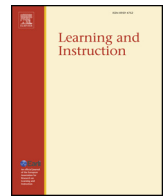




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Searching for the role of emotions in e-learning

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ABSTRACT

This special issue of *Learning and Instruction* examines the role of emotions in academic learning, with a special focus on emotions in computer-supported academic learning (or e-learning). Three central research challenges concerning emotion in e-learning are: identification (e.g., what are the key emotions in e-learning?), measurement (e.g., how can we tell how strongly a learner is experiencing each key emotion during e-learning?), and explanation (e.g., what are the causes and consequences of the learner's emotional state during learning?). A useful goal of research on emotions in e-learning is to test an affective-cognitive model of e-learning with links among an e-learning episode, the learner's emotional reaction during learning, the learner's cognitive processing during learning, and the learning outcome.

1. Introduction

The goal of instruction is to create learning experiences that promote a change in knowledge in the learner, or more concisely, the goal of instruction is to promote learning (Mayer, 2011). According to cognitive models of learning, such as the cognitive theory of multimedia learning, an instructional message causes cognitive processing in the learner that yields a learning outcome (Mayer, 2009, 2014). However, researchers have called for expanding theories of academic learning to include the role of affective processing, because cognitive processing is not the only internal activity in the learner during learning (Lajoie, 2014; Moreno & Mayer, 2007; Pekrun & Perry, 2014; Plass & Kaplan, 2016). In particular, affective-cognitive models of learning seek to incorporate the learner's emotional state during learning within the causal chain that produces a learning outcome. Emotion is short-term, intense affect caused by a particular object or event (Duffy, Lajoie, Pekrun, & Lachapelle, 2018 this issue). Fig. 1 summarizes an affective-cognitive model of academic learning which incorporates both affective processing and cognitive processing during learning: the learning episode causes an emotional reaction in the learner that affects cognitive processing during learning and leads to a learning outcome.

This special issue of *Learning and Instruction* provides the latest update in attempts to clarify some of the boxes and links in this kind of affective-cognitive model of academic learning. In particular, this special issue examines the role of emotions in academic learning, with a special focus on emotions in computer-supported academic learning (or e-learning). Three central research challenges concerning emotion in e-learning are: identification (e.g., what are the key emotions in e-learning?), measurement (e.g., how can we tell how strongly a learner

is experiencing each key emotion during e-learning?), and explanation (e.g., what are the causes and consequences of the learner's emotional state during learning?).

2. Identification of emotions in e-learning

A first step is to determine the key emotions that learners experience during e-learning. In a large-scale meta-analysis of emotions in technology-rich learning environments, Loderer, Pekrun, and Lester, 2018 (this issue) were able to identify three kinds of emotions that belong in the box labeled "affective processing" in Fig. 1: positive activating emotions such as enjoyment, negative activating emotions such as anxiety, and negative deactivating emotions such as boredom. Similarly, in an interview study of students in a medical learning environment, Duffy et al., 2018 (this issue) identified positive activating emotions such as enjoyment and negative activating emotions such as anxiety as the most strongly experienced emotions. In an observational study of students learning in collaborative groups, the most commonly reported emotions were being annoyed or frustrated (Jarvenoja, Jarvela, & Maimberg, this issue). In an experimental study involving learning in augmented reality, the highest intensity emotional states were the positive emotions of enjoyment and curiosity (Harley, Lajoie, Tressel, and Jarrell, 2018, this volume). Overall, these studies suggest that research on emotions in e-learning should focus on negative activating emotions such as anxiety and positive activating emotions such as enjoyment.

3. Measurement of emotions in e-learning

A second step is to determine how to measure the key emotions that

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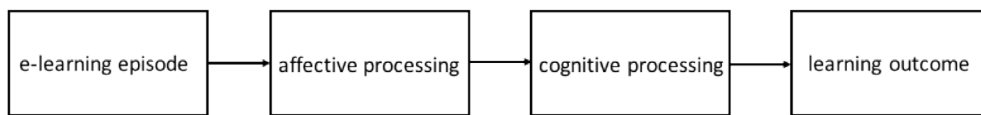


Fig. 1. A cognitive-affective model of e-learning.

learners experience during e-learning. Duffy et al., 2018 (this issue) provide an example of how to construct and validate a scale for measuring emotions experienced by students engaged in medical learning environments. The scale asks learners to rate their level of experiencing each of 22 emotions on a 5-point scale (from “not at all” to “very strong”), based on single words representing positive activating emotions (e.g., enjoyment), negative activating emotions (e.g., anxiety), positive deactivating emotions (e.g., relaxation), or negative deactivating emotions (e.g., boredom). Overall, most of the studies in this special issue rely on surveys in which learners rate how strongly they are experiencing individual emotions such as anxiety or enjoyment at a given point in time in the context of a specific activity at hand. For example, Duffy et al., 2018 (this issue) report that the Achievement Emotion Questionnaire (Pekrun, Goetz, Frensel, Barchfeld, & Perry, 2011) is the most commonly used emotion survey used in educational settings. A potential complementary direction for future research is to explore the role of biometric measures of emotion during learning, such as electro-dermal activity (EDA) or heart rate variability (HRV).

