Effects of element interactivity on learning from transient information

Mona Wong - The University of NSW
Juan C. Castro-Alonso - Universidad de Chile
Paul Ayres - The University of NSW
Fred Paas - University of Wollongong

It is often argued that dynamic visualisations (e.g., animations or videos) are more beneficial than statics (e.g., pictures or textbooks) when teaching abstract concepts and complex systems in science, technology, engineering, and mathematics (STEM) education (cf. Lowe & Schnotz, 2014). This argument is based on the superior capacity of dynamic visualisation to directly depict changes (Rieber, 1990; see also congruence principle by Tversky, Morrison, & Bétrancourt, 2002). Ayres and Paas (2007a, 2007b) have introduced the transient information effect as one of the reasons to explain why instructional animations might not have consistently resulted in better learning outcomes than statics.

The transient information effect is a loss of learning due to information disappearing before learners are able to process it or link it with existing knowledge (Sweller, Ayres, & Kalyuga, 2011). In terms of instructional visualisations, this detrimental effect predicts that the transient nature of dynamic visualisations will induce heavier loads in learning and understandings than equivalent static visualisations. Although processing of transient information might not be a problem with low element interactivity learning tasks, high element interactivity learning tasks might make it impossible for learners to process transient information due to the high or excessive cognitive load imposed by the need to integrate transient information with existing knowledge in working memory before it disappears.

In the present experiment, a well-matched comparison (i.e. the learning material features were carefully matched in order to avoid induced biased results. For details, see Castro-Alonso, Ayres, & Paas, 2016) between a permanent, a less-transient and a more-transient presentation with materials differing in element interactivity (simple vs. complex) was designed. The learning materials were two separate but very similar biological life cycles, which were different series of stages that organisms undergo in life and reproduction. The simple life cycle (gametic) involved one stage less, and fewer key components and terms than the complex life cycle (zygotic). A total of 132 university students, who had no biological science background, were recruited. Each participant was required to first complete two spatial ability tests, a biology pre-test, and then study both simple and complex materials in counterbalanced order. They were required to complete a post-test and a cognitive load measure after each learning task. Preliminary analysis showed that there were no differences between conditions for the pre-test results. For post-test scores, there was a difference between the more-transient dynamic visualisation group and the less-transient dynamic visualisation group, where the more-transient version was more effective than the less-transient version only when learning the simple task but not the complex task. Also, male participants were found to score higher than female participants when learning simple task using more-transient dynamic visualisation. However, such difference was not found in less-transient dynamic visualisation group or permanent visualization group.