Collaborative learning with single or multiple animations

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Abstract. For the last decade, a growing body of research has investigated how individuals learn about dynamic phenomena from multimedia animations. However, the factors that contribute to the animation instructional effectiveness are not clear yet. Moreover, few multimedia studies have used a collaborative learning situation, despite its instructional relevance. This paper reports an experimental study comparing a format that emphasizes the segmentation of the dynamic phenomenon by providing multiple simultaneous animations, to a format providing a single animation, in collaborative learning situation. The results of the comprehension tests showed no significant difference between the two experimental conditions. However, the participants in the "multiple animations" condition took significantly less time to study the animation content and recognized faster still frames taken from the animation. Results suggest that the multiple animations were used as communication artifacts that allowed participants to build a shared representation of the subject more efficiently.

Keywords: collaboration; multimedia animation.

Introduction

Although the use of multimedia animations seems to increase, their conception is most often based on intuitive or esthetic rationales rather than on scientific guidelines (Lowe, 2003). In order to be effective for learning, the design of instructional animations should take into account the way students process and understand graphical information (Tversky, Bauer-Morrison & Bétrancourt, 2002).

According to recent cognitive models (Mayer, 2005; Schnotz, 2005), learning from multimedia instruction is conceived as the building of mental models based on the interaction of bottom-up processes (auditive and visual information processing) and top-down processes (activations of existing cognitive schemas) .

Extracting information from animation is not always easy for novices of the domain and can lead to comprehension errors. In order to understand how a dynamic system works, learners should not only perceive the mutliple minute changes but also segment the continuous chain of events in a series of discrete steps (Tversky et al., 2002). Segmenting the animation in relevant steps could help learners in this demanding process. On the contrary, learners do not always process the information sufficiently because animation gives the illusion that the phenomenon is easy to perceive and understand ("underwhelming effect", Lowe, 2003).

In order to encourage learners to process more deeply the information of the animation, we used a collaborative situation in which learners were prompted to explain what they saw on the screen.

In collaborative learning settings, partners construct shared representations of the situation: they negotiate concepts and compare their points of view (Dillenbourg, 1999). Shared representation allow participants to establish a common vocabulary, which is a necessary condition to construct a shared representation of the problem (Clark & Brennan, 1991).

In this paper, we studied how the presentation format influences the way learners studying collaboratively memorize and understand the animation of a biologicial process. Our hypothesis is that giving several steps simultaneously (several animations representing the main steps displayed simultaneously), would give more reference elements to the participants than a single animation of the whole process, thus helping the construction of a common understanding between learners. Moreover, from an individual point of view, multiple animations should help learners to build a segmented mental model of the dynamic phenomenon.

Method

Participants. 40 students of the University of Geneva participated in our study. 35% of them were men, and the mean age was 23.68 years (s.d. 3.01). Students were allocated to dyads according to their time constraints, so that there were 10 dyads in each of the two experimental conditions, multiple or single animation format.

Experimental condition and material. The material was an animation showing a biological process called meiosis, already used in Rebetez (2009). Two version of the multimedia animation were designed, according to the two experimental conditions. In the "single animation" condition, one animation was displayed on the screen, running from beginning to the end of the process. In the multiple animations condition, the animation was segmented in five distinct animations, each one representing a major step of the meiosis. The five animations were simultaneously running on the screen.

The content of the animation was the same in the two experimental conditions. There was no sound or audio commentary. To ensure comparisons across conditions, the animation was not user-controlled and was continuously cycling until learners decided to stop the study phase.

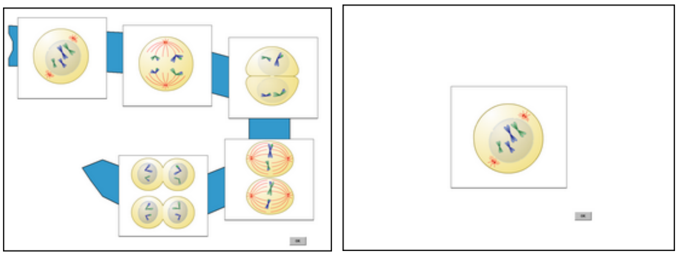

Figure 1. On the left is the multiple animations material. On the right is the animation given to the "single animation" group.

