



Commentary

Motivation and emotion as mediators in multimedia learning



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ABSTRACT

Against the background of Moreno's "cognitive-affective theory of learning with media" (CATLM) (Moreno, 2006), three papers on cognitive and affective processes in learning with multimedia are discussed in this commentary. The papers provide valuable insights in how cognitive processing and learning results can be affected by constructs such as "situational interest", "positive emotions", or "confusion", and they suggest questions for further research in this field.

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1. Introduction

For a long time, research on technology-based learning and instruction has primarily been focusing on cognitive aspects. For example, the "Cognitive Theory of Multimedia Learning" (CTML) (Mayer, 2005) or the "Integrative Model of Text and Picture Comprehension" (Schnotz, 2005) have, together with "Cognitive Load Theory" (Sweller, 1988), widely been used to inspire research in the field of multimedia learning. From this research we know a lot about learning with combinations of verbal and pictorial information, and based on these theories and models we are able to describe, explain, and predict effects of different formats and designs of multimedia instruction. Affective aspects, however, such as emotion and motivation, although having a long tradition in research on learning and instruction, have largely been neglected in research on technology-based learning and instruction. Against this background, Moreno (2006) proposed a "Cognitive-Affective Theory of Learning with Media" (CATLM), which expands Mayer's CTML by including the concept of "affective mediation", that is, the idea that motivational factors may mediate learning by affecting the cognitive engagement of the learners. The papers by Magner, Schwonke, Alevén, Popescu & Renkl (2013), Plass, Heidig, Hayward, Homer & Um (2013), and D'Mello, Lehman, Pekrun & Graesser (2013), to be discussed in the present commentary, follow this line of reasoning and provide valuable insights in how learning with multimedia is affected by emotional and motivational factors.

2. The papers' contributions

In their study on triggering situational interest, Magner and colleagues found that decorative illustrations are not always detrimental for learning achievement in multimedia learning settings, as is often predicted based on a purely cognitive theoretical analysis of the learning situation. According to, for example, Mayer's CTML, decorative illustrations can be considered as seductive details that require investment of cognitive resources that might then not be available for processing essential information. On the other hand, however, decorative illustrations might foster situational interest and, thus, ease the learner's focusing of attention and reducing effort of cognitive activation. Results of two classroom studies on geometry learning of 8th graders indicate that the effect of decorative illustrations on near transfer is moderated by prior knowledge: If prior knowledge is low, decorative illustrations hamper learning for near transfer; if prior knowledge is very high, decorative illustrations foster learning for near transfer. As it seems, this aptitude-treatment interaction is a pure cognitive effect, due to cognitive overload of low prior-knowledge learners: Although decorative illustrations affect learners' situational interest positively, situational interest is not correlated with near transfer achievement. Thus, the positive effect of decorative illustrations on near transfer is not mediated by situational interest as was expected by the authors. For far transfer there is no direct effect of decorative illustrations, nor any interaction of decorative illustrations and prior knowledge. There is, however, an indirect positive effect of decorative illustrations on far transfer that is mediated by increased situational interest. Thus, situational interest seems to be important for more demanding learning goals such as far transfer but not for less demanding

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learning goals such as near transfer. An interesting point however, that is not addressed by the authors, is the question whether the mediated effect of decorative illustrations on far transfer via situational interest might be moderated by prior knowledge. For testing such a moderated-mediation hypothesis, however, a larger sample would be needed. Furthermore, as the motivational effect of decorative illustrations on learning is expected to be mediated via increased cognitive engagement, it would be interesting to have measures of cognitive engagement for testing this hypothesis.

