Understanding Enjoyment in ARTé: Mecenas with EGameFlow

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Abstract—**Game flow analysis has been widely used to examine the player's enjoyment in a game. In this paper, we presented the game flow results of ARTé: Mecenas by adopting the EGameFlow scale. We adapted questions in the questionnaire from the EGameFLow scale, which formed six game flow factors – Concentration, Goal Clarity, Challenge, Autonomy, Immersion, and Knowledge Improvement. From our findings, the students overall enjoyed the game. They were able to concentrate on the learning tasks in the game. They received clear goals at the beginning of the game and each game level. The challenges in the game tasks improved their understandings of the content knowledge. Their senses of controlling the game continuously increased during the gameplay. The students increased their content knowledge after the gameplay, though they could not decide if they were emotionally involved. In addition, we found that the content knowledge in the game, game levels and visuals could influence the player's game experience.**

Keywords—art history, educational game, game flow, game experience, EGameFlow, game enjoyment

I. INTRODUCTION

A player's experience is an important element in any games' success. Game flow analysis is one way to understand a player's gameplay experience. Several different methods have been proposed to study flow experience. For instance, Sweetser and Wyeth [1] proposed the GameFlow model of player enjoyment for the flow analysis. Previous research studies have extensively used this model in the design and evaluation phase of serious games (e.g., [2, 3]) and other types of games (e.g., [4]). Other techniques for the flow analysis include using flow scales such as Flow State Scale-2 and Dispositional Flow Scale-2, which are based on the flow dimensions initiated by Csikszentmihalyi [5]. Self-reporting is also a common method for the flow analysis [6]. Although a number of studies have reported their game flow results, detecting the player game experience in our game is still necessary and important. Therefore, we probed two research questions in this paper:

(1) What are the game flow results from the studies of using an educational game – ARTé: Mecenas in the undergraduate-level art history courses?

(2) What are the possible reasons resulting in the students' learning experience from the gameplay?

II. RELATED WORK

Game flow relates to the flow state, which is an emotional state fully engaging in an activity that directs to the optimal experience [5]. Flow occurs when activities have clear goals and rules, encourage deep engagement and autonomy, and require the development of skills [1, 5]. The optimal experience integrates cognition, motivation and emotion. According to Csikszentmihalyi [5], flow experiences result in enjoyment. Therefore, detecting a player's game flow experience is a way to examine his or her gaming enjoyment.

Derived from the GameFlow model, Fu, Su and Yu [7] present a scale (i.e., EGameFlow) measuring enjoyment in e-learning games. They transformed the GameFlow criteria into a usable questionnaire. They used four different games relating to different knowledge content from 166 students' responses to test the validity and reliability of the EGameFlow scale [7]. Other research studies have also adopted this scale to measure gaming experiences. For example, Eckardt and Robra-Bissantz [8] examined students' experiences using three versions of a serious game for learning information literacy. Söbke [9] adopted this scale to investigate student engagement in a gamified quiz app.

The initial GameFlow model [1] was structured into eight factors: (1) concentration, (2) challenge, (3) skills, (4) control, (5) clear goals, (6) feedback, (7) immersion, and (8) social interaction [2]. Comparatively, the EGameFlow scale is composed of (1) concentration, (2) goal clarity, (3) feedback, (4) challenge, (5) autonomy, (6) immersion, (7) social interaction, and (8) knowledge improvement.

The factor Concentration relates to a player's ability to focus on the game task, which can be achieved when the game task has clear goals and provides timely feedback [1]. Goal clarity requires game tasks clearly explained at the beginning [7]. Feedback helps learners navigate the gap between the status quo of knowledge and the knowledge required for completing the game tasks [1]. Challenges in a serious game should fit the player's level of competences and stay in accordance with the

increase in the player's competence level [7]. Autonomy is a player's perceived sense of control over his or her action in the game [10]. Immersion is a player's deep involvement in the experience [7]. Social Interaction relates to the collaboration with peers in the game [7]. Knowledge Improvement is a replacement of the player skills factor in the original GameFlow model to suit the goals of educational game development [7].

III. METHODOLOGY

A. Data

In Spring 2017, we conducted two studies at two public universities in the United States to evaluate student game experience in the educational game - ARTé: Mecenas (v1.2) [11]. Participants were mainly recruited from two undergraduate art history survey II courses. Participants were asked to play the game in two weeks. Participants completed a pre-test before starting the game and finished a post-test and questionnaire relating to student game experience after the gameplay. Initially, 142 students joined the studies. After excluding the participants who did not complete the studies, we collected information from 127 students in total for the game flow analysis.

