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Exploring effects of discussion on visual attention, learning performance, and perceptions of students learning with STR-support

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ABSTRACT

In this study, we aimed to explore effects of discussion on visual attention, learning performance, and perceptions of non-native English speaking students attending lectures in English in learning environments supported by Speech-to-Text Recognition (STR) system. One experiment was carried out with 60 students who were assigned into the control (n = 30) and experimental (n = 30) groups. Students in the control group attended lectures without discussing lectures content whereas students in the experimental group attended lectures and discussed lectures content. Our result showed that students in the experimental group had higher fixation time during two lectures compared to their counterparts in the control group. We also found that students in the experimental group had higher fixation count during the first lecture compared to the control group but there was no difference between the two groups in fixation count during the second lecture. Our results demonstrated that the experimental group outperformed the control group on both tests. In addition, most students in the two groups had high perceptions towards usefulness of STR-text for learning; however, no differences were found between the two groups in their perceptions towards STR-text. Based on our results, we suggest that learning activities, such as student discussion, need to be introduced during lectures in order to stimulate active learning, which in turn, enhances students' learning and comprehension of lecturing content. Discussion may encourage and facilitate students to take more active role in their learning.

1. Introduction

1.1. Speech-to-text recognition

Speech-to-Text recognition (STR) technology has received much attention recently in the research literature. STR synchronously generates text from a lecturer's speech and displays it for students on a whiteboard or computer screens. Recent evidence suggests that applications of STR technology are beneficial for learning (Huang, Liu, Shadiev, Shen, & Hwang, 2015). For example, during lectures, STR-text helps students overcome difficulties in reading, writing, and spelling (Nisbet, Wilson, & Aitken, 2005), assists participation of deaf students (Leitch, 2008; Wald & Bain, 2008), facilitates comprehension of learning content (Ranchal et al., 2013),

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especially of non-native speakers (Ryba, McIvor, Shakir, & Paez, 2006; Shadiev, Hwang, Huang, & Liu, 2016; Wald & Bain, 2008) and students in online synchronous learning environments (Hwang, Shadiev, Kuo, & Chen, 2012; Kuo, Shadiev, Hwang, & Chen, 2012).

1.2. Multimedia related theories

Mayer (2010) argued that learning is an active process and for meaningful learning to occur a learner needs to be engaged in appropriate cognitive processing during learning such as selecting of relevant learning content, organizing it into a coherent cognitive representation, and integrating it with prior knowledge activated from long-term memory. In order to understand the usefulness of STR-text for learning, we need to refer to a cognitive theory of multimedia learning which explains how a learner learns with content presented in different modalities (Mayer & Moreno, 2003). According to this theory, visual and verbal information is received and decoded through different processing systems. The visual channel takes input initially from the eyes and ultimately produces pictorial representations whereas the verbal channel takes input from the ears and decodes them into verbal representations. When listening to speech, a learner pays attention to the auditory message, parses speech, segments it into words that are kept in verbal working memory, and then transforms words into verbal mental representations. After this process, the connections among words are mentally built to organize them into cause-and-effect chains. Similarly, a learner pays attention to visual messages, selects images, and retains them in visual working memory. A learner also mentally builds connections that organize the images into a cause-and-effect chain. Finally, the visual mental model, verbal mental model, and prior knowledge from long-term memory are merged through constructing referential connections between them (Mayer, 2009). Thus, presenting verbal and visual information simultaneously helps process learning content better. During lecture, when the instructor delivers lecturing content and STR generates text from the speech, which is displayed for students simultaneously, students receive information in two modalities - verbal (i.e. speech of the instructor) and visual (i.e. STR-text). Learning information presented in two modalities enables students to attain a better understanding of lecture content.

According to cognitive load theory (Paas, Renkl, & Sweller, 2003), students working memory has limited cognitive capacity to accommodate demands imposed by learning tasks. When students attend a lecture in a foreign language, their working memory is at risk to be cognitively overloaded. The reason is because students need to receive and retain lecturing information in working memory and integrate it with what follows, all the while continually adjusting their understanding with prior knowledge (Chen & Chang, 2009). When students' cognitive load exceeds the limit of cognitive capacity, it may negatively affect learning performance (Mayer & Moreno, 2003; Paas et al., 2003). In our study, students attended lectures in English which was their foreign language. In order to facilitate knowledge construction and to reduce cognitive capacity overload during lectures in a foreign language, we provided students with STR-text. So students could refer to STR-text during lecture, for example, to textually confirm what is being said in lecture.

However, it is suggested that the same information presented in two modalities (i.e. auditory and visual) increases cognitive load as presented information becomes redundant and gives rise to a split-attention effect (Mayer, Lee, & Peebles, 2014). That is, it is possible that presenting STR-text during lectures may result in the redundancy effect since the same information will be presented in verbal (i.e. a lecturer's speech) and visual (STR-text) forms simultaneously. On the other hand, Clark and Mayer (2011) claimed that there are exceptions to the redundancy principle; that is, redundant visual text can be acceptable and even necessary along with the verbal information, in specific situations. For example, a situation when the verbal information is difficult to understand, which commonly happens when students attend lectures in a foreign language. Another consideration, which relates to multimedia learning and cognitive load, is the expertise reversal principle (Kalyuga, 2014) and it also needs to be seriously considered. According to this principle, the effectiveness of instructional techniques on students with differing levels of prior knowledge can be reverse. That is, instructional techniques that are highly effective with novice learners may not be effective when used with more knowledgeable learners. For example, students with low language ability and lack of prior knowledge need learning information presented in visual and verbal forms to comprehend it better. On the other hand, students with high language ability and prior knowledge need information to be presented in one modality only. Multimodal information can be redundant for such students as it requires additional cognitive resources to process it. So in this study, we attempted to explore whether STR-text can be useful for students during lectures in a foreign language and for what kind of students, i.e. low ability or high ability.

1.3. Discussion

Discussion, when students talk about learning material to and exchange their ideas with other students, plays a valuable role in lecture or seminar. Noroozi, Weinberger, Biemans, Mulder, and Chizari (2013), Noroozi, Weinberger, Biemans, Mulder, and Chizari (2012), and Stegmann, Wecker, Weinberger, and Fischer (2012) suggested that discussion is a learning activity that engages students in small groups in argumentation, critical thinking, elaboration, and reasoning processes. Discussion facilitates individual knowledge acquisition and collaborative elaboration. In addition, discussion enables students to build up a shared understanding of learning content. There are several advantages of discussion, which were highlighted in the literature. Grzega and Schoner (2008) argued that discussion encourages and stimulates students to take a more active role in their learning. Noroozi et al. (2013, 2012) and Stegmann et al. (2012) suggested that students share their knowledge with learning partners and it leads to greater cognitive effort. Students not only confront each other with different viewpoints but contribute diverse information to discussion as well. Students articulate a variety of opinions and points of view and acquire knowledge and insight from diverse points of view (Crippena & Earl, 2007). Discussion offers students opportunities to test their ideas and opinions against those of their peers (Aleven & Koedinger, 2002). In addition, discussion helps students understand and apply what they have learned (Hubscher, 2010). In addition, during discussion,