Executive summary

Over the past decade we have witnessed a proliferation of new technologies involving an increasingly sophisticated use of data. In education, the field of learning analytics (LA) is one such example, seeking to explore how the analysis of student data can bring new insights into the learning process. However, the breadth and diversity of technologies available today and the corresponding wealth of learning data stands in stark contrast to the day to day operations and processes that operate in formal education. Large educational systems such as Universities, TAFEs and other providers, have an essential requirement for technical stability and scalability.

The learning management system (LMS) is an example of a standalone solution that provides stability and scalability. LMSs combine a myriad of features that can be used in learning and teaching. From the management of courses and enrolment, to discussions, group work, and even assessment and assignment tracking, the modern day LMS provides a seemingly viable solution. Yet there are numerous other tools and platforms that can provide alternate and often more authentic learning experiences - social media and MOOCs for example. However, an ecosystem of technologies requires significantly more resources to maintain, and to date there have been few solutions for aggregating the data from a learning ecosystem. Despite these complexities, restricting our academic teachers and students to a single institutionally endorsed tool such as the LMS encourages a binary of compliance or non-compliance. As such, tools like the LMS are frequently viewed by teachers and students as barriers to overcome rather than a tool to embrace and support teaching and learning practice.

This project explored the dynamic between the need for teaching innovation alongside the need for the formal administration of education technologies. The project sought to identify a solution that would enable educational innovators to teach across platforms and systems using authentic real-world technologies, while recognising the need for quality, privacy, ethics and data control. Project outcomes demonstrate that it is possible to provide rich and authentic learning experiences for students 'in the wild', and still deliver learning analytics to staff and students using interoperable data that is ethically collected and securely stored.

The *Beyond LMS* project aimed to improve the quality of student engagement and learning in collaborative online environments by incorporating analytics developed using the data generated in social media platforms that the majority of students already use. The project explored the possibilities created by the emergence of a new educational data standard Experience API, (xAPI), investigating its potential for harmonising learning data from a wide array of online environments and then using it to deliver Learning Analytics (LA) to students and staff.

The project created a suite of open source tools that work within closely delimited learning activities, underpinned by connected learning pedagogy. These tools are designed to give students an understanding of, and control over, the data they collect. This both preserves student privacy and helps students to learn about how their social media data is used in analytics systems.

A case study consisting of a series of pilot trials of the Connected Learning Analytics (CLA) toolkit was conducted over a period of 18 months at QUT. This informed a number of key findings for this project (more details can be found in Chapter 2):

Finding 1: To be effective, LA dashboards must be tightly coupled to the learning design and/or assessment regime of a subject. User interpretation of LA results are contingent on the pedagogical context.

Finding 2: Students can make use of LA dashboards and reports to develop an understanding of their approaches to learning beyond the LMS.

Finding 3: Student awareness and training to interrogate data is required. Students were likely to readily accept the LA reports without question.

Finding 4: Tightly coupled LA architectures are difficult to maintain and prone to quick obsolescence.

These findings led to a major redevelopment of the CLA toolkit V2, which remains an active project currently being pursued at UTS. More technical findings and recommendations of this project stem from that redevelopment process (see chapter 4):

Finding 5: Designers of institutionally scalable LA infrastructure should seriously consider a highly modular architecture that will enable ongoing extensions of the datasets used, modifications of reports, and new integrations.

Finding 6: To be useful in a student facing context, learning analytics dashboards must be highly configurable, with different reports turned on or off depending upon: tools used; learning design; assessment regimes; and student data literacy.

Finding 7: The data traces created as students make use of any configurable dashboards are likely to be a rich source of information about metacognition, critical thinking and self-regulated learning. They should be a priority for future LA work seeking to develop 21st century skills.

An important set of outcomes associated with this project concern the concept of data interoperability. As universities enter into more porous relationships with their students it will become increasingly essential that the digital traces those students generate make sense across all of the learning ecosystems with which they engage. It should not matter which educational data standard is supported by the university that a person chooses to attend; all data should be mappable between learning environments as the need arises. This

project has tackled the problems of data interoperability and its implications for lifelong data portability (see chapter 3), which has to date driven its most profound impact.

The major output of this project is an extensive open source codebase. The original primary objective of this project to deliver the Connected Learning Analytics (CLA) toolkit, but this infrastructure has now been extended with a series of modularised components that serve to build up a Learning Analytics API (LA-API). Thus, a major outcome of this project is a concept and codebase for the delivery of LA at scale. In addition to this codebase and the project webpages, a number of publications, public talks, and informal outputs are highlighted in Appendix B.

To date, the impact of this project has rather unusually centred around the broad and systemic category. The work on data interoperability that has been carried out during this project has been fed into work by two standards bodies (the ISO and the IEEE), changing the ground rules about what is considered acceptable in educational data interoperability. The Learning Analytics Community Exchange (LACE) project run by the European Union has referred to this project extensively in its work package on data interoperability for LA. They have used the findings of this project to produce recommendations for the field (especially under the emerging environment created by the GDPR legislation).

As the LA-API infrastructure currently being implemented at UTS rolls out, the tools delivered by this project will be used to scale the delivery of LA across an entire university. A number of other institutions have expressed interest in the CLA toolkit, and with the new more modular codebase now being delivered with V2 it will be easy for them to adopt those parts of the infrastructure that suit their needs.

Table of contents