4. Explanation of emotions in e-learning

The ultimate step is to determine the nature of causal links among the four boxes shown in Fig. 1: e-learning episode, affective processing, cognitive processing, and learning outcome. An important contribution comes from a large-scale meta-analysis of emotions in technology-rich learning environments by Loderer et al., 2018 (this issue), which found replicated evidence for correlational links between affective processing (e.g., emotions experienced during e-learning) and cognitive processing (e.g., level of engagement and strategy use during learning) and between affective processing and learning outcomes (e.g., task performance). In particular, two possible affective-cognitive pathways suggested by this review are a positive path from learning episode (involving high perceived control and value) to enjoyment to engagement to good learning outcome, and a negative path from learning episode (involving low perceived control and value) to anxiety to disengagement to poor learning outcome.

Similarly, in an interview study in a medical learning environment, Duffy et al., 2018 (this issue) found significant positive correlations between learners' experiencing of positive emotions and their learning outcome performance, as well as significant negative correlations between learners' experiencing of negative emotions and their learning outcome performance. Experimental research is needed to establish the causal links suggested by these correlational links.

In a well-controlled within-subjects experiment, Plass et al., 2019 (this issue) examined the first link in the affective-cognitive model in Fig. 1, that is, the link between the e-learning episode and experienced emotion. In particular, they examined how the facial expression, color, shape, and dimensionality of game characters evoke emotions such as happy or sad in participants. Overall, happy emotions were reported for characters with happy facial expressions and warm colors, whereas sad emotions were reported for characters with sad emotions and neutral colors. Using immersive 3-dimensional renderings also increased the level of emotional arousal as compared to 2-dimensional renderings. This work provides an example of how to investigate the affective-cognitive model, one link at a time.

In a between-subjects experiment, Harley et al., 2018 (this issue) compared two versions of augmented reality support for a museum tour, which caused differences in amount learned but not in levels of experienced emotion during learning. In order to clarify the links in the affective-cognitive model in Fig. 1, additional work is needed to explore

the idea that differences in the design of e-learning episodes can create differences in cognitive processing without creating differences in affective processing, or that cognitive processing can affect affective processing.

The search for the role of emotion in e-learning has led to several proposed theories of academic learning that include emotional state (or affective processing) as a key component. Most of the papers in this special issue draw on Control-Value Theory of Achievement Emotion (CVT; Pekrun & Perry, 2014), which posits that the learner's emotional state can be caused by antecedents such as perceived control (i.e., the learner's beliefs about his or her competence to learn the material) and perceived value (i.e., the learner's belief about usefulness or personal value of the to-be-learned material) of the learning task at hand, and can cause outcomes such as engagement and achievement. When the focus turns to e-learning, papers in this special issue also acknowledge Plass and Kaplan's (2016) Integrated Cognitive Affective Model of Learning with Multimedia (ICALM) and Moreno and Mayer's (2007) Cognitive-Affective Model of Learning with Media (CATLM), both of which extend Mayer's (2009, 2014) Cognitive Theory of Multimedia Learning (CTML) by incorporating affective and cognitive processes in the same model for describing how e-learning works. Clarifying how instruction causes affective and cognitive processes during learning and how these processes interact with each other to produce learning outcomes is the central challenge of research on emotion in e-learning.

5. Conclusion

Overall, a useful goal of research on emotions in e-learning is to test a cognitive-affective model of e-learning with links among an e-learning episode, the learner's affective processing (or emotional reaction) during learning, the learner's cognitive processing during learning, and the learning outcome. The sampling of current work in this special issue shows that progress is being made in identifying which emotions to study and how to measure them using self-report surveys, but systematic experimental research is needed to determine the causal link between aspects of the e-learning episode and the learner's affective processing during learning, the link between affective processing during learning and cognitive processing during learning, and the link between cognitive processing and learning outcome performance. This task has theoretical implications for creating a more complete theory of e-learning and practical implications for emotional design of learning episodes, that is, how to design instruction that primes emotions that enable deep cognitive processing leading to strong learning outcomes (Mayer & Estrella, 2014; Plass et al., this volume; Plass, Heidig, Hayward, Homer, & Um, 2014; Um, Plass, Hayward, & Homer, 2012).

Conflicts of interest

There are no conflicts of interest to declare.

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