B. Instrument

ARTé: Mecenas [11] is an educational game that focuses on the 15th and 16th century Italian Renaissance (see Fig. 1). During the gameplay, a player can virtually experience history as the head of the Medici family, one of the most famous families of the time. Playing as the Medici avatar, the player must learn to balance the relationships with multiple stakeholders in different areas. As the player become a patron of those famous artists such as Michelangelo and Da Vinci, the player also learns to increase the financial wealth, establish a good reputation and commission the artworks. ARTé: Mecenas creates a relevant art history experience, deviating from traditional learning approaches to engage students in a 3D gaming environment for a deeper learning.
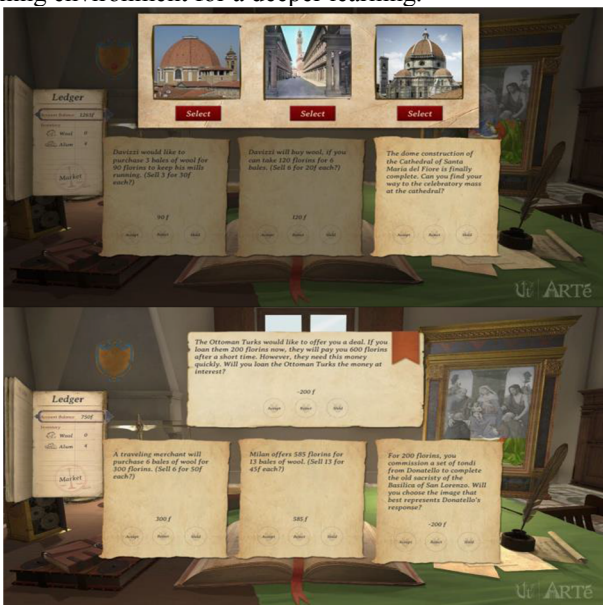

Fig. 1. ARTé: Mecenas

C. Measurements

We adopted a questionnaire including 24 items for six factors adapted from the EGameFlow scale [7] and extra 16 items for the player's overall learning experience from the gameplay. Each item was in a seven-point Likert scale with 1 being strongly disagree to 7 being strongly agree. We did not include the factors of Feedback and Social Interaction due to the nature of the game.

D. Analyses

The composite scores for each factor were used for analyses. The statistic results showed that the model was a moderate fit ($\chi 2(127) = 428.589$ (p < .0001), CFI = 0.872, RMSEA = 0.082, SRMR = 0.077). Reliability, central tendency and dispersion for each game flow factor and the player's overall gameplay experience were calculated. We examined the association between each game flow factor by using the nonparametric Spearman's rho. We ran the descriptive analyses for the items related to students' learning experience from the gameplay. All analyses were conducted in JMP Pro 15 and R version 3.5.2.

IV. RESULTS

A. Game Flow Results

Table I lists the reliability and descriptive statistics of six factors – "Concentration", "Goal Clarity", "Challenge", "Autonomy", "Immersion", and "Knowledge Improvement". Overall, students could concentrate during the gameplay and agreed that the in-game activities were related to the learning tasks (5.4698 ± 1.2087). The students had clear goals of what they were to achieve during the gameplay (5.7106 ± 1.1975). They were able to understand the knowledge delivered in the game and integrated what they learned from the class, which lead to their knowledge improvements (5.5764 ± 1.0068). They also agreed that the game supported them to make decisions through hints when meeting the challenges in the game, and their understandings of the knowledge content were improved at the same time (5.4508 ± 1.0298). In addition, their senses of controlling the game continuously increased because the game system allowed them to make errors and gave sufficient opportunities to solve problems in the game (4.6299 ± 1.1551). However, the students could not decide if the game provided them with an emotional involvement (4.1772 ± 1.343).

TABLE I.   GAME FLOW RELIABILITY AND DESCRIPTIVE STATISTICS

Factor	Cronbach's Alpha	Mean	SD
Concentration	0.7447	5.4698	1.2087
Goal Clarity	0.8731	5.7106	1.1975
Challenge	0.7196	5.4508	1.0298
Autonomy	0.7572	4.6299	1.1551
Immersion	0.8382	4.1772	1.343
Knowledge Improvement	0.8586	5.5764	1.0068

All six factors of game flow are significantly correlated with each other (see Fig. 2). Particularly, the factor

