



Using Emotional Learning Analytics to Improve Students' Engagement in Online Learning

Chaitali Samani, Amara Atif and Kaska Musial-Gabyrs

University of Technology Sydney

Online learning is learning enabled by technology as students' interact with subject content, access and download resources, watch videos, and participate in online quizzes. Epistemic Emotions (EE), e.g., curiosity, surprise, confusion, frustration or boredom has a complex impact when learning online due to the lack of real-time feedback loop. It becomes vital to detect such emotions timely and accurately before they starts impacting the learner adversely (e.g., D'Mello et al., 2017; Kosasi et al., 2020). EE activate or confines the learning. EE can be positive (surprise, enjoyment) or negative (frustration, boredom), or two folded (confusion). Positive emotions contribute to learning achievement, while negative emotions can cause frustration or anxiety, leading to impaired learning. Emotions are ambiguous and dynamic, and without innovations in learning analytics (LA) and Educational Data Mining, it is challenging to predict such emotions (D'Mello, S., 2017). This extended abstract focuses on how LA can help detect surprise and confusion in online learning, ultimately accomplishing achievement emotion(s) in learners.

LA provides tools and techniques to measure, collect, analyse, and report interaction data of students. Deeper data analysis of all kinds of digital traces collected on online learning platforms has the potential to detect emotional and cognitive states (Karaoglan & Yilmaz 2022; Han et al., 2021; Silvola et al., 2021). Innovations in emotional learning analytics leverage the voluminous and heterogeneous data available and propose adopting data-driven analytical approaches to study the impact of such emotions on students' engagement and cognition. EE like surprise helps learners discover new knowledge, and improve memory and focus and cognition (Foster & Keane, 2019). It adds the "novelty factor" to nourish students' curiosity and motivation (Hayden et al., 2011; Roesch et al., 2012). Whilst, confusion has a complex impact on cognition. Confusion causes disequilibrium due to incongruent information (Arguel et al., 2017). When students overcome the confusion, it helps in positive learning gains, but prolonged confusion can leave a student frustrated or bored, impeding their learning (Atapattu et al., 2019; Baker et al., 2010).

The voluminous activity log data is valuable and non-intrusive source of information in detecting important epistemic emotions and can help identify potential learning difficulties. Such data promotes unbiased real-time assessment of emotions and is technically easy to deploy simultaneously. Text data on online platforms are analysed to isolate emotions like confusion and frustration (e.g., Ai et al., 2006; Lee et al., 2011). Online quiz data is analysed using fuzzy logic inferences (Author, 2021) and multilayer perceptron (Author, 2021) techniques to detect confusion in online learning. Both surprise and confusion can be induced to promote meaningful learning, for example, some studies have added conflicting text or triggered high-confidence errors in their experimentation. Epistemic Emotion Scales (EES) were then used to detect surprise, confusion and even curiosity, by analysing the impact of such unexpected text. (e.g Pekrun et al., 2017, Vogl et al., 2020).

We show in this study, that LA tools and techniques can be utilised to detect EE to foster meaningful learning engagement and interventions, hence providing great research potential.

Keywords: Epistemic Emotions, Emotional learning analytics, Surprise, Confusion

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