Research Article

A GAME-BASED LEARNING APPROACH TO IMPROVE STUDENTS' LEARNING ACHIEVEMENT IN DATA FLOW DIAGRAM COURSE

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ABSTRACT

This research practically develops the educational computer games in order to improve students' learning achievement in Data Flow Diagram course. The objectives were 1) to analyze and design the educational computer game for Data Flow Diagram course, 2) to develop the educational computer game for Data Flow Diagram course, 3) to study the learning achievement of the students who studied with the educational computer game for Data Flow Diagram course, and 4) to evaluate the satisfaction of the students who studied with the educational computer game for Data Flow Diagram course. The 40 samples were bachelor degree students of Department of Computer and Information Technology, King Mongkut's University of Technology Thonburi, who were studying in 2nd semester, academic year 2016, derived from simple random sampling. The research instruments were 1) the educational computer games in order to improve students' learning achievement in Data Flow Diagram course, 2) learning achievement pretest and posttest, and 3) evaluation form of students' satisfaction. The data was statistically analyzed by mean, standard deviation, and paired sample t-test.

The results of the research show that the game-based learning approach to improve students' learning achievement in Data Flow Diagram course have significant improve upon students' learning achievement. The posttest scores of the students ($\bar{x}$ = 30.15, S.D. = 3.29) were significantly higher than the pretest scores ($\bar{x}$ = 11.71, S.D. = 4.38) ($t = 26.09$, $p<.05$). The students satisfied with the game-based learning approach to improve students' learning achievement in Data Flow Diagram course at the level of "much" ($\bar{x}$ = 3.81, S.D. = 0.8). The research can be concluded that the game-based

learning approach to improve students' learning achievement in Data Flow Diagram course has decent quality and be able to provide for related educators as references.

Keywords: game-based learning, learning achievement, data flow diagram

INTRODUCTION

Today, people cannot deny the fact that computer and information technology have become the essential for them rather than machine due to its involvement, which has drastically modified our life since the time of the invention of the computers to the present day. These drastic alterations that computer and information technology have come across in our lifetime have thoroughly direct effect on our daily lives and presumably our lifestyles. Gaining benefit from the innovations of computer and information technology, life has turn into much easier from day to day for all humanity around the planet.

Responding to this perspective with facts, computer and information technology learning approaches aim to be the key success factors. Students should be aware of not only computer network but also information system from information technology due to its immensely beneficial usages in this global digitalized world. Information systems help to regulatory compliance, support better management decision making, completion and development.

As a consequence, students who want to pursue knowledge in this field must understand the concept of system development. A structured analysis technique called data flow diagrams (DFDs) is one of techniques that play significant role in system analysis. However, now most learning approaches of data flow diagrams (DFDs) are in incorporate with the traditional face-to-face manner, and handbooks often seem abstruse with its many phases, concepts and case studies, but lack practical exercise. The educational computer games are attainable improvement of learning interest and motivation of students (Ebner & Holzinger, 2007; Huang et al., 2012) further point out that well-made educational computer games might have tremendous capability for improving students' learning achievements.

In conclusion, students appreciate the game-based learning approach, that using data flow diagrams (DFDs) course as activity content, allows students to acquire learning achievement, transform the enjoyment of game, fun, interactive into instruction, accomplishing the determination of edutainment.

Literature Review

Games provide a remarkable construction of making up for traditional teaching strategies and stimulate teaching with vitality, foster creative thinking and offer various methods for teaching. Games make learning principles more flavorful for students and allows students the freedom to explore their creative thoughts. Games inspires creative behavior and alternative ideation (Lowenstein & Martha, 2004)

Prensky (2001) pointed out that Digital Game-Based Learning is any marriage of educational content and computer games, the premise behind Digital Game-Based Learning is that it is possible to combine computer games with a wide variety of educational content, achieving as good or better results as through traditional learning methods in the process. Prensky further indicated that Game-Based Learning benefits the students in their learning motivation by the reason of its entertaining and Game-Based Learning is also enormously versatile, adaptable to almost any subject, information, or skill to be learned, and when used correctly, is extremely effective.

In addition, several studies have shown that game-based learning can also have significant impact on the learning achievement of students (Cheng & Su, 2012) A The study of Han and Gwo (Sung & Hwang, 2013) showed that educational game not only benefits the students in promoting their learning attitudes and learning motivation, but also improves their learning achievement and self-efficacy. In the meantime, Hwang et al. (2013) further conducted the online game experiment of elementary school children in natural science course and found that the game-based learning not only significantly promoted the flow experience, learning attitudes, learning interest and technology acceptance degree of the students, but also improved their learning achievements.

METHODOLOGY

1. Participants

This study recruited 40 students from bachelor degree students of Department of Computer and Information Technology, King Mongkut's University of Technology Thonburi, who were studying in 2nd semester, academic year 2016.

