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# Comprehension through Visualization: The Case of Reading Comprehension of Multimedia-Based Texts

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***Abstract*** – The present study investigated the effect of visualization on reading comprehension through multimedia-based texts. To do this, a group of 60 Iranian intermediate EFL learners who studied English in a language institute of Rasht were selected through a language proficiency test. They were randomly divided into three equal groups, each with 20 EFL learners: multimedia-based texts with static visuals, multimedia-based texts with dynamic visuals and control group with no visualization. They were provided with reading texts which was in these three formats. The results of independent sample t-test showed that there is a significant difference between different types of visualizations (static and animation) in their performance on reading comprehension of multimedia-based texts. More specifically, it was found that dynamic type of visualization is more effective in enhancing EFL learners' reading comprehension. The results of this study proved that reading comprehension while using dynamic visualization would lead to better comprehension among EFL learners. Dynamic visualization increased the motivation of learners to improve their reading comprehension as they experienced different ways to learn reading.

***Keywords***: dynamic visualization, reading comprehension, static visualization

## I. INTRODUCTION

Latest developments in instructional technology have given researchers and instructors a platform (opportunity) for designing instruction that integrates different visualizations. Diagrams and pictures, which remained fixed or static in both print and computer-based environments for a long time, can now be converted into animated ones so that they are applied as influential tool to brightly present abstract ideas or phenomena that are imperceptible to human eyes (Hegarty, 2004). The potential benefit of using advanced technology in instructional design, which intensely is utilized as visualization, has aroused interest in instructional designers and academic experts. Nevertheless, despite a long history of visualization in instructional material, previous research has revealed that merely adopting a new technology does not actually enhance learning (Hegarty, 2004). Mayer (1994) refers to visualization as "illustration in textbook-based instruction or animations in computer-based instruction" (p. 126). Narayanan and Hegarty (2000) state that over the last two decades, the instructional technology researchers' interests have shifted from interactivity that was limited to scanning, rereading, annotating and page turning with the medium of paper to interactive control over the presentation of textual, aural and visual material on a

computer. According to Hegarty (2004, p. 343), "with developments in hypermedia systems and interactive interfaces, we can create documents that allow students to browse the information in any order, rather than being constrained by the linear ordering of information in printed books." Concerning how effectively and efficiently dynamic visualizations is applied in educational context, several empirical studies have been conducted (e.g., Mayer, Hegarty, Mayer, & Campbell, 2005). They indicate that the conditions under which dynamic visualizations would be useful and variables that may cooperate with the dynamic representation of visuals to produce varied effects.

In order to appreciate the importance of visualization in language teaching and learning, a brief elucidation of two types of visualization, static and animation are in order. In fact, recent investigations on visualization have formed some attention-grabbing findings about the format of visualization pigeonholed as static picture and dynamic animations. According to Dulac, Viguier, Leveson, and Storey (2002), a static visual representation is "a snapshot of the specified behavior of the system at a particular time or a static description of all possible behavior" (p. 73). On the other hand, Betrancourt and Tversky (2000) refer to animation as "any application which generates a series of frames, so that each frame appears as an alteration of the previous one and where the sequence of frames is determined by the designer or the user" (p. 312).

In general, static and animated graphics can be utilized to demonstrate materials that are different in nature and their characteristics (static and animated graphics varies in nature and their characteristics). Concerning the role of visualization in educational context, research has revealed the superiority of animated visualization over static visuals which demonstrate efficiently movements invisible to the human eye or alters in shapes or movement of objects (Wong, 1994). Animation is used and applied powerfully in demonstrating instructional materials that are dynamic in nature. They are too abstract to be comprehended without a tangible example, such as what exists in science concepts, or naturally cannot be seen, such as the process of carbon cycle or water cycle on earth (Dwyer, 1994).

Rieber and Kini (1991) have given animation several advantages over static graphics. For example, it is believed that when learners use animated graphics there is no need to make a mental image of the event or action being focused on and, hence, misunderstanding cannot be caused by creation of mental images. Additionally, concerning a continuity of movement, animation offers an amplified capacity to present information (Wong, 1994).

