

Loop: A learning analytics tool to provide teachers with useful data visualisations

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One of the great promises of learning analytics is the ability of digital systems to generate meaningful data about students' learning interactions that can be returned to teachers. If provided in appropriate and timely ways, such data could be used by teachers to inform their current and future teaching practice. In this paper we showcase the learning analytics tool, Loop, which has been developed as part of an Australian Government Office of Learning and Teaching project. The project aimed to develop ways to deliver learning analytics data to academics in a meaningful way to support the enhancement of teaching and learning practice. In this paper elements of the tool will be described. The paper concludes with an outline of the next steps for the project including the evaluation of the effectiveness of the tool.

Keywords: Learning Analytics, Higher Education, Learning Design, Data Visualisation.

Introduction

Learning analytics offers the potential to deliver data to teachers in ways that can inform the design and facilitation of learning activities. In order to realise this potential it is necessary to develop tools that allow student data to be analysed and visualised in ways that take into consideration the pedagogical design of learning tasks. This paper reports on the current progress of a project, funded by the Australian Office for Learning and Teaching (OLT), which explores what analytics would be useful for teachers in higher education to inform the development of a generic learning analytics tool. In previous papers we have outlined the overarching approach to the project and the preliminary findings from the first stage of the research (Kennedy et al., 2014). In this paper we will showcase the design of the tool and outline the next steps that will be taken to evaluate the effectiveness of the tool within real teaching scenarios.

Advances in learning analytics approaches and methods have resulted in calls for tools that can help academics access and interpret data about their students' engagement in online learning environments (Drachler & Geller, 2012). Previous tools have provided different forms of visualisations of student data from learning management systems including access to resources (Di Bitonto, Pesare, Roselli & Rossano, 2015), assessment (Petropoulou, Kasimatis, Dimopoulos & Retalis, 2014), and social interaction analysis (Schreurs, Teplovs, Ferguson, De Laat & Buckingham Shum, 2013). While these tools provide different ways of viewing data about students' engagement with online resources and activities, they do not facilitate an explicit connection with learning outcomes and pedagogical design.

The Loop tool provides student data to teachers on students' learning interactions and processes to inform teaching and feedback dialogues with students. A fundamental premise of the Loop tool is that the teachers' pedagogical intent, which underpins the design of a learning activity, drives the framing of the analytics that are presented for each technology-based tool. This means that the data associated with students' interactions with learning material can be used to determine the extent to which the pedagogical intent of the task has been reflected in students' interactions. These premises are underpinned by the field of learning design and the Laurillard's (2002) conversational framework. The learning design field provides a context through which more meaningful interpretation of student

data can be made (Lockyer, Heathcote, & Dawson, 2013) by articulating the pedagogical intent of the learning activities to which student engagement data can be compared. The conversational framework highlights the importance of interaction, dialogue and feedback between teachers and students, which should take place in an iterative cycle. Analysis of student data provides an evidence base to inform such feedback and remediation processes between teachers and students.

The Loop Tool

The Loop tool is an open source analytics application, developed as part of the OLT project, that allows users to visualise student data from learning management systems in a meaningful way. Loop is made up of two components: a log processing component that includes a data warehouse, and a web application that includes dashboards and reports. The Loop tool is programmed in Python using the Django web application framework. The tool is able to process logs from both the Moodle and Blackboard learning management systems to produce a number of different data representations and visualisations. Importantly, the tool is designed to integrate the course structure (i.e., course hierarchy) and course schedule in its associated visualisations to allow teachers to evaluate the effectiveness of learning activities scheduled throughout the course. The word 'course' has been used within the tool to represent a single subject or unit of study. Loop allows teachers to define key learning tasks or events (e.g. exam or non-instruction weeks) which are incorporated into the data representations in the tool to support the interpretation of patterns of student activity. These critical events allow for either isolated (e.g., mid-term exam) or recurrent events (e.g., weekly lectures) across the course to be defined. After its trial and before its formal release, the tool will be supplemented with a pedagogical helper tool that will assist teachers in disaggregating the learning objectives and learning design of their course. It will be this element of the Loop tool that will assist teachers to articulate their pedagogic intent and identify metrics that relate to their design intentions. When used together, the two tools will help teachers see the degree to which students' interactions with learning tasks and assessments are manifest in LMS data corresponding with the pedagogical intent envisaged by teachers. The three main sections of the Loop tool are: dashboard, course access, and students.

