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Effect of computer-based video games for vocabulary acquisition among young children: An experimental study

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Abstract-This study investigated the role of computer-based video games on facilitating children's cognitive learning. This study investigated the effect of the varied types of instructional delivery strategies on children's learning achievement. English has been taught through computer games allow linguistic development. This research hypothesized that using computer games may compensate for such shortcomings and computer-based video game playing not only improves participants' fact/recall processes), but also promotes problem-solving skills by recognizing multiple solutions for problems. The subjects comprised of 418 EFL teachers and learners dealing with EFL in Iranian institute. There are no statistically significant differences in students' achievement when they receive two different instructional treatments: (1) traditional computer-assisted instruction (CAI) programs; and (2) a computer-based video game. The treatment period was conducted in the spring semester of 2011. Data were statistically analyzed through SPSS 11.5, and the results showed that there was a significant difference in both between those subjects who used computer games and those who did not. The experimental group who used computer games outperformed the control group who did not use it as a teaching aid in foreign language classroom ($p<.05$). In other words computer games exchanges can play a facilitative role in teaching and learning second language (L2).

Keywords-Game learning, play theory, cognitive processes, educational technology

1. INTRODUCTION

The use of multimedia in education has significantly changed people's learning processes. Results from a number of research studies indicate that appropriately designed multimedia instruction enhances students' learning performance in science, mathematics, and literacy (Gee, 2003). Previous studies indicate that computer-assisted instruction (CAI) programs have important factors that can motivate, challenge, increase curiosity and control, and promote fantasy in children (Tzeng, 1999). Despite the fact that computer and video games have the same multimedia capability as CAI programs, their potential learning impact is often discounted by parents and educators. Recently, computer-based video games' presence and popularity have been ever-growing, and game developers and researchers have started to investigate video games' impact on students' cognitive learning (Begg, Dewhurst, & Macleod, 2005; Squire, 2003; Vaupel, 2002). For example, Pillay commenced a study investigating the influence of recreational computer games on children's subsequent performance on instructional tasks (Pillay, 2002). While game-playing is regarded somewhat negative in educational settings, particularly for young children, re-scrutinization of its influence in a teaching and learning context is crucial. This study investigated whether computer-based video games facilitate children's cognitive learning achievement. In comparison to traditional CAI programs, this study explored the impact of the varied types of instructional delivery strategies on children's learning achievement. Research results from the Kaiser Family Foundation and the Children's Digital Media Centers (Rideout, Vandewater, & Wartella, 2003) found that children in the United States are growing up with media and are spending hours a day watching television and videos, using computers, and playing video games. According to the findings, today's children are starting to be exposed to technologies and media at a much younger age than previously thought. Therefore, educators' investigations become critical concerning the impact of technologies and media on children's development. This study investigates two main questions: (1) Can computer-based video games be instructional tools in early childhood education? (2) Should instructional strategies be modified to fit into young children's media experience?

Most previous research studies related to computer-based video games focused on the discussions of psychological study and child behavior (Provenzo, 1991; Squire, 2003).

In psychological study, research results indicated that video games can promote hand-eye coordination, visual scanning, auditory discrimination, and spatial skills (Johnson, Christie, & Yawkey, 1999; Lisi & Wolford, 2002). For child behavior, evidence showed that violent video games may raise children's aggressive play and violent behaviors (Funk, 2001). Separate from previous research this study discusses computer-based video games from an educational perspective by exploring the following issues:

(1) How might some of the motivating aspects of computer-based video games be harnessed to facilitate learning?

(2) How might motivational components of popular computer-based video games be integrated into instructional design?

