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# A POE Strategy-Based Gaming Approach for Mathematics Learning

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**Abstract:** Although many related studies have confirmed that digital game-based learning can effectively improve students' learning motivation. Some studies have reported that properly integrating learning strategies into digital games-based learning can effectively improve students' learning achievement. However, few research has been focused on the effects of learning retention. In this study, an integrated POE strategy and digital game-based learning approach has been developed for improving learning retention, and an experiment has been conducted to evaluate students' learning achievement, learning retention in a mathematics course. The experimental results show that the POE strategy-based gaming approach can significantly improve the students' learning achievement and learning retention.

**Keywords:** digital game-based learning, POE strategy, learning retention.

## 1. Introduction

The effective and successful teaching and learning is Learners not only to acquire new knowledge but also to retain this knowledge for long periods of time after instruction (Georghiades, 2004), so the effect of learning retention is really important. Some studies have reported that digital game-based learning can promote the learning motivation of students (Hwang, Chiu, & Chen, 2015; Hsu, Tsai, & Liang, 2011). When properly integrating learning strategies with digital games-based learning can effectively improve students' learning achievement (Charsky & Ressler, 2011; Qian & Clark, 2016), but less studies has been conducted regarding the effects of learning retention. The predict-observe-explain (POE) strategy may be able to promote the conceptual understanding of lasting retention, which is integrated into the digital game-based learning, so that the learning effect of the students can be effectively improved. Therefore, this study proposes a POE strategy-based gaming approach for mathematics learning, the following research questions are investigated:

(1) Do students who learn with the integrated POE strategy and digital game-based learning approach have significantly better learning achievement than students without the POE strategy?
(2) Do students who learn with the integrated POE strategy and digital game-based learning approach have significantly better learning retention than students without the POE strategy?

## 2. Literature Review

### *2.1 Digital Game-based Learning*

Researchers have indicated that improper lead-in of learning strategy might decrease learning motivation, increase cognitive load and cause negative learning effects (Charsky & Ressler, 2011). So it is important to integrate some appropriate learning strategies in the digital game.

### *2.2 The Predict-Observe-Explain (POE) Strategy*

White and Gunstone (1992) have promoted the predict-observe-explain (POE) procedure as an efficient strategy for eliciting and promoting students' science conceptions. This strategy involves students

predicting the outcome of a problem, observing the situation of the problem, and finally explaining any discrepancies between their prediction and observation. POE strategy can help students clarify their own individual ideas and effective in promoting a durable conceptual change (Küçüközer, 2013).

## 3. Development of an Integrated POE Strategy and Digital Game-based Learning Mode

In this study, we tried to develop a role-playing game by integrating POE strategy as part of the gaming scenarios to assist students in improving their learning performance. Fig. 1 shows the integrating POE as part of the gaming scenarios in a gaming mission.


P(Prediction) O(Observation) E(Explanation)

Figure 1. Integrating POE as part of the gaming scenarios in a gaming mission.

## 4. Experiment Design

The subjects of this study were two classes of fifth graders of an elementary school located in New Taipei City. A quasi-experiment was designed by assigning the students in one class with 26 students to the experimental group, and those in the other class with 26 students to the control group. The experimental group learned with the POE strategy-based gaming approach, while the control group learned with the digital game without the POE strategy. The research tools in this study included a pre-test, a post-test and a delayed post-test.

## 5. Experimental Result

Table 1 shows the ANCOVA result of learning achievements. There was a significant difference ($F=4.14$, $p < .05$) between the two groups; Table 2 shows the ANCOVA result of learning retention, and there was also a significant difference ($F=12.11$, $p < .01$) between the two groups; that is, the students who learned with the POE strategy-based gaming approach can showed significantly better learning achievements and learning retention than those who learned with the game without POE strategy.

Table 1: ANCOVA result of learning achievements.

| Grop | N | Mean | S.D. | Adjusted mean | Std.error | *F* |
|---|---|---|---|---|---|---|
| experimental group | 26 | 69.42 | 18.28 | 69.44 | 3.40 | 4.14* |
| control group | 26 | 62.54 | 19.41 | 62.51 | 3.40 | |

*$p < .05$

Table 2: ANCOVA result of learning retention.

| Grop | N | Mean | S.D. | Adjusted mean | Std.error | *F* |
|---|---|---|---|---|---|---|
| experimental group | 26 | 70.31 | 17.44 | 70.33 | 3.71 | 12.11** |
| control group | 26 | 57.46 | 14.66 | 57.44 | 3.71 | |

***p* < .01

## 6. Discussion and Conclusions

In this paper, a POE strategy-based gaming approach is presented. The experimental results show that the POE strategy-based gaming approach can significantly improve students' learning achievement and learning retention. That is, the POE strategy can help students clarify their own individual ideas and effective in promoting a durable conceptual change, as indicated by several researchers (Akpinar, 2014; Küçüközer, 2011). It means that the POE strategy is properly integrated into the game. Therefore, integrated POE strategy and digital game-based learning approach is a potential and effective way to help students for better learning.

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