Dynamic visualizations such as animations have popular support among other instructional tools (Ayres & Paas, 2007). However, research so far conducted on the effectiveness of dynamic and static visualizations remains rather unclear and research studies have not yet determined if animation has superiority over static visualizations. Twenty studies on the use of animation have been reviewed by Szabo and Poohkay (1996). Since half of the studies demonstrated that animations always have superior effect on the static picture, the other half represents no significant differences.

Being under the impression that animations always have superior effect on the static picture, some researchers (e.g., Mayer, Hegarty, Mayer, & Campbell, 2005; Schnotz, Bockheler, & Grzondziel, 1999) draw different conclusions from this issue. Studies conducted by these researchers demonstrated that animation was no more effectual and sometimes less effective than the equivalent static graphics. Mayer et al. (2005) have conducted a research to investigate the effect of annotated illustrations versus narrated animation in multimedia instruction on students' retention and transfer test performance. Ninety-five college students were selected from the psychology subject pool at the University of California, Santa Barbara. Students either received a static diagram with explanatory text or animation with narration explaining the process of how lightning, a toilet tank, ocean waves and a car's breaking system work. The result of their experiments demonstrated that there was no support for the dynamic media hypothesis. In fact, there was support for the static media hypothesis when equivalent paper and computer treatments were compared on retention and transfer measures.

Of the relevance to the aim of the present study is the question of enhancing the quality of reading multimedia-based texts through visualization. This study investigated the relative effect of different types of visualizations on reading comprehension of multi-media based texts. Therefore, the following research question was posed to address the purpose of the study:

- What type of visualizations (dynamic or static) is more effective in enhancing EFL learners' reading comprehension?

## II. METHODOLOGY

### A. Participants

To conduct the current study 60 Iranian EFL learners were selected based on their performance on Oxford Placement Test (OPT). It was general proficiency test that was administered to select the participants in a convenient sampling format. The participants aged from 20 to 25. All of the participants were learning English as their foreign language in a language institute in located in the city of Rasht, Iran. Their level of English language proficiency was intermediate. Their native language was Persian. Then, the participants were randomly divided into two experimental groups and one control group.

### B. Instruments

The first instrument used in this study was the Oxford Placement Test (OPT) (Edwards, 2007). This test consists of 70 items, including 10 multiple-choice and true-false reading, 10 writing, and 50 multiple-choice language use items.

A multimedia-based computer program was used in the study, consisting of the two different reading texts that were provided for two groups of the study. The instructional materials initially

available in print form were further developed and converted into a computer-based format with either static or animated visuals, which were accompanied with different reading strategies. Regarding the organization of the software, in the bottom was a navigation bar that helped students to go back or move forward within the instructional module. Reading materials were placed on the left side of the software screen and visual materials, either static or animated, were displayed on the right side of the screen.

Based on reading texts, reading comprehension questions were prepared. True/false questions and multiple-choice questions comprised the reading comprehension questions used for data collection.

### C. Procedure

The first step of the study was administration of OPT. It was given to 74 EFL students. Their OPT scores were used to select a more homogeneous group of students (i.e., intermediate level) and to figure out the reading proficiency level of the students. Based on the performance of the participants on OPT, 60 intermediates were selected. They were randomly assigned to three equal groups. The first group received multimedia-based texts with static visualizations, the second group was given multimedia-based texts with dynamic visualizations and the control group was given simple reading texts through conventional methods of teaching reading.

The participants were asked to complete their demographic information. Afterwards, prior to beginning each instructional phase (i.e., pre-reading, reading, and post-reading phases), there was an introduction page that described the purpose of study, procedures to be followed during the study, the instructional content and its organization, and a brief description of reading comprehension test that the participants need to complete. Afterwards, the participants were asked to choose the static/animation options. By clicking on the static option, they could see the reading texts with static pictures. By clicking on the animation option, they could see the reading texts with animated pictures.

Immediately after reading each text, the participants in each group were provided with a reading comprehension test, appraising the participants' understanding the content of the reading text. Finally, the data set will be organized according to the research questions of the study. Then the collected data will be analyzed.

