

Title: Self-regulation with diagrams when learning through multimedia instruction

Keywords (maximum five): multimedia learning, self-regulation, diagrams, monitoring accuracy

Research Overview:

We examined the effect of incorporating diagram use as a way of self-assessment to promote self-regulated learning after learning from multimedia instruction. The conditions included (a) control (no diagram), (b) completing pre-structured provided diagrams, (c) creating their own diagrams. Monitoring accuracy, test performance, mental effort, and diagram quality were examined.

Purpose of Study

Our aim was to examine incorporating diagram use as a way of self-assessment after learning from multimedia instructions to facilitate self-regulated learning.

Learning with multimedia requires learners to actively regulate their learning, make decisions about learning, and determine whether they understand the materials (Azevedo & Cromley, 2004). However, the potential of learning from digital media learning environments may be undermined by learners' inability to regulate their learning (Azevedo, 2005). In particular, accurate evaluation of understanding is essential for regulating strategies and effort, whereas inaccurate evaluation can lead to ineffective restudy decisions and strategy choices (Dinsmore & Parkinson, 2013).

However, learners often display “the illusion of knowing,” in which they overrate their comprehension and consequently misjudge their understanding (Glenberg et al., 1982). That is why self-regulated learning (SRL), including strategies such as monitoring and evaluation, is needed (Winne & Hadwin, 1998). However, in digital media learning environments, many learners do not spontaneously use effective SRL strategies (Azevedo & Cromley, 2004), and low SRL leads to lower likelihood of success (Hsu et al., 2009). On the other hand, metacognitive prompts can lead to more metacognitive control, as well as better scores on knowledge test (Daumiller & Dresel, 2018).

One way to encourage self-assessment (i.e., evaluation) in SRL is through diagram use (van de Pol et al., 2019; van Loon et al., 2014). In Pijera-Díaz et al. (2023), students completed pre-structured diagrams based on a text paragraph and then self-assessed how many boxes they had filled in correctly. This guided students to use more reliable cues (i.e., completed or empty boxes in the diagram) for predicting their performance, thereby improving their metacognitive judgments and supporting their self-regulated learning. In addition, a previous study has shown that delayed diagram completion can improve learners’ monitoring accuracy of their learning of cause-and-effect relations (van Loon et al., 2014).

Evidence supports the use of diagrams for text comprehension, but currently it is not clear how diagrams might support self-regulated learning in multimedia environments. When learning from a video, learners are particularly prone to overestimate how much they understand (Rozenblit & Keil, 2002). Moreover, from the “Cognitive Theory of Multimedia Learning” perspective, diagram-based evaluation supports accurate metacognitive judgments and the construction of mental models, promoting the organization and integration of information and resulting in deeper learning (Mayer, 2014).

In addition to using or not using diagrams, we examined diagram use with two conditions, creating their own diagrams and completing pre-structured diagrams. According to the ICAP framework, generative/constructive activities are more effective for learning but more cognitively demanding (Fiorella & Mayer, 2021). Therefore, we also measured cognitive load to examine whether that was the case and compare between conditions.

This study investigated incorporating diagrams as a way of self-assessment in multimedia learning through investigating monitoring accuracy (RQ1), learning performance (RQ2), and mental effort (RQ3).

Methods

129 participants are planned to participate, with each participant randomly assigned to one condition. The 3 conditions include (a) control (filler task instead of diagram), (b) completing pre-structured diagrams, (c) creating their own diagrams. 2 videos, one on the Suez Canal and one on Botox, were utilized as stimulus. Participants watched the Suez Canal video first as a practice session, with judgments of learning (JOLs) measured before and after the diagram. Then they completed the learning test and a mental effort Likert-type scale. Next, participants watched the Botox video as the main session, with the same flow as the practice session, except for a restudy choice question before the learning test.

Results and Discussion

As this study is still in progress at the moment of submission, we present the expected results. For RQ1, we anticipate that both the completing pre-structured diagrams condition and creating their own diagrams condition will show more accurate JOLs compared to the control condition. These results would suggest using diagrams can lead to learners' correct evaluation of their learning, allowing for sufficient SRL when learning with multimedia instructional

materials. For RQ2, we expect a similar pattern for test performance, which would further support the argument for diagram use in promoting learning outcomes. For RQ3, based on prior research indicating that generative activities have higher cognitive demands, mental effort is expected to be highest for the creating their own diagrams condition. The insight we gain could guide the use of diagrams for monitoring learning, or for providing training prior to learning to reduce cognitive load.

The findings of this study can give insight to a way of self-assessment that supports students' learning outcomes in multimedia learning environments. This study has implications for improving the way multimedia instruction and learning materials are designed and structured and can directly contribute to improving SRL in multimedia learning. Considering that many modern classrooms utilize multimedia instructional materials on a day-to-day basis, this study has practical value for developing students' transferable capabilities.