Learning and teaching biotechnological methods using interactive animations

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Abstract

Animations have a great potential for improving the way people learn. A number of studies related to different scientific disciplines have shown that instruction involving computer animations can facilitate the understanding of processes at the molecular level. The purpose of this study was to explore the use of animations as visualization tools in order to promote high school biology and biotechnology students' comprehension of biotechnological methods in the framework of learning biotechnology. This study aims to represent the complexity of learning about biotechnological methods using animations, in terms of the cognitive factors involved, as well as the pedagogical ones. Using written questionnaires, I found that an animation is significantly advantageous to students' comprehension of the Polymerase Chain Reaction (PCR), compared to still images equivalent to the animation. I also found that prior knowledge is not an essential factor when learning about PCR using animation; thus the dynamic display of a biotechnological process by animation may compensate for a student's insufficient knowledge in imagining the relevant motions. While learning about PCR using still images, low prior knowledge was found as an obstacle to learning. Using the conceptual status framework for analyzing biology majors' discourse while learning about the PCR, I have learned that the use of the animation was advantageous in understanding the mechanistic aspects of the biotechnological method, compared to students who learned this method using still images. This advantage was also reflected while analyzing biotechnology majors' concept maps, before and after learning about the restriction enzymes digestion process using animation.

Findings regarding the challenges involved and the recommended teaching strategies for enacting animations in class were obtained by analyzing teachers' focus group, teachers' interviews and two exemplary case studies. I

found that the teacher's contribution to the enactment of animations in class is pronounced in the following three aspects: establishing the "hands on" point of view, helping students deal with the cognitive load that accompany the use of animations and implementing constructivist aspects of knowledge construction while studying using animations. These findings strengthen my preliminary assumption that students and teachers should work together in transforming knowledge while studying from animations.

I believe this study shed some light on the complexity of using animations in class, thus make a difference in considering the common conception, that animations are an ideal tool for learning and teaching. Through this research I was able to show the unique contribution of animations, and their advantage over still images, for the acquisition of certain kinds of information, namely the mechanistic aspects of biotechnological methods. These findings could have educational implications in learning of various scientific disciplines, in which mechanistic understanding and reasoning causality is crucial. In addition, in this study I was able to show the unique contribution of animations to certain kinds of learners, namely students with low prior content knowledge. The constructivist mediation of the teacher while learning from animations enables the students to employ this unique tool of animations most effectively.