2. Procedure

The total duration of the educational game experiment was 150 minutes. Prior to the formal learning and playing activity, a 15 minute pre-test was administered to assess data flow diagrams (DFDs) knowledge. Following the pretest, the rules of the game, DFD games, were outlined in a 10

minute explanation. The formal learning and playing activity with educational game then proceeded for 90 minutes. After the learning activity, a post- test (containing the same questions as the pretest but reordered) as well as a learning satisfaction questionnaire (The researcher identified the satisfaction of the students into 5 levels as Likert's scale) were administered. The 20 minute post-test and 15 minute questionnaire required for completion.

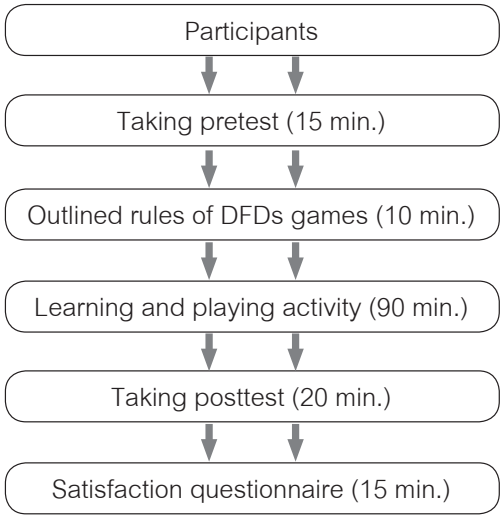

Figure 1 Diagram of Experiment Design

3. Research Tools

3.1 Educational Computer Game

The educational computer games was developed from analyzing learners' context, content analysis and learning objectives before implication with the participants. The educational computer games composed of 7 games.

Table 1 The Aim of Each Game

Number	Name of the game	Aim of game
1	Drag and drop grocery bags	Learn about conventions used in data flow diagrams
2	True or false facts (context, 0 and child DFD)	Learn about context diagram, diagram 0 (the next level) and child diagrams (more detailed levels)
3	Checking diagrams for errors	Learn about correct and incorrect data flow
4	True or false facts (logical and physical DFD)	Learn about logical and physical data flow diagrams
5	Drag and drop (create logical DFD)	Learn more detail about logical DFD
6	Drag and drop (create physical DFD)	Learn more detail about physical DFD
7	Partitioning DFD	Learn how to partitioning data flow diagrams

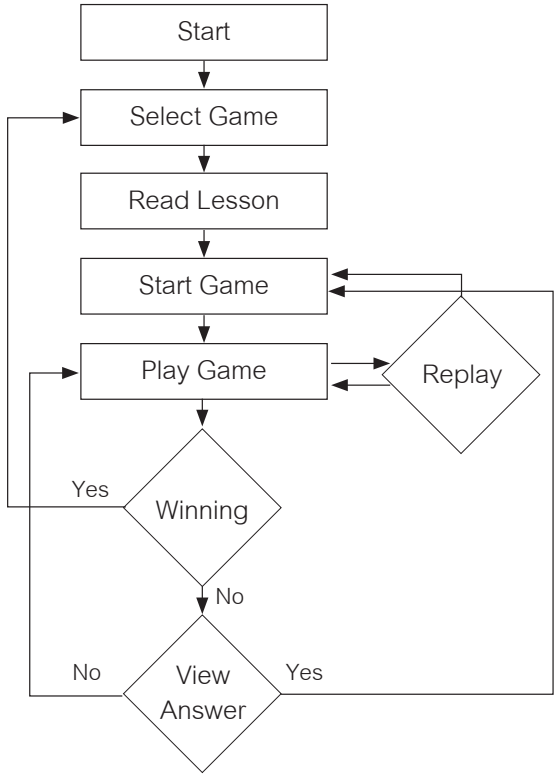

Figure 2 Workflow Play Game (Flowchart)

