Completing the loop: returning learning analytics to teachers

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This paper provides an outline of an Australian Government Office of Learning and Teaching project that aims to investigate and then develop ways in which learning analytics data can be more usefully harnessed by academic teachers in higher education. Fundamental to this project is linking the learning design of online tasks provided to students with the learning analytic affordances of the technology-based tools that support them. The paper provides an outline of the background to the project, including its conceptual underpinnings, and sets out the program of research and development. The expected outcomes of the project are discussed.

Keywords: Learning Analytics, Higher Education, Learning Design

Introduction

The last few years have seen a growth in interest and development in the use of analytics to support teaching and learning. This emerging field examines how students' educational experiences and outcomes can be supported and improved through the analysis of data relating to students' activities in online environments. In broad terms the field of analytics can be divided into academic analytics, which focuses at the level of the whole institution with a view to understanding and improving organisational processes, and learning analytics, which focuses on students' use of digital learning environments with the aim of understanding and improving teaching and learning processes and outcomes (see Long & Siemens, 2011).

As an emerging field, many areas of academic and learning analytics still need to be better understood in order to determine how they can be usefully implemented in higher education. Much of the initial focus has been on determining indicators of students who are at risk of discontinuing their studies with a view to using them to improve retention (see, for example, Goldstein & Katz, 2005). There has also been a strong development focus in the area of learning analytics, with researchers investing effort in designing tools that capture, extract, analyse and display data about students' learning interactions, often harvested from students' engagement with learning activities in learning management systems (e.g. SNAPP; see Ferguson, 2012; Norris & Baer, 2013).

When learning analytics are applied at this more granular level of specific learning activities, the analysis and interpretation of data is complex, as students' interactions are heavily dependent on the design of specific learning tasks and contexts with which they are presented. While the development of bespoke analytics tools has provided a much needed foundation for the field, many of the tools have been developed without an explicit consideration of the overarching pedagogical design which underpins students' learning interactions in digital environments (for a notable exception, see LocoAnalyst in Jovanovic, Gasevic, Brooks, Devedzic, Hatala, Eap & Richards, 2008). This is troublesome as it often becomes very difficult for teachers, or others, to make sense of learning analytics data without a clear understanding of the pedagogical intent behind the design of learning tasks set for students. Linking the pedagogical design of learning tasks with established learning analytics tools and techniques will hopefully lead to a better understanding of how analytics can be most usefully applied,

interpreted, and actioned by academic staff.

With this background in mind, this paper provides a preliminary report of a national project, funded by the Australian Government's Office of Learning and Teaching that aims to:

1. understand what analytics teachers would find useful and how they could be more easily interpreted in the context of students' assigned learning activities;
2. develop a systematic and generic tool to enable teachers to access learning analytics that can help them address common and fundamental educational problems they face in online learning environments; and
3. implement and evaluate this tool with teachers and students in a range of university contexts.

By focusing on these three areas this project will "complete the loop" by providing easily accessible data to university teachers about their students' interactions in online learning environments. It will target the practical problem of how to better support effective academic teaching and student learning, while at the same time seeking to address the conceptual need across the entire higher education sector to further our understanding of how learning analytics can be genuinely useful in teaching and learning practice.

Conceptual framework

Two areas of educational research and development underpin this project: Diana Laurillard's (2002) influential conversational framework, and the field of learning design. Broadly speaking, the conversational framework proposes that the interaction, dialogue and feedback between teachers and students are critical to students' learning processes and outcomes. A simplified version of the framework is presented in Figure 1. A generalised learning interaction begins (1) when a teacher [T] designs and presents material or an activity to learners [L] who then engage with this by acting upon it (2). Learners subsequently respond to the material or activity given their current understanding (3), often directly to a teacher. This is then reflected and acted upon by the teacher (4) before a new loop or cycle is initiated in which the teacher may choose to re-present the material or activity, remediate or provide learners with feedback.