In their study on emotional design in multimedia learning, Plass and colleagues found that positive emotions can be induced in learners by specific design features of multimedia learning material. Results of two classroom studies on biology learning of graduate students indicate that these induced positive emotions, compared to neutral emotions, lead to lower perceived task difficulty, to higher intrinsic motivation, and, finally, to better comprehension, but – at least in one of the two studies – not to better transfer achievement. Furthermore, the joint emotional effect of the visual design features “face-like shape of biological agents” and “warm colors” could be disentangled to be mainly due to the shape design feature and less to the color design feature. Unfortunately, the results of the two studies are not completely consistent, as emotional design features affect comprehension (but not transfer learning achievement) as well as perceived task difficulty and intrinsic motivation in Study I, whereas in Study II there are emotional design effects on comprehension and transfer learning achievement but not on perceived task difficulty and intrinsic motivation. Across both studies, however, it could be shown that students’ emotions could be affected by emotional design features of the material which provides a promising starting point for further research in this field. Like in the Magner-et-al. study, it would be interesting to focus this research on the causal chain of emotional effects. Regarding this causal chain it might be hypothesized that the effect of positive emotions on learning achievement is mediated by increased motivation and – perhaps – by increased cognitive engagement. Whether or not this mediation might be moderated by prior knowledge is also an interesting question.

In their study, D’Mello and colleagues found that confusion, induced through experiencing cognitive conflicts, is an emotion that can promote learning. Results of two lab studies on simulated cooperative scientific-reasoning learning of undergraduate students indicate that confusion, if successfully induced in learners by providing contradictory information and helping them to resolve the resulting cognitive conflict, leads to increased knowledge and transfer achievement through – as hypothesized – deeper processing of learning materials and effortful deliberation. Unfortunately, the effect of confusion on deeper processing and effortful deliberation was not directly tested by the authors. Thus it is more an interpretation of the results than an empirically validated fact. Again, like in the other two studies, it would be interesting to think – for future research – about an independent measure of “deep processing” and “effortful deliberation” in order to be able to test the causal-chain hypothesis that the effect of confusion on learning results is mediated by respectively modified cognitive processing.

3. Conclusion

The three papers discussed so far follow Moreno’s (Moreno, 2006) line of reasoning that learning with multimedia is affected by emotional and motivational factors. They provide valuable insights in how this is achieved with a focus on “situational interest” as a motivational construct (Magner and colleagues) as well as on “positive emotions” (Plass and colleagues) and “confusion” (D’Mello and colleagues) as emotional constructs. All three papers

applied sophisticated statistical analyses based on experimental approaches, that is, differences in motivation and emotion were induced in learners by varying the design of learning environments. Thus hypotheses about cause and effects could appropriately be investigated which is a major advantage compared to correlational studies. In line with Moreno’s CATLM, all authors had mediation hypotheses in mind: Experimentally induced differences in motivation/emotion lead to differences in the cognitive processing of learning materials which in turn leads to differences in learning results. Unfortunately however, presumably due to the unavailability of appropriate measures of cognitive processing, in none of the three papers the crucial link between motivation/emotion and cognitive processing was studied directly. So far, the effects of motivation/emotion on learning can, at least for the present papers, only be *interpreted* in terms of modified cognitive processing. Future research should try to develop and use independent measures of cognitive processing in order to be able to test the mediation hypothesis.

Motivation and emotion, as studied in the present papers, are state constructs that may occur in a given learning situation. For further research, an interesting question would be to ask whether the occurrence of specific motivations/emotions as states in a given learning situation is perhaps modified by individual differences in overarching (non-cognitive) trait constructs like, for example, neuroticism, openness, conscientiousness, anxiety, frustration tolerance, learned helplessness etc. It could even be the case that the whole mediation process from motivation/emotion over cognitive processing to learning results might be moderated by specific traits. There is a growing body of research on *cognitive* trait constructs that moderate the effectiveness of multimedia design features for learning like, for example, prior knowledge (Magner et al., 2013), spatial ability (e.g., Höffler, 2010; Höffler & Leutner, 2011) or learning preferences (e.g., Plass, Chun, Mayer, & Leutner, 1998). So far however, research on *non-cognitive* trait constructs that might moderate the effectiveness of multimedia design features, however, seems to be at its very beginning. The present papers provide a valuable step in this direction.

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