Measures. The time taken by the dyads to study the animation was recorded. Two comprehension tests were administered: a) A recognition test in which participants had to tell if an image comes from the animation or not, and b) a recall test in the form of an open question, instructing to write down what the participant remembered from the animation.

Procedure. The participants took a training phase to get used to the other participant and to the material's presentation. During the next phase (learning phase), they had to study the animation, to talk about it and to explain it to each other. When they felt they understood the meiosis, they stopped the study phase and underwent the comprehension tests individually.

Results

The mean study time was significantly different between the two experimental groups ($F(1,38) = 8.393$, $MSE = 252193.774$, $p<0.01$, $ETA = .425$): Participants of the single animation condition studied the animation longer than the participants of the multiple animations condition.

There was no significant effect of presentation type on the recall test ($F(1,38) = 44.100$, $MSE = .942$, n.s.). However, the participants studying multiple animations were faster to write their text than the participants of the single animation condition ($F(1,38) = 12.479$, $MSE = 740487.229$, $p < 0.01$, $ETA = .497$). Moreover, participants in the multiple animations condition were faster on the recognition test than participants with single animation ($F(1,38) = 12.931$, $MSE = 247864.537$, $p<0.01$, $ETA = .504$), but there was no significant difference on the scores ($F(1,38) = 2.882$, $MSE = 99.225$, n.s.).

Discussion & Conclusion

Results showed that learners studying multiple animations condition were faster to learn the material, and to describe the meiosis (open question) than learners studying a single animation, for the same comprehension performance. Moreover, participants in the multiple animations condition were faster in the recognition test for equal accuracy, than participants in the single animation condition. Contrary to what could be expected from a cognitive load perspective (e.g. Sweller, 2005), simultaneous visual sources had no negative impact on learning. On the contrary, it seems that they lead to a more efficient learning of the dynamic phenomenon. We assume that the multiple animations offered a better basis to participants for building a common ground necessary to discuss the topic and construct a shared representation of the problem. Facilitating the construction of a shared representation was assumed to be one of main factors supporting individual learning in collaborative situations (Dillenbourg and Betrancourt, 2006).

Our results suggest that the use of several short animations, each of them portraying a key step of the dynamic process to be conveyed, promotes an effective cognitive processing, particularly in collaborative situations.

References

Clark, H. H., & Brennan, S. E. (1991). Grounding in communication. In L. B. Resnick, J. M. Levine, & S. D. Teasley (Eds.), Perspectives on socially shared cognition (pp. 127-149). Washington, DC, USA: American Psychological Association.

Dillenbourg, P. (1999). What Do You Mean By “Collaborative Learning”? In P. Dillenbourg (Ed.), *Collaborative Learning: Cognitive and Computational Approaches* (pp. 1-19). Oxford: Elsevier.

Dillenbourg, P., & Bétrancourt, M. (2006). Collaboration Load. In J. Elen & R.E. Clark (Eds.), *Handling Complexity in Learning Environmen.* (pp. 141-165). Amsterdam: Elsevier.

Lowe, R. (2003). Animation and Learning: Selective Processing of Information in Dynamic Graphics. Learning and Instruction, 13, 157-176.

Mayer, R. (2005). Cognitive Theory of Multimedia Learning. In R. Mayer (Ed.), The Cambridge Handbook of Multimedia Learning (pp. 41-48). New York: Cambridge University Press.

Rebetez, C. (2009). Learning from animations: control, collaboration and learners' exploration. PhD Thesis, Univesity of Geneva.

Schnotz, W. (2005). An Integrated Model of Text and Picture Comprehension. In R. Mayer (Ed.), Cognitive Theory of Multimedia Learning (pp. 49-67). New York: Cambridge University Press.

Sweller, J. (2005). Implication of Cognitive Load Theory for Multimedia Learning. In R. Mayer (Ed.), The Cambridge Handbook of Multimedia Learning (pp. 19-30). New York: Cambridge University Press.

Tversky, B. Bauer-Morrison, J., & Bétrancourt, M. (2002) Animation: Can it facilitate? *International Journal of Human-Computer Studies*, 57, 247-262.