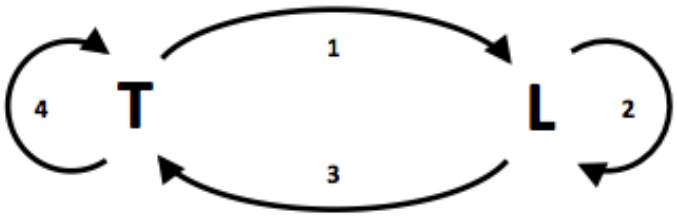

Figure 1: A simplified version of Laurillard's (2002) *Conversational Framework*

A critical component of the model is that both teachers and students are aware of each other's understanding of any particular concept being focused upon. While obviously applicable to learning contexts where face-to-face dialogue between teachers and students is apparent, the framework can be equally applied to students' engagement with and use of online learning tasks and resources set by a teacher. Laurillard's (2002) framework highlights how learning analytics could be used to provide data to teachers on what students are doing when engaging in online learning, which could subsequently be used for student feedback and remediation, as an evidence base for the modification and re-presentation of learning materials, or for ongoing reflection on students' learning processes. Given this, the conversational framework provides a very useful lens for understanding how to effectively provide learning analytics data to teachers for specific online learning activities.

The field of learning design is increasingly important in higher education as academics, designers and practitioners seek to understand how designed contexts, tasks and resources can promote effective learning interactions between teachers and students (see Goodyear, 2010; Lockyer, Bennett, Agostinho & Harper, 2009). Fundamental to this field is the ability to describe educational tasks in sufficient detail to enable these "learning designs" to be shared and reused among educational practitioners. In one sense, a learning design articulates the pedagogical intent of a teacher or designer (Lockyer & Dawson, 2012; Lockyer, Heathcote & Dawson, 2013). The clear promise of learning analytics is that they will provide educators with the ability to test the extent to which the pedagogical intent of the teacher is realised in the action of students. This reflects the useful distinction made by Ellis and Goodyear (2010) between learning tasks that are designed and set by staff, and learning activities that describe the actions and activities of students who engage with these tasks. We cannot

fully understand students' learning processes as captured through learning analytics without an understanding of the design of the learning task.

In addition to the learning design of the task, the technology-based tool(s) that support the task play a central role in any interpretation of students' learning behaviour. An online learning task with a particular learning design could be supported by a variety of technology-based tools, each of which could have a different structure and functionality. Given this variation, a key determinant of what learning analytics data are actually available for any particular learning design – including the form and granularity of those data – is the technology-based tool employed.

This project will, therefore, explicitly frame the collection, use and interpretation of learning analytics data around the intersection between the learning design of specific tasks and the structure and functionality of commonly used technology-based tools (see Figure 2). Linking learning designs with practical learning analytics output from common technology-based tools is a largely unexplored area nationally and internationally (Lockyer & Dawson, 2012), and will produce outcomes of widespread value to the higher education sector.

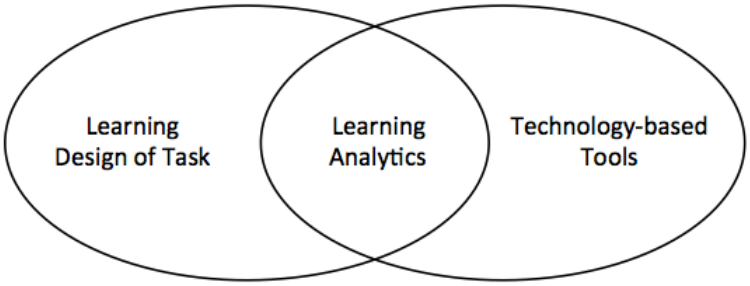

Figure 2: Interpretation of learning analytics requires an understanding of learning design and the affordances of technology-based tools

Project methodology

The project has three phases. The first phase will explore teachers' views on how learning analytics might help them address known difficulties or problems with teaching and learning online. The aims of this phase are to (i) determine the ways in which learning analytics could be used to assist teachers to address fundamental educational problems they commonly face with students in online learning environments, and (ii) provide information to inform the design specification of a web-based analytics tool to be developed in Phase 2. This phase has largely been completed; twelve semi-structured interviews with teaching staff have been carried out across the participating universities with a spread of disciplines (e.g. arts, sciences, professions) being purposively selected to accommodate potential disciplinary differences. In the interviews participants were asked about their learning designs at the macro (i.e. course structure and curriculum) and micro (i.e. design of particular tasks) levels, and their use of technology-based tools. They were also asked more generally about the problems they and their students face, particularly as they relate to online learning environments. Finally, participants were asked to define what actions they could, and would be prepared to take in relation to the identified educational problems. Thematic analyses of the interview transcripts is ongoing at the time of writing.

