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# Code Book©- The development of an Adventure Action Game for History Instruction and the Evaluation of Flow State, Learning Performance and Gender Difference

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**Abstract:** This study aims to develop a first-person adventure action game-Code Book© for history learning, and to explore learners' learning performance and their flow state in the game. The present empirical research included 38 Taiwanese college students. The results showed that learners' learning performance improved and they reached high flow state. In addition, no significant difference was found between male and female students in terms of their learning performance and flow state, suggesting that this game is suitable for learners of both genders.

**Keywords:** history, game-based learning, role-playing, flow, learning effectiveness

## 1. Introduction

In the recent years, Game-based learning (GBL) has been applied to many school subjects. History is one of the subjects that contain many elements such as people, place, events, and so on. Learners were traditionally required to memorize lots of knowledge for history learning, and it may reduce their learning motivation. Dondlinger (2007) indicated that games can stimulate learners' deep thinking in history learning. Several studies have also reported that GBL provides a self-learning environment (Raybourn & Bos, 2005) and it can promote learners' motivation (Annetta et al., 2009). In the present study, our research team (NTUST MEG)(http://www.ntustmeg.net/) developed an educational game with FPS Game Creator© to assist learners in learning the history of Opium Wars (a diplomatic event in China, 1840-1842). The background of the game was during the World War II, and a secret agent was looking for a confidential file in the headquarter of the German Army. The secret agent needed to analyze the information in the books or confidential files hidden in different locations and to get the code book to escape from the headquarter. The study adopted the role-playing theories (Shaftel & Shaftel, 1967) by asking the learners to play the secret agent. With the background and missions in the game, learners were encouraged to accomplish the missions by believing that they were the agent in the game. We also adopted the scaffolding theory (Wood, Bruner, & Ross, 1976) by showing history information along with the prompt of every file (see Figure 1). With the prompt, players could find out the code book and the way out. This game also added intense plots and the scenario of chasing and escaping from the enemy (see Figure 2). This study aims to explore learners' flow state in history learning through this action game, to evaluate learners' learning performance, and to analyze gender differences.

**Figure 1 Screenshot of the game-a related historical file was found**

**Figure 2 Screenshot of the game-challenging scenarios**

## 2. Method

Participants in this study were 38 college students from one institute of technology in Taiwan. They were 11 males and 27 females of 19-22 years old. This study adopted the flow scale developed by Kiili(2006) to measure the learners' flow. The Chinese version was translated and revised by Hou & Chou(2012). The five-point Likert scale questionnaire included 23 items with two dimensions: flow antecedents and flow experience. The analysis of data from our samples showed that its Chronbach's alpha reliability was 0.93. This study used the same questions in pre- and post-tests, and the questions were designed by an expert in history. There were five questions for the test. The procedures of this study were as follows. Five minutes for the pre-test, ten minutes for introduction of the game and basic operations, 25 minutes for students to play the game, five minutes for the post-test and 25 minutes for the flow questionnaire.

## 3. Results and Discussions

In terms of learning effectiveness, this study conducted a paired-samples t-test on the pre- and post-test scores. The results indicated that after the GBL activity, students' knowledge in history was significantly improved ($t=-5.33$, $p<0.001$).

**Table 1 Paired-Samples t Test**

| | pretest(n=38) | | pretest(n=38) | | |
|---|---|---|---|---|---|
| Outcome | M | SD | M | SD | t |
| Pretest-posttest | 1.32 | 1.25 | 2.68 | 1.45 | -5.33*** |

***$p<0.001$

As for the flow, as shown in Table 2, the average scores of each dimension were above 3.00 (the median was 3.00). It shows that most of the learners were reached high flow state during the game. In terms of the sub-dimension of the flow antecedents, the mean scores of feedback (M=3.68) and playability (M=3.68) were higher, suggesting that learners could know how they performed in the game based on the feedbacks and that learners could play the game easily. In addition, in terms of the sub-dimension of flow experience, the average scores of concentration (M=3.80) and time distortion (M=3.79) were higher, implying that learners' attention to the game was high. This high attention to the game made learners forget about the time and reach high flow experience.

**Table 2 The mean and standard deviation of flow questionnaire**

| Flow Dimensions | M | SD |
|---|---|---|
| Flow Antecedents | 3.63 | 0.67 |

| | | |
|---|---|---|
| Challenge | 3.54 | 0.83 |
| Goal | 3.64 | 0.78 |
| Feedback | 3.68 | 0.76 |
| Control | 3.62 | 0.75 |
| Playability | 3.68 | 0.77 |
| Indicators of Flow Experience | 3.73 | 0.59 |
| Concentration | 3.80 | 0.80 |
| Time distortion | 3.79 | 0.70 |
| Autotelic experience | 3.70 | 0.82 |
| Loss of self-consciousness | 3.57 | 0.68 |

The study explored the differences of flow state and learning performance between learners of different genders with a t-test (see Table 3). The results showed that no significant difference was found between male and female students in terms of their flow antecedents (t=0.12, p=0.906) and flow experience (t=-0.29, p=0.774). This finding violated our hypothesis that male students may be more involved in the 3D first-person action game. One possible explanation is that most participants in this study are students from the multimedia design discipline, and many of them had the experience in 3D game objects design or operation. Moreover, the game included both battle and puzzle-solving missions. Whether the player could accomplish the missions mainly relied on the clues hidden behind the history knowledge. This may explain why no significant difference in students' interests in this part was observed between males and females. Scores from both genders in all dimensions were higher than the median 3.00, suggesting a positive flow state to a certain degree. Likewise, no significant difference existed between males and females in their improved learning performance. Therefore, this game should be suitable for both genders even though it was an action game.

**Table 3 Gender difference in flow state and pre- and post-tests**

| Dimensions | Groups | | | | | |
|---|---|---|---|---|---|---|
| | Male(n=11) | | Female(n=27) | | | |
| | M | SD | M | SD | t | p |
| Flow Antecedents | 3.65 | 0.60 | 3.63 | 0.70 | 0.12 | .906 |
| Indicators of Flow Experience | 3.68 | 0.64 | 3.74 | 0.58 | -0.29 | .774 |
| pretest scores | 1.73 | 1.35 | 1.15 | 1.20 | 1.30 | .201 |
| posttest scores | 3.00 | 1.84 | 2.56 | 1.28 | 0.85 | .400 |

Future research may further investigate learners' learning process with more large-scale experiments and behavioral pattern analysis.

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