2. REVIEW OF LITERATURE

Computer Assisted Language Learning (CALL) has existed for almost 70 years now. Several methods and systems have been proposed to help improve particular focus areas in language learning using computers. Most work in the CALL domain does not explore the ability of technology to teach English using persuasive computer games to immigrant high school children. This is by far the only study we know that focuses on teaching pronunciation and provided a visually detailed feedback and training. Powers et al [6] is also a similar system and goes a step further by acting as Embodied Conversational Agents (ECA). While these systems mention encouraging results, they lack information about how motivational these systems might be. Multimodality has also been briefly investigated for pedagogical benefits in English Language Learning (Zhang, Wu, Wei & Wang, 2011). Chen, Dana and Ballard (2004) suggest that spoken language can be grounded sensory perceptions of the real world. It describes a learning interface that bridges a gap between the real world physical objects and the virtual interface. Gorjian, Alipour and Saffarian (2012) describe a collaborative table top based simple matching to help develop the reading skills of young groups of children. These systems also continue to focus on the writing, reading, and vocabulary parts of the language (Zhang & Wu, 2011a). However, recently there has been a growing interest in including computer based tools that use automated speech recognition to provide a guided reading experience for the users (Zhang, Wang, Wu and Huo, 2011). While the Reading Tutor involves use of stories, Gorjian, Pazhakh and Naghizadeh (2012) have successfully shown the use of games, especially the use of mobile games as persuasive tools for improving English literacy of the illiterate English as second language. Johnson, Christie and Yawkey (1999) present a system being used by the US Army to learn Arabic in Iraq. However, we feel that due to nature of the intended use and lack of a particular pronunciation focus, this product is unsuitable for use by young children. The users hence, learn how to structure the sentences properly and learn appropriate word placements (Zhang & Wu, 2011b). This system is focused more on the grammar than spoken language. Its adoption demonstrates that speech-enabled games can be designed to promote language learning (Yoshimoto, McGraw, Seneff, 2009). There is a fun aspect to matching pictures using a novel speech interface, but the task of matching itself is not typically considered to be enjoyable (Brandon Yoshimoto, Ian McGraw, Stephanie Seneff , 2009).

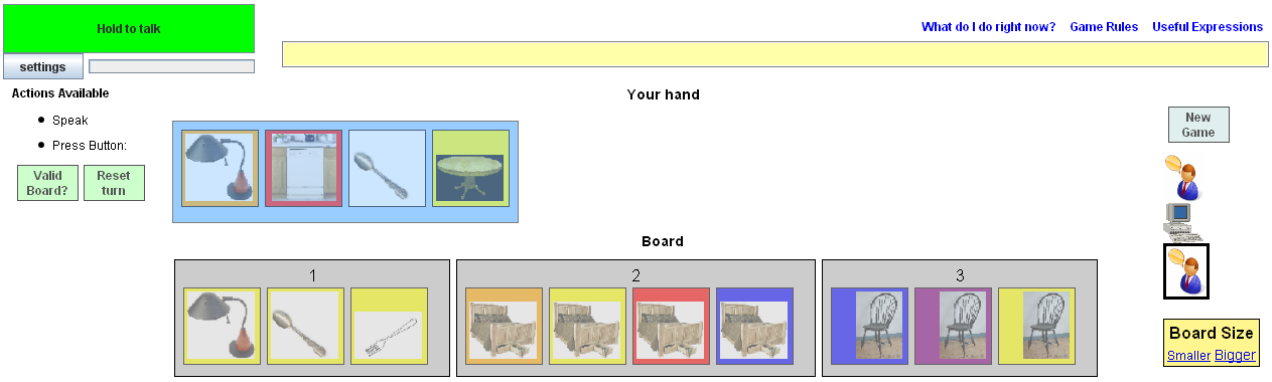

Figure 1: Screenshot of Rainbow Rummy

3. METHODOLOGY

3.1. Participants

The research population included 90 female EFL learners' female students. Learning EFL selected in private language institutions in Behbahan .The learning prerequisite for participants was the ability to use basic computer tools and Internet-browsing resources. One hundred and fifteen students agreed to participate in this study and provided parental consent. .Then they were divided in two experimental and control groups i.e. each included 30 participants. Their level was judged through their scores on the pre-test administration as pre intermediate level .Experimental group received computer games, while the control group was taught through some placeboes.