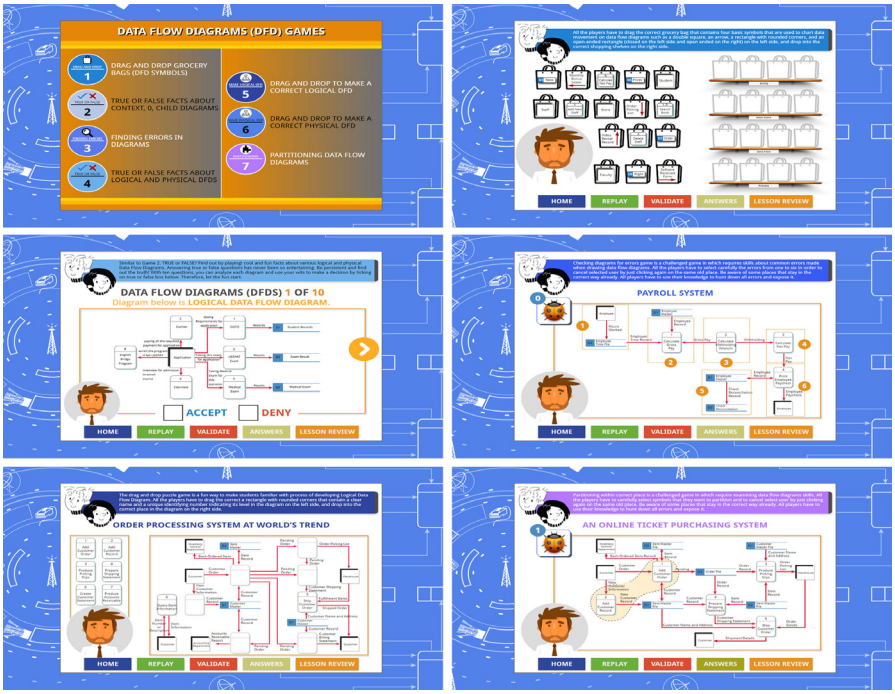

Figure 3 The Ducational Computer Games of Data Flow Diagram Course

3.2 Achievement Test

The primary objective of the learning achievement test was to gauge the comprehension of participants with regard to system analysis concepts associated with data flow diagrams (DFDs). The content of the test was based on the learning content in the data flow diagrams course. In the development of the test, researchers made revisions according to suggestions provided by supervisor, books and websites. The test included 35 multiple choice problems, each contributing points for a total score of 35 points. It was used as a pretest applied before the experiment and as a posttest applied after the experiment.

3.3 Satisfaction Questionnaire

Researcher developed a satisfaction scale according to (Likert, 1932) to evaluate the degree to which students satisfied the educational game according to three aspects:

1. Educational content
2. Educational game design
3. Interaction

First aspect included seven question items. Second aspect included five question items. Last aspect included four question items. The questionnaire included 16 question items. Researcher employed a five-point Likert scale in which the students asked to rate level of satisfaction; most (5 points), much (4 points), moderate, (3 points), little (2 points), or least (1 point).

4. Measuring Tools

In this study, the measuring tools were a pretest, a posttest and the questionnaire for measuring the students' satisfaction by randomized one group (Engel & Schutt, 2005; Gravetter & Forzano, 2009)

Table 2 Research Methodology

Samples	Pretest	Treatment	Posttest
R	T1	X	T2

Meaning of the symbols

R represented Random Sampling

X represented Treatment

T1 represented Pretest

T2 represented Posttest

RESEARCH RESULTS AND DISCUSSION

Research Results

Learning Achievement

Table 3 The Learning Achievement of 40 Samples

Test Result	$\bar{x}$	S.D.	D-Bar	t-test	Sig. (2-tailed)
Pretest	11.71	4.38	18.43	26.09*	.000
Posttest	30.15	3.29			

*p < .05

From Table 3, the research found that the posttest scores of the students ($\bar{x}$ = 30.15, S.D. = 3.29) were significantly higher than the pretest scores ($\bar{x}$ = 11.71, S.D. = 4.38), t-value of 26.09 is greater than the critical value of 2.023 and the p-value of 0.000 is less than alpha of 0.05. Therefore, it can conclude that the game-based learning approach to improve students' learning achievement in Data Flow Diagram course have has an influence to the sampling group. Students' satisfaction

Table 4 The Satisfaction of the Students

Description	Result		
	$\bar{x}$	S.D.	Level of satisfaction
On content	3.79	0.69	Much
On design	3.88	0.88	Much
On interaction	3.77	0.86	Much
Total	3.81	0.80	Much

Form Table 4, the analysis of students' satisfaction to the game-based learning approach to improve students' learning achievement in Data Flow Diagram course, it was found that the average score was equal to 3.81, and the standard derivation score was equal to 0.80. Comparing with the criteria, the satisfaction of the students who studied with the game-based learning approach to improve students' learning achievement in Data Flow Diagram course was at the level of "much".

Discussion

This study had implemented the game-based learning approach to improve students' learning achievement in Data Flow Diagram course. The results of the research show that the postest score of learning achievement ($\bar{x}$ = 30.15, S.D. = 3.29) was pointedly higher than the pretest score ($\bar{x}$ = 11.71, S.D. = 4.38) (t=26.09, p<.05). The students satisfied the game-based learning approach to improve students' learning achievement in Data Flow Diagram course at the level of "much" ($\bar{x}$ = 3.81, S.D. = 0.80). The research can be concluded that the game-based learning approach to improve students' learning achievement in Data Flow Diagram course significant improve upon students' learning achievement and make the students interested in lesson and lead to eager learning. The students intend to study and gain more knowledge. These results correspond to the use of the educational computer games in game-based learning in previous studies (Cheng & Su, 2012; Hwang et al., 2013).

SUGGESTIONS AND RECOMMENDATIONS

In future work, we expect to conduct in-depth studies on students' achievement towards learning and playing using the data flow diagram games to identify the elements that arouse interest and how knowledge is acquired from playing games. Finally, this study focused on analysis technique course in system analysis; we suggest that future researchers create educational games for other courses such as Unified Modeling Language (UML) Concepts and Diagrams and Data Dictionaries.

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