In Phase 2 a web-based analytics tool will be developed which will provide teaching staff with reports of meaningful, useful, analysed data about students' learning interactions with specific learning tasks (designs), supported by common technology-based tools. The development of the tool will be informed by the findings of Phase 1 and an analysis of existing learning analytics tools; particularly those that interface with the two main learning management systems (LMSs) used in Australian higher education (Blackboard and Moodle). It is expected that the web-based tool will draw together already-existing learning analytics technologies and extend these with newly designed areas of functionality. The tool will allow teachers to dynamically select the data they need to inform their investigation of students' activities for specific learning tasks and technology-based tools over specific time periods. For example, if a teacher is interested in how students are using a wiki-based collaborative writing task that has been set for them, they could access data which would show the level of individual participation (e.g. visits to the wiki, degree and type of input, number of wiki comments) and a visualisation of the social network of students' participation over a number of weeks. These analytics would provide evidence to the teacher about how students were negotiating the learning task and provide the basis for intervention – about the collaborative learning process or the content area – if it were deemed necessary.

The technology specifications for the tool developed will be compiled into an open-course framework, which will be available for educational technology developers. By focusing on the two major LMSs in Australian higher education, this tool could be used by the majority of Australian universities, but the development of a technical framework will also enable other universities to develop a similar analytics building block for their systems.

In Phase 3 the web-based analytics tool developed in Phase 2 will be trialed in four large undergraduate subjects, two subjects at the University of Melbourne, and one subject each at Macquarie University and the University of South Australia. These pilots will take place during the first semester of the 2015 academic year. Each case study will focus on how the web-based analytics tool can provide useful data about students' learning interactions, and evidence of students' difficulty with online learning tasks designed and set by the teachers. Academic staff involved in the trial will be interviewed about their experiences using the tool and its usefulness in support their understanding and remediation of difficulties in online teaching and learning. Administrative and technical staff will also be interviewed to determine facilitators and barriers to the adoption of the tool. The findings from this series of interviews will be combined with observations of the tool's use in a specific learning context to create four descriptive case studies.

Project outcomes

These case studies from Phase 3, when combined with the findings from Phase 1 and the tool developed in Phase 2, will inform a series of recommendations about the effective use of learning analytics in higher education. The outcomes of the three phases will also form the basis of a handbook, which will provide, along with the recommendations, educational, practical and technical advice about how to use learning analytics effectively in higher education. The handbook will underpin the content for a workshop series, which will be delivered at universities across Australia, and will explore how learning analytics can be used to support effective teaching and learning processes. The tool will provide teaching staff with access to new forms of empirical data on their teaching and students' learning activities, which will allow them to (i) provide valuable feedback to leaners (ii) inform educational interventions, and (iii) provide information to inform curriculum revisions and renewal (see Clow, 2012). The aim will be to equip academics with an empirical basis for positive changes in teaching and learning practice.

Current progress and conclusion

At the time of writing the majority of interviews for Phase 1 have been completed. Preliminary analyses indicate that a range of issues are emerging and these will inform the design of the learning analytics tool being developed in Phase 2. A preliminary specification and frame of the tool have been completed, and will be iteratively revised as the results of Phase 1 emerge and after preliminary testing and feedback. The results of the Phase 1 and a demonstration of the prototype tool will form the basis of the presentation of this paper at ascilite.

While learning analytics has certainly grabbed the attention of educational technologists, and educational and university leaders in recent times, more research and development is needed to ensure that as a community we move beyond using high level analytics to predict 'at risk' students. This project aims to make a contribution to the analytics area by focusing on concrete online teaching and learning activities, and by collecting meaningful data on students' learning interactions and behavior, it will provide teachers with useful evidence that can assist them with their teaching as well as students' learning.

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