Dashboard

The course dashboard provides a quick overview of activity within the course. Figure 1 provides a screenshot of the dashboard with data from one course with which Loop is being piloted. This dashboard summary of the data can be viewed for a particular week or for the entire course. The first representation of the dashboard is associated with "Daily Page Views" (Figure 1-A). This displays simple metrics of students' levels of activity over time for three key areas of a course: content, communication, and assessment. The vertical lines on the daily page views graph represent the dates of teacher-identified critical learning events in the course (Figure 1-B). This visual representation allows teachers to easily see how students' interactions with critical course materials are influenced (or unaffected) by critical events or key milestones within the course. A representation of "week metrics" (Figure 1-C) presents a digestible summary of key weekly activities in the course including the number of unique page views, the number of unique students who were active, the number of student sessions conducted, the average number of sessions, and the average number of page views per session. The dashboard also presents a list of the course material most visited by students over the time period (e.g., "Top Accessed Content"; Figure 1-D).

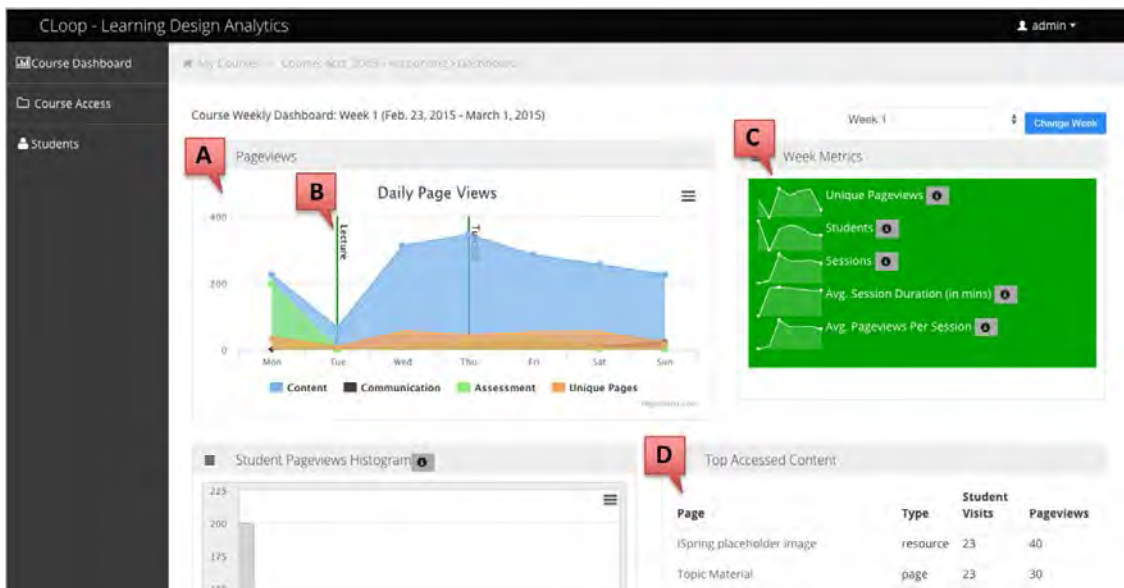


Figure 1: The Loop tool dashboard for week 1 of a course. A = Daily page views. B = Critical learning events. C = Week metrics. D = Top accessed content. Course Access

The course access section provides teachers with the opportunity to explore, in more detail, students' access and interaction with the course. The three-fold classification of content, communication, and assessment is again used to structure teachers' exploration and investigation of the learning analytics data. Each of these sub-sections is described below.

Content

The content section displays all students' interactions with the content material in the course. Teachers can elect to see the total number of student views for each item of content material within the course structure, per week and aggregated across the whole course. Teachers can also elect to see "unique student views" which shows how many unique students viewed each item of content material (either per week or in total aggregate). From either of these two sets of data teachers can access further details on any specific item of content. Figure 2 shows this more detailed view for a course content item. It and shows how the level of student access can be visualised in relation to key learning events over a three-month period. Teachers also have the option with this detailed view to see a histogram of access frequencies, and a list of students who have not yet accessed the particular item of content.