3. 2. Instrumentation

The instructional topic used for this study was fire-fighting. Instructional content covered the basic knowledge about the danger of fire and fire-fighting

techniques. The content was chosen because it covers a variety of educational objectives (facts, concepts, analyses) and is not related to the participants' courses, thus avoiding potential threats to internal validity of the study. Two different instructional materials: computer-assisted instruction and a computer based video game were used in this study. For the computer-assisted instruction, a unit of text-based instructional materials was developed. For the computer-based video game, Fire Department 2: Fire Captain, 3D, real-time strategy game developed by Monte Cristo Games, was chosen for this study. This computer game has been assessed by the Pan-European Game Information (PEGI) age rating system, and has been approved for children seven years and older. This 3D, real-time computer game applied the design principles derived from (Gorjian, Pazhakh, & Parang, 2012) attention, relevance, confidence, and satisfaction (ARCS) model of motivation to facilitate children's learning. Below is a description of how the game's design strategies related to the ARCS model of motivation.

The dependent variables used in the study were the outcome of participants' post-test scores and the results of the three sub-categories in the post-test. A post-test containing 28 items was designed for the study. It has a total of 100 points. The following details the three sub-categories in the post-test:

(1) Part 1: Multiple-choice (16 items): Part 1 measures knowledge of specific facts, terms, and definitions by asking participants to answer multiple-choice questions that relate to the topic of fire-fighting. The objectives measured in this test require an understanding of factual materials and concepts.

(2) Part 2: Matching (6 items): Part 2 evaluates participants' ability to associate specific terms from a list of appropriate context. The objectives measured in this test also focus on recalling facts and identifying factual information. The difference between part 1 and part 2 is that for matching up specific terms, participants need to analyze and compare the similarities and differences in the descriptions.

(3) Part 3: Application (6 items): In part 3, participants are required to demonstrate their understanding of how to put out a fire as a firefighter in an emergency scenario. This part requires that participants thoroughly understand the danger of fire, fire safety information, and fire-fighting processes during a rescue scenario. The test measures a higher-level cognitive task that shows understanding of what is being taught and its use in other circumstances.

3.3. Procedures

The experimental study required 115 third-grade students to compare two different types of instructional treatment by looking at their learning performance. By using similar content, this study investigated which instructional treatment better affects students' cognitive learning (the computer-assisted instruction versus computer-based video game playing). Different instructional treatments were designed and selected for this study.

Participants in the control group (CG) learned by interacting with computers individually. The contents of the computer-assisted instruction in this study used a text-based format. The fire-fighting content was presented in a single web page without hyperlinks. The content included elements of fire, fire categories, fire-fighting techniques, and fire safety information. Participants determined their own reading pace by dragging the scroll bar on the right side of the web browser. No teacher was involved in this study, and the researcher provided only technical support to the participants when needed.

The purpose of this study was to determine whether computer-based video games support students' cognitive processes. With this hypothesis, a game called Fire Captain was chosen for the experimental group (EG). This computer game used similar instructional content as the control group. The primary goal of this game is to master all kinds of knowledge and skills to prevent fire. Although five single-player campaigns with increasingly complex missions constitute this game, the tutorial mission is one that participants have to play first in the study. In the tutorial mission, the participants learned everything they need to know to be a firefighter through each relevant and inclusive introductory task. Because Fire Captain is a real-time strategy game, the players needed to put out a fire at the end of tutorial mission, and their performance was graded by the game. To avoid interference with others, no teacher was involved in the experiment. As in the control group, the researcher provided only technical support to the participants when needed. After obtaining approval from the Office for Regulatory Compliance from the researchers' universities, the researchers contacted the principal of the selected school in order to obtain a formal agreement for conducting this study. Two weeks prior to the formal study, parental consent forms were distributed to 136 students. These parental consent forms needed to be signed by the recruited students' parents.