"Knowledge Improvement" had the modarate correlations with the factor "Goal Clarity" ($\rho = 0.4509$, $p < .0001$), "Autonomy" ($\rho = 0.474$, $p < .0001$), and "Immersion" ($\rho = 0.4194$, $p < .0001$); it had a strong correlation with the factor "Concentration" ($\rho = 0.5221$, $p < .0001$).
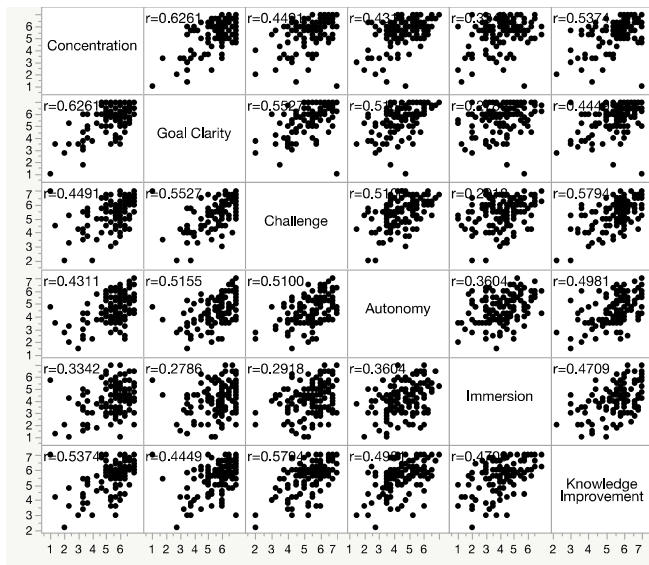

Fig. 2. Scatterplot matrix

B. Students' Learning Experience from the Gameplay

According to the student evaluation, ARTé: Mecenas was a fun game (5.126 ± 1.3273) that well engaged students into the gameplay-learning process (5.5039 ± 1.0607). The students overall had an enjoyable learning experience (5.5039 ± 1.0607).

ARTé: Mecenas had four game levels in total. All students ($n = 127$) reached their gameplay to the level 4. They reported that they learned the most through the level 3 (6.4173 ± 1.6205) and the level 4 (6.6457 ± 1.6834), while the level 1 (5.7323 ± 1.144) and the level 2 (5.9528 ± 1.2653) were still helpful for increasing their knowledge.

Overall, the students considered that the visuals in the game helped them understand the subject concepts (5.4016 ± 1.2987) and improve their knowledge (5.6535 ± 1.2433), which resulted in the mastery of the course content (5.378 ± 1.3682). The game could be used as a helpful learning resource, which facilitated the students to better understand the textbooks (5.4409 ± 1.5153). The students were willing to recommend this game to their peers (5.252 ± 1.4363) and teachers (5.3622 ± 1.6459) as well.

V. DISCUSSION

Regarding the first research question (i.e., What are the game flow results from the studies of using an educational game – ARTé: Mecenas in the undergraduate-level art history courses?), the game successfully gave the students an enjoyable game experience. Considering the adoption of the EGameFlow, this scale was manifest in ARTé: Mecenas in the following ways:

- Concentration: The gaming activities in ARTé: Mecenas are related to the learning tasks, and the players could remain their concentrations on these activities.
- Goal Clarity: The game goals and the intermediate goals are clearly presented in the beginning of the game and each level of the game.
- Challenge: The challenges occurring in the gameplay, such as trading activities, supporting artworks as Medici, or balancing the established relationships, can improve student understandings of the content knowledge through making decisions in the game.
- Autonomy: As a simple choice-based game, the player is easily in control of the objects in the game and gaming strategies.
- Immersion: The game draws players in, but students could not decide if they were emotionally involved in the game.
- Knowledge Improvement: The game delivers and increases the students' content knowledge.

Among these factors, Knowledge Improvement is the most meaningful factor for an educational game. To achieve this improvement, the game should catch a player's attention to the learning tasks within the game, while improving the player's sense of controlling the game and engaging the player into the gaming environment can also greatly help the improvement in learning.

Concerning the second research question (i.e., What are the possible reasons resulting in the students' learning experience from the gameplay?), there are several possibilities. First, the structure of the content knowledge covered in the game levels can have an impact on student learning experience during the gameplay. It is also not a surprise that higher game levels yield more learning challenges and improvements. Second, visuals have great impacts on learning, because visuals can directly map thoughts and boost the acquisition of information. Visualization in the game can enhance the player's sense of immersion as well. Meanwhile, visual attention in the game can be one of the possible reasons that students are able to concentrate during the gameplay. This result aligns with previous research findings (e.g., [12] – [13]). Therefore, visuals in the game are beneficial for student learning and gameplay. Moreover, compared with the textbook, the game provides additional content knowledge in depth, which allows students to use it as a supplementary learning tool.

VI. CONCLUSION

ARTé: Mecenas is a useful tool to support student learning in the art history. The results demonstrated that ARTé: Mecenas can provide players with a joyful gameplay experience. Considering the findings from this paper, the game flow analysis is quite meaningful for an educational game, which can detect the status of the game from the players' perspective. This detection can be very helpful, especially in the design and development stages of a game. The benefit of adopting the

EGameFlow scale is its focus of the educational game setting, which intentionally considers learning aspects in the game.

In our future research agenda, we will investigate the student game experience from the lens of game design. This research interest can lead to a meaningful design framework addressing important design rules and giving a useful guidance in each phase of the game development process in an educational game.

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