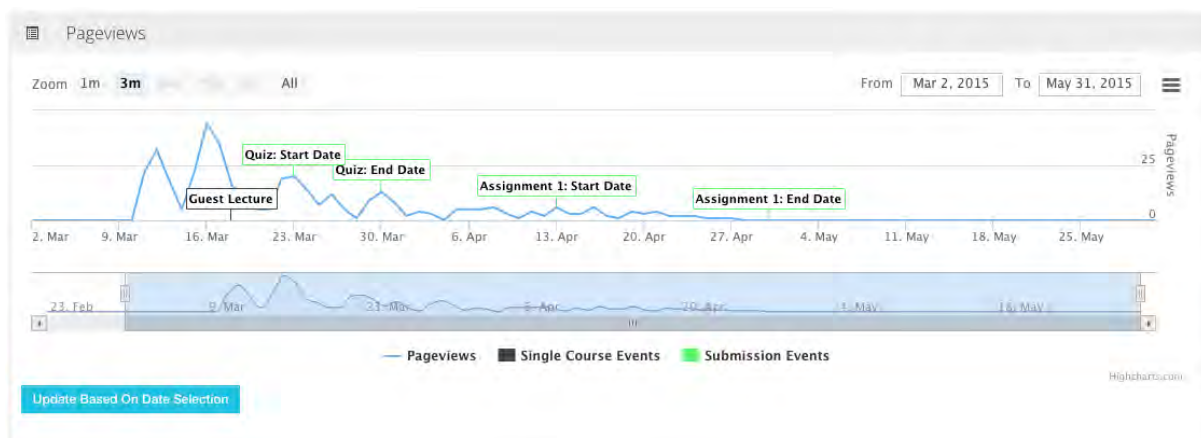


Figure 2: A three-month visualisation of access to a course content item aligned with key learning events

Communication

The communication section contains visualisations of students' interactions with discussion forums across the course. In this section it is possible to see the number of views and posts for each of the forums available in the discussion board, both per week and in total. The number of unique students

viewing each forum is also available. The numbers of views for each forum included in the discussion board in relation to a selected learning event date, are presented visually (see Figure 3). Figure 3 shows students' access to discussion forums relative to the specific event of the weekly lecture. Teachers may, for example, be interested in whether students are actively engaging in or viewing discussion posts on a specific topic before or after a particular lecture or class. The visualisation shows how many discussion views have occurred (indicated by the size of the circle), as well as the proportion of discussion forum views that occurred before the learning event (blue circle segments) or after the learning event (red circle segments).

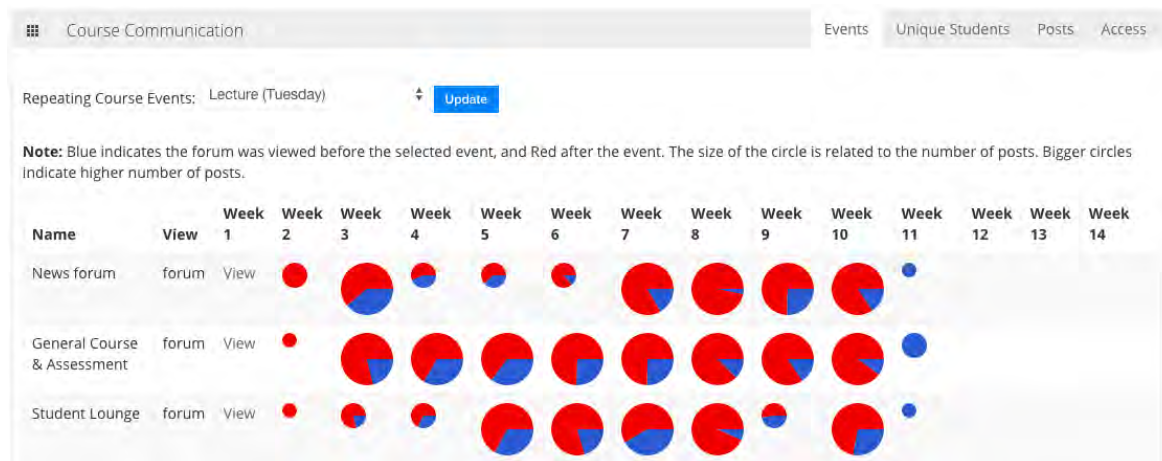


Figure 3: A visualisation of student access to discussion forums in relation to course events

Assessment

The assessment section displays data related to students' interaction with each assessment available across the course. The number of attempts for each assessment, per week and in total, are presented in a primary table. Teachers also have the ability to view the same data filtered by access by unique students. A "grade" table presents students' grades for each assessment within the course. An "event" table presents students' interaction with each piece of assessment in relation to a defined learning event, using the same visual representation techniques (i.e. size and colour) as those used in the content and communication sections.

