In the end, they also symbolized this system in their game title acronym (R:R). Their work demonstrates creating a complex set of meanings (i.e., Renaissance as background, science/math knowledge, rules, and interactions) that open possibilities for players to create different meanings.

Enacting the historical figures. Some groups solved the problem of how to create a dynamic narrative with historical figures and their roles within the historical time of Renaissance. One group's solution was to create a role-playing card game, using the important Renaissance figures as their characters. They called their game, Race of Renaissance. They decided to use Da Vinci, Galileo, Gutenberg, and Kepler for the roles of four players. As they were creating decks for each figure, they realized that they needed to learn about their accomplishments in order to create enough Action and Accomplishment cards. They described themselves as "researchers", as they decided to do research on each figure beyond their textbook. They explained that it helped them have more choices on what information to use in their game. Their final game involved players unlocking actions to eventually win by unlocking the masterpiece of their chosen figure. Their work demonstrates how they materialized their understanding into a system that has constituents, actions and rules.

Balancing the game. As the groups tested their games within their groups as well as with other classmates, they learned that the gameplay needed to be sustained by balancing its system and rules. This problem was not only identified by the students themselves, but also reminded by the game designer who visited them. The initial design of the R:R game's chance cards could make players quickly lose their resources, which made players' efforts to change their situation meaningless. The group decided to refine their cards when they noticed that players were frustrated drawing those cards. They also made players make their own decision about taking risks (i.e., chance cards) based on feedback. The change was for players to choose their desired route in order to take or avoid the risk of getting a chance card. For Race of Renaissance, the group realized that certain characters were likely to win because of the differences in their "strengths". They modified the decks of each figure or the points of action cards to balance the game through playtesting within the group multiple times.

Conclusion

We briefly described our findings of how game design practices provided opportunities for learners to develop game design literacy and deepen their disciplinary understanding. They not only engage in deciding the set of rules, which are informed by their disciplinary understanding, but also make sense of games as dynamic systems with emergent patterns and outcomes. We witnessed that learners' designing games for both their own and others' learning challenged them to transform their ideas into the creative, communicative and coherent expressions of a playable game. This study contributes to the scholarly discourse of advocating game design as an approach to help learners think creatively, flexibly and systematically for multiple, but connected disciplines.

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