## III. RESULTS

The participants of all three groups took pretest in order to check whether or not their reading comprehension is almost at the same level. The descriptive statistics of the participants of each group on pretest has been presented in Table 1.

**Table 1: Descriptive statistics for the participants' scores on the pretest**

| | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Dynamic (Pretest) | 20 | 10.00 | 19.00 | 13.9000 | 2.90009 |
| Static (Pretest) | 20 | 10.00 | 19.00 | 15.0000 | 3.09499 |
| Control (Pretest) | 20 | 10.00 | 19.00 | 14.7500 | 2.80741 |

In order to ensure that there is no significant difference among the three groups regarding their pretest scores, the researcher ran a one way ANOVA. The results are provided in Table 2.

**Table 2: ANOVA on pretest**

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 13.300 | 2 | 6.650 | .771 | .467 |
| Within Groups | 491.550 | 57 | 8.624 | | |
| Total | 504.850 | 59 | | | |

The results show that there is not any significant difference ($F_{2, 57} = .77$, $p > 05$) among the pretest scores of the three groups of participants.

In order to verify the research question of the study in finding what type of visualization is more effective on Iranian EFL learners' reading comprehension of multimedia-based texts, a one-way ANOVA was run. The results are shown in Table 3.

**Table 3: ANOVA on posttest**

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 556.133 | 2 | 278.067 | 14.392 | .000 |
| Within Groups | 3608.850 | 57 | 63.313 | | |
| Total | 4164.983 | 59 | | | |

The results showed that there is a significant difference ($F_{2,57} = 14.39$, $p > 05$) among the posttest scores of the three groups of the study. It shows that visualization made a significant difference among three groups. Scheffe post-hoc test was performed in order to find the location of differences. The results are shown in Table 4.

**Table 4: Scheffe Post-hoc test on posttest**

| Multiple Comparisons | | | | | | |
|---|---|---|---|---|---|---|
| Dependent Variable: Posttest | | | | | | |
| Scheffe | | | | | | |
| (I) Groups | (J) Groups | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
| | | | | | Lower Bound | Upper Bound |
| Dynamic | Static | 3.00000* | 2.51621 | .029 | -5.3245 | 7.3245 |
| | Control | 6.90000* | 2.51621 | .000 | .5755 | 13.2245 |
| Static | Dynamic | -3.00000* | 2.51621 | .029 | -7.3245 | 5.3245 |
| | Control | 5.90000* | 2.51621 | .000 | -.4245 | 12.2245 |
| Control | Dynamic | -6.90000* | 2.51621 | .000 | -13.2245 | -.5755 |
| | Static | -5.90000* | 2.51621 | .000 | -12.2245 | .4245 |
| *. The mean difference is significant at the 0.05 level. | | | | | | |

As the results indicate, there is a significant difference between dynamic and control groups as well as static and control groups. Considering the mean scores, it was revealed that the dynamic group has outperformed the static and control group. Static group also has performed better than the control group.

## IV. DISCUSSION AND CONCLUSION

This study investigated the superiority of animations over static graphics in a multimedia learning environment in relation to learning knowledge about reading texts, the finding revealed that instructional animations are more effective in the retention and process knowledge in the reading texts. Research on the effectiveness of type of visualizations (static or dynamic) remains rather unclear; the present study reinforced previous studies (Kaiser, Proffitt, & Anderson, 1985; Rieber, 1989; Rieber, Boyce, & Assad, 1990) that showed the superiority of animations over the static visualization. The present finding approves Hoffler and Leutner's (2007) results that demonstrated a declarative knowledge with animations would result in positive effectual learning. Animation visuals are more effective in facilitating learners' comprehension of the material. However, the most important finding of this study was supported by previous research (e.g., Hasler, Kersten, & Sweller, 2007; Mayer & Chandler, 2001; Moreno, 2007), who indicated that if additional supporting instructional strategies incorporated into animations, animations would become more effectual.

The results of this study does not confirm those of Chan and Black (2005) who found that static graphics significantly outperformed the system-controlled animation and direct-manipulation group on the system drawing.