Participants were asked to participate in two instructional sessions. Estimates were that sessions lasted 40 minutes, for a total of 80 minutes (the length of a regular class period in elementary schools in Behbahan), for a total of 80 minutes. In the first session, the control group received a unit of computer-assisted instruction about fire-fighting. The experimental group was asked to play the computer game Fire Captain. In the next session, all participants were required to take a quiz to allow assessment of their learning achievements. As the experiment began, the researcher asked the participants to turn on their monitors. For the participants in the control group, their monitors immediately showed a text-only web page. The researcher informed the participants that they would have 35 minutes to read through the instructions. The participants could browse the contents at their own pace. As soon as they finished the text-based instruction, they raised their hands to indicate to the researcher completion of the task. However, anyone who finished early had to remain seated and wait for the other children to finish until the time was up. For the experimental group at the beginning of the class, the researcher used five minutes to demonstrate the skills of mouse control for the computer game. After the demonstration, the experimental group turned on their monitors, put on headphones, and began playing the computer game. The main menu of Fire Captain appeared on their monitors. Participants also had

35 minutes to explore this game freely. However, they had to finish the tutorial mission as soon as possible. How fast they completed the tutorial mission was a significant factor for evaluating their ranking at the end of the mission. Participants had permission to raise their hands at any time to ask for any technical support during this session.

After receiving various instructional treatments, each participant was required to take a quiz during the second session. The quiz was designed and developed to assess participants' learning achievements after finishing their instruction. From three categories of questions-fact differentiation/recall, analysis/comparison, and understanding/problem-solving-different types of learning outcomes were determined. The researcher graded and recorded all the post-tests.

4. RESULTS

After taking the pre and post-tests, the participants' scores were corrected by two raters. The assigned score for each paper was the mean score of two raters' scores. Descriptive statistics was carried out for all measures involved in this study. The scores for both groups in pre and post tests phases are presented in Table 1.

Table 1. Descriptive Statistics

Groups	N	Min.	Max.	Mean	Std. Deviation
Pre-test (Control)	30	14.00	20.00	17.48	1.939
Post-test (Control)	30	17.00	20.00	16.52	1.557
Pre-test (Experimental)	30	1500	20.00	17.72	1.568
Post-test (Experimental)	30	1900	20.00	19.72	1.214

Table 1 shows that the mean score of control group in pre-test was 17.48 and means score of experimental group was 17.72. After administering the post-test the mean score for both control and experimental groups were 16.52 and 19.04 respectively which indicates the higher performance of experimental group in post-test. An Independent Samples *t*-test was conducted to compare the means of control and experimental groups in pre-and post tests administration as it is shown in Table 2.

Table 2. Independent Samples *t*-test (Pre-and post-tests of both groups)

Groups Tests	Mean	SD	*t*-test	df	Level of significance	Critical *t*
Control Group Pre-test	17.48	1.939	-.872	58	.388	2.01
Post-test	16.52	1.557				
Experimental group Pre-test	17.72	1.568	6.687	58	.000*	2.01
Post-test	19.04	1.059				

*Significant at ($p<0.05$)

Table 2 indicates that there was a significant difference in the scores for the experimental group. Results indicate suggest that computer games affected learners' vocabulary acquisition at the pre intermediate level. The statistical results clearly show a significant difference between computer-assisted instruction and computer based video game playing in students' learning achievement. Based on this finding, playing computer based video games was determined to be more effective in facilitating third-graders' average learning outcome than text-based computer-assisted instruction. Therefore, it may be concluded that this null hypothesis should be rejected.

According to the results of post-test scores, computer-based video games can clearly facilitate students' learning performance. With this finding, it may be concluded that computer-based video games can be considered an instructional approach to improve students' higher-order thinking .In conclusion, computer-based video games might improve students' achievement in learning factual knowledge, problem-solving strategies, and higher-level cognitive thinking processes. Kids' play with computer games exemplifies forms of knowing and being in the world that are irreducibly and simultaneously social, technical, material, and symbolic (Mizuko, 1997).

While computer-based video games may be manipulated to positively influence children's learning, particular attention must be given to guidelines derived from game design and experimental methodology, as well as to learner characteristics and learning styles. Only by initiating a systematic program of investigation where independent variables are judiciously manipulated to determine their relative effectiveness and efficiency of facilitating specifically designated learning objectives will the true potential inherent in game design for learning be realized.

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Vitae

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