Students

The students section of the tool provides the ability to monitor the activity, communication and progress of individual students. An aggregated table presents an overall count of activity for each student. When an individual student is selected, specific data related to the student's interaction with content, communication and assessment can be viewed. This section can be used by teachers who are interested in investigating engagement patterns of students, potentially to identify those who are struggling with the course. For example, the teacher can check when a student has accessed content materials that relates to particular poor assessment attempts by the student, or whether a student is engaging with other peers on discussion forums after they have been set a topic or problem to investigate.

Next steps

The Loop tool will now be piloted in four courses across the three institutions participating in this project: a biomedical course and a pharmacology course at the University of Melbourne, an education course at Macquarie University, and an accounting course at the University of South Australia. These pilot studies will take place in the second semester of the 2015 academic year. Teaching staff involved in each pilot will take part in an interview at the beginning of semester during which they will be introduced to the functions of the tool and asked how they expect they will use the tool to support their teaching practice. Throughout the semester participants will be asked to complete a short diary entry each time they access the tool to record the purpose of their use and any outcomes and/or actions that results from viewing the data. At the end of semester they will be interviewed again and asked to reflect on their use of the tool, the results of any educational interventions made, and the usability of the tool. The findings of this data collection process will inform any changes to the tool

before it is released as an open source tool for other institutions to use. Moreover, the pedagogical helper tool will be developed, which will assist teachers in articulating their pedagogic intent of their course and its activities, based on its learning objectives and learning design.

Conclusion

The Loop tool represents a step forward in providing learning analytics that are able to support and inform learning design. The tool is unique in that it has been designed to provide dashboards, reports and visualisations that incorporate course hierarchy (i.e., content tree structure), course schedule (i.e., reporting for each week in the semester) and key course events (i.e., recurring events such as lectures and single assessment submission dates). This structure, manifest in Loop's design and interface, is essential to give teachers an understanding of the how students' learning behavior is temporally related to the pedagogical structure of their course, and the specific learning activities within it.

References

- Kennedy, G., Corrin, L., Lockyer, L., Dawson, S., Williams, D., Mulder, R., Khamis, S., & Copeland, S. (2014). Completing the loop: returning learning analytics to teachers. In B. Hegarty, J. McDonald, & S.-K. Loke (Eds.), *Rhetoric and Reality: Critical perspectives on educational technology. Proceedings ascilite Dunedin 2014* (pp. 436-440).
- Di Bitonto, P., Pesare, E., Roselli, T., & Rossano, V. (2015). Digitally Enhanced Assessment in Virtual Learning Environments, In *Proceedings of 21st International Conference on Distributed Multimedia Systems*, Vancouver, Canada.
- Drachler, H., & Greller, W. (2012). Confidence in learning analytics. In *Proceedings of the Second International Conference on Learning Analytics and Knowledge* (pp. 83-92). New York, NY: ACM.
- Laurillard, D. (2002). *Rethinking University Teaching. A conversational framework for the effective use of learning technologies*. London: Routledge.
- Lockyer, L., Heathcote, E., & Dawson, S. (2013). Informing pedagogical action: Aligning learning analytics with learning design. *American Behavioral Scientist*, 57(10) 1439–1459.
- Petropoulou, O., Kasimatis, K., Dimopoulos, I., & Retalis, S. (2014). LAe-R: A new learning analytics tool in Moodle for assessing students' performance. *Bulletin of the IEEE Technical Committee on Learning Technology*, 16(1), 1-13.
- Schreurs, B., Teplovs, C., Ferguson, R., De Laat, M., & Buckingham Shum, S. (2013). Visualizing social learning ties by type and topic: Rationale and concept demonstrator. In *Proceedings of the Third International Conference on Learning Analytics and Knowledge* (pp. 33-37). ACM.

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