As the results of this study imply, integrating reading strategies, such as incorporating advanced organizers and visualization into reading materials is of essence to both teachers and students. Thus, designing and applying various reading strategies into L2 classroom can have a substantial effect on L2 reading comprehension.

## REFERENCES

Ayres, P., & Paas, F. (2007). Making instructional animations more effective: A cognitive load approach. Applied Cognitive Psychology, 21, 695–700.

Betrancourt, M., & Tversky, B. (2000). Effect of computer animation on users' performance: A review. *Le Travail Humain, 63*, 311-329.

Chan, M. S., & Black, J. B. (2006). *Learning Newtonian mechanics with an animation game: The role of presentation format on mental model acquisition*. Paper presented at the American Education Research Association Annual. San Francisco, CA.

Dulac, N., Viguier, T., Leveson, N., &Storey, M. (2002). *On the use of visualization in formal requirements specification.* Retrieved November 4, 2011, from http://sunnyday.mit.edu/papers/RE02_visualization.pdf

Dwyer, F. M. (1994). One dimension of visual research: A paradigm and its implication. In D. Moore & F. M. Dwyer (Eds.), *Visual learning: A spectrum of visual learning* (pp. 383-401). NJ: Educational Technology Publications.

Hasler, B. S., Kersten, B., & Sweller, J. (2007). Learner control, cognitive load and instructional animation. *Applied Cognitive Psychology, 21*, 713-729.

Hegarty, M. (2004). Dynamic visualizations and learning: Getting to difficult questions. *Learning and Instruction, 14*, 343-351.

Hoffler, T. N., & Leutner, D. (2007). Instructional animation versus static pictures: a meta-analysis. *Learning and Instruction, 17*, 722-738.

Kaiser, M. K., Proffitt, D. R., & Anderson, K. (1985). Judgments of natural and anomalous trajectories in the presence and absence of motion. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 11*, 795-803.

Mayer, R. E. (1994). Visual aids to knowledge construction: Building mental representations from pictures and words. In W. Schnotz, & R. W. Kulhavy (Eds.), *Comprehension of graphics* (pp. 125-138). Amsterdam: North-Holland.

Mayer, R. E., & Chandler, P. (2001). When learning is just a click away: Does simple user interaction foster deeper understanding of multimedia messages? *Journal of Educational Psychology, 93*(2), 390-397.

Mayer, R. E., Hegarty, M., Mayer, S., & Campbell, J. (2005). When static media promote active learning: Annotated illustrations versus narrated animations in multimedia instruction. *Journal of Experimental psychology, 11*(4), 256-265.

Moreno, R. (2007). Optimizing learning from animations by minimizing cognitive load: Cognitive and affective consequences of signaling and segmentation methods. *Applied Cognitive Psychology, 21*, 765-781.

Narayanan, N. H., & Hegarty, M. (2000). *Communicating dynamic behaviors: Are interactive multimedia presentations better than static mixed-mode presentations?* Retrieved October 7, 2014, from http://www.psych.ucsb.edu/~hegarty/papers/17Communicating%20 dynamic%20behaviors.pdf

Rieber, L. (1989). The effects of computer animated elaboration strategies and practice on factual and application learning in an elementary science lesson. *Journal of Educational Computing Research, 5*, 431-444.

Rieber, L., Boyce, M., & Assad, C. (1990). The effects of computer animation on adult learning and retrieval tasks. *Journal of Computer-Based Instruction, 17*(2), 46-52.

Schnotz, W., Bockheler, J., & Grzondziel, H. (1999). Individual and cooperative learning with interactive animated pictures. *European Journal of Psychology and Education, 14*(2*)*, 245-265.

Szabo, M., & Poohkay, B. (1996). An experimental study of animation, mathematics achievement, and attitude toward computer-assisted instruction. *Journal of Research on Computing in Education, 28*(3), 390-402.

Rieber, L. P., & Kini, A. S. (1991). Theoretical foundations of instructional applications of computer-generated animated visuals. *Journal of Computer-based Instruction, 18*(3), 83-88.

Wong, A. Y. K. (1994). *The use of animation in computer-assisted instruction*. Unpublished doctoral dissertation, Carleton University.