

The Effect of Visual Cueing and Narration Speed on the Comprehension Scores with Types of Task and Overall Cognitive Load

Jewoong Moon

Chonnam National University, Republic of Korea
jewoong.moon@gmail.com

Jeeheon Ryu

Chonnam National University, Republic of Korea
jeeheon@jnu.ac.kr

Abstract: The purpose of this study was to investigate how visual and auditory information affect comprehension in different types of task and the overall cognitive load measures. Arrows on screen was used as visual cueing, and narration was applied with different speed. In order to process narration it requires more cognitive load than visual information does. Different narration speeds could have different impacts on comprehension and cognitive load when it combines with visual cueing. Fifty-six college students were recruited as paid participants. Independent variables were presence of visual cueing and narration speeds, and 2x2 factorial design was applied. Dependent variables were comprehension scores and cognitive load measures. Pre-test was measured as a covariate variable. The learning content was the blood circulation in human heart system. It was made of 1) the functions of human heart for conceptual tasks and 2) the circulation process of blood in heart for procedural tasks. In the conceptual task, there was no significant difference in comprehension score. However, a significant difference by narration speed was found in the procedural task. The participants in normal speed of narration outperformed for those in fast narration speed. No main effect of visual cueing and no significant interactions were found. Interestingly, there is no effect by the presence of visual cueing. It can be explained that there was stronger modality effects. For the overall cognitive load measures no significant result was found when pre-test of concept and procedural tasks were controlled. Although there was no significant effect by the independent variables, some significant relationships between pre-test scores and the cognitive load measures were found. The results revealed that the pre-test score of conceptual task had a significant relationship with the task difficulties. The pre-test score of procedural task had significant relations with the task difficulties and usability of cognitive load measures. The results indicated that types of task may have different impacts on the cognitive load measures.

Keywords: *narration speed, visual cueing, types of task, cognitive load*

INTRODUCTION

Multimedia learning with faster narration could provide efficient learning process. Especially, faster narration reduces learning time and draw learning efficiency by giving direct verbal information. But, it also has constraint that auditory information should hold information until it is processed. In the perspective of cognitive load theory, auditory information increase more intrinsic cognitive load rather than visual one does. Because this information had more element interactivity due to successive structures. The level of intrinsic cognitive load for a particular task and knowledge level is assumed to be determined by the level of element interactivity (Sweller, 2010).

Narration speed

Narration is the dialog that can be used to deliver an instructional message (Ritzhaupt & Barron, 2008). Narration, unlike its textual information, is inherently time-dependent. In fact, the use of narration can actually increase the time required by a learner to complete a multimedia program. The goal of an instructional designer in a learning setting was to maximize a learner's comprehension and satisfaction, while minimizing the amount of time the learner will spend on a learning task. Because learners couldn't deal with whole information entering the auditory system, time-compressed narration caused cognitive learner and hinder learning outcomes

Visual cueing

Visual cueing is the addition of non-content information to visual representation such as arrows, circle, and coloring. It helps to find specific information on screen layout and reduce extraneous cognitive load which cause split-attention effect. From the cognitive load perspective, a substantial number of studies have found that visual cueing is an effective method to reduce cognitive load in multimedia learning (Lin, Atkinson, 2011). If overall cognitive load is increasing due to faster narration, visual cueing give adequate visual aids for dropping cognitive load.

Types of task

Conceptual and procedural tasks were applied in this study. Both of tasks had significant differences in learning process. Conceptual task reflects concepts and their relationship. Concepts relate to a set of object, symbols or events, which are composed of and can be decomposed into their defining characteristics. But, procedural task replicates the temporal order and spatial relationships between actions that are intended to achieve a goal.

METHOD

Participants

Fifty-six college students were recruited as a paid participant. Participants were collected 56 university students (33 female and 23 male) majoring in different fields from Chonnam National University (age $M = 21.1$ years, $SD=2.32$) and randomly assigned to a group receiving each conditions (n=14).

Materials

For topic for experiment we chose a circulation process of blood attached in Figure 1. It shows concepts of each part and whole process of blood circulation in human body. The original text has been divided into 6 modules with 2000 words. Narration was recorded by adult female TTS (text-to-speech) program using Audacity™, which is sound editor. Narration speed was standardized by SPM (syllable per minutes). Fast narration was 462SPM, normal one was 325SPM.



Figure 1. Visual cueing (left) and no cueing (right) conditions

Procedures

This research was constructed 2 (visual cueing vs. no visual cueing) x 2 (fast speed vs. normal speed) factorial design, independent variables are composed of time-compressed narration and visual cueing on multimedia learning environment. Each participant had own their computer including headphone. Participants had 45 min to complete the experiment. At first, participants were conducted pretest and showed video with the instruction. When learning material is finished, they performed measurement for cognitive load and comprehension task.

RESULT

Comprehension score

A two-way analysis of covariance (ANCOVA) was planned to evaluate the effect if narration speed (faster vs. normal) and visual cueing (cued vs. un-cued) on participant's comprehension score. The percentage correct score on the pretest for comprehension score was used as a covariate. There was significant difference on narration speed in procedural task ($F(1, 51) = 6.34, p = .001$) described in Figure 1 below.

Overall Cognitive Load

A multiple two-way analysis of covariance (MANVOCA) was planned to evaluate the effect of narration speed and visual cueing on overall cognitive load. There were no significant differences by the independent variables. But pre-test score within types of task in cognitive load had significant results (conceptual task: task difficulty, self-evaluation, usability; procedural task: task difficulty, self-evaluation).

DISCUSSION

The result of this study revealed that types of task had different impacts on the comprehension scores and overall cognitive load. Faster narration will give benefits to learners if they want to learn the content quickly. This can be commonly happened when a learner tries to review the content again to reduce the learning time. However, as revealed in this study, if the learning content is procedural it may not be useful for learners to use fast narrations. It is speculated that the different treatment effect of narration speed between the types of task was driven by the complexity of learning process. Procedural task may require more cognitive demand for learning because a learner should remember the elements of learning content as well as right sequence of them to make a correct process.

The interesting but unexpected result of this study was no significant difference by visual cueing. It was expected that visual cueing will facilitate learning even if in the procedural learning task. However, no significant difference was found. Two answers are possible. First, there might be a strong modality effect in the learning. While the learners are receiving the content in auditory format with various speeds, visual cueing had nothing to do for the learning. Second, comprehension test format may have something to do with the results. If auditory information already provided enough information to take a comprehension test, it won't have any impact on the learning outcomes.

This study focuses on overall cognitive load but for the separated cognitive load for the types of task. It could be a limitation of this study to interpret the results. As reported in the result section, pre-test scores had significant impacts on some of the cognitive load factors differently. For the conceptual task, pre-test score of conceptual task had a significant impact on the perceived task difficulty. However, for the procedural task, pre-test score had significant impacts on perceived task difficulty and usability factors of cognitive load. These results imply that types of task possibly can have different degrees of cognitive loads

Literature Reference

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