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Mobile learning in higher education environmental science: state of the field and future possibilities

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Abstract

Authentic, place-based learning is essential for students of ecological and environmental sciences, providing connection to the discipline and building environmental literacy (O'Neil et al. 2020). In a COVID-affected world where opportunities to provide field-based learning may be limited, evaluating how mobile technologies may be used to enhance the field-based learning experiences of students is increasingly important.

Advances in mobile technologies have seen a surge in customised applications for species identification, data collection and collation aimed at public users and citizen scientists (e.g. iNaturalist: Unger et al. 2020; eBird: Sullivan et al. 2009; FrogID: Rowley et al. 2019). With field-based learning central to ecology and environmental science disciplines, there is a clear opportunity for the expanded use of mobile tools in higher education. We evaluated recent projects through a systematic review of the use of mobile learning technologies and approaches in field-based environmental sciences within higher education over the last decade.

Our search criteria terms encompassed mobile learning, mobile devices, teaching methods, field-based learning, undergraduate students and science disciplines and identified 1613 initial records. After removing irrelevant and duplicate records, 130 studies were identified that implemented mobile learning within science, technology, engineering and mathematics (STEM) disciplines, with engineering (32/130 studies, 24.6%), geology and geosciences (17/130, 13.1%) and natural/environmental sciences (17/130, 13.1%) the most common. Narrowing this search again to field-based studies, we identified 18 records, most of which (12/18, 66.7%) were in geology and geosciences disciplines.

A range of mobile learning technologies were used in the field, spanning the SAMR continuum (Laurillard 2012) from the *substitution* of traditional field activities with species identification apps (Pfeiffer et al. 2009; Thomas and Fellowes 2017), and *augmentation* of field experiences with multimedia resources such as podcasts (Jarvis and Dickie 2010) and other apps and resources viewed on mobile devices (Welsh et al. 2015; France et al. 2016; Unger et al. 2018), through to the *modification* and *reinvention* of field-based learning by incorporating multimedia displays, visualisations, games and information hotspots (Habib et al. 2012; Fitzpatrick et al. 2012; Bursztyn et al. 2015), virtual field trips and augmented reality (Stokes et al. 2010; Howard 2011; Litherland and Stott 2012; Kingston et al. 2012; Bursztyn et al. 2017; Prietnall et al. 2019), and customised apps that allow student-generated content (Chang et al. 2012) such as data collection, analysis and reflection (Chatterjea 2012; Wang et al. 2016). Studies used both enterprise and custom-built tools, with most incorporating geolocation capabilities.

Our review criteria only identified two studies in ecology disciplines, both of which utilised an existing enterprise application for species identification (Pfeiffer et al. 2009; Thomas and Fellowes 2017). There remains ample opportunity to develop collaborative mobile learning systems that use custom-built applications for field data collection and are integrated with the learning management systems, such as those in development in collaborative international projects (Bone et al. 2020). We strongly encourage the exploration of the potential for mobile learning in these contexts, and the publication of other projects that have incorporated mobile tools in ecological and environmental sciences curricula.

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