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Completing the Loop: Returning Meaningful Learning Analytic Data to Teachers

Final report 2016

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List of acronyms used

ALASI – Australian Learning Analytics Summer Institute

ASCILITE – Australasian Society for Computers in Learning in Tertiary Education

CAL – Computer Assisted Learning

LAK – Learning Analytics and Knowledge Conference

LMS – Learning Management System

OLT – Australian Government Office for Learning and Teaching

Executive summary

The Completing the Loop project was designed to identify common situations and challenges faced by teachers and students when learning online, and determine the types of learning analytics teachers would find useful to effectively address these challenges. These insights were then used to develop a web-based analytics tool to support teachers to more easily interpret learning analytics to help them improve teaching and learning practices.

The aims of this project were (1) to 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 context.

The project took place in three phases. The first phase explored teachers' views on how learning analytics could help them address known difficulties or problems with teaching and learning online. Twelve semi-structured interviews were held with teaching staff across the participating universities with a spread of disciplines 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.

In the second phase a web-based analytics tool, the Loop Tool, was developed to provide teaching staff with reports of meaningful and useful data about students' learning interactions with specific learning tasks (designs). The development of the tool was informed by the findings of Phase 2 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). The tool allows 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. These analytics provide evidence to the teacher about how students were negotiating learning tasks and provide the basis for intervention if it were deemed necessary. The technology specifications for the tool developed were compiled into an open-source framework, which is available for educational technology developers. By focusing on Moodle and Blackboard, the majority of Australian universities can use this tool, but the development of a technical framework will also enable other universities to develop a similar analytics building block for their systems.

In the third phase the Loop Tool was trialled in three large undergraduate subjects, one subject each at The University of Melbourne, Macquarie University and University of South Australia. These pilots took place during the second semester of the 2015 academic year. Each case study focused on how the Loop Tool could 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 were interviewed at different points through the semester about their experiences using the tool and its usefulness in supporting their understanding and remediation of difficulties in online teaching and learning.

The Completing the Loop Project has two major outputs. The first is the Loop Tool, an open-source application compatible with Blackboard and Moodle. The second is a handbook entitled "Completing the Loop: Returning Meaningful Learning Analytical Data to Teachers. A Handbook for Educators and Learning Analytics Enthusiasts". The handbook includes a literature review and discussion on current topics related to learning analytics and learning design, a presentation of the findings of the project, a comprehensive guide to the Loop Tool, the technical framework, and key recommendations for the higher education sector on the use of learning analytics.

To date, the project has reached over 600 educators in Australia and worldwide through the delivery of seminars, webinars, workshops and paper presentations related to the project. Workshops for the project are currently being delivered across Australia in Sydney, Brisbane, Perth, Melbourne and Adelaide. Moreover, six academic publications have been presented in internationally-renowned conferences in the fields of educational technology and learning analytics (ASCILITE, LAK and ALASI).

Another key output of the project is the website (available at http://melbourne-cshe.unimelb.edu.au/completing-the-loop). The Completing the Loop website provides information about the project and links to download the Loop Tool, handbook and academic publications. The project website and the GitHub repository from which the Loop Tool will be available, will act as the online foci of the project. It is hoped that the resources developed as part of this project and made available on these sites will facilitate the ongoing impact of the project. It is also hoped that a practitioner-focussed learning analytics community will form around the Loop Tool. While the project team of course hopes this community will use the Loop Tool, and importantly add to and improve it, it is also expected that the more long-term and widespread impact of the project will result from the conceptual foundations and advice provided by the project to teachers, regardless of which analytics tools they elect to employ.

The project determined a range of educational, administrative and technical recommendations, which are covered comprehensively in the Handbook delivered as part of the project. The key recommendations are summarised below:

- To get the most from learning analytics teachers need to clearly identify the teaching and learning goals for their course and how they are using resources and technology-based tools to support them.
- Having a clear, succinct couple of pedagogically focussed questions, to guide their learning analytics investigation will greatly assist teachers.
- It is important not to jump to conclusions about what learning analytics data mean; consider a range of alternative explanations of the students' learning behaviour that is revealed by learning analytics.
- Care should be taken in the interpretation of analytics that form the basis of potential interventions and also teaching staff should be mindful that a range of interventions may be appropriate given a single learning analytics finding.
- Much of students' engagement with learning might happen offline or outside university sanctioned digital learning systems, and as such it is useful to consider how additional information can be gathered on these activities to support the interpretation of learning analytics data.
- Just as learning analytics can effectively be used as the basis for individual staff reflection and educational intervention, they can underpin important contributions to teachers' academic scholarship of teaching and learning.
- It is important to acknowledge – and have strategies to manage – the not inconsiderable time investment required by teachers to undertake investigations using learning analytics.
- To realise the potential benefits of learning analytics, and the potential benefits of the Loop Tool, a greater commitment to the professional development of staff is required.
- The frequency with which data from local LMS are integrated with the Loop Tool needs to be negotiated with local system administrators; more regular data feeds can provide teachers with more options and opportunities to modify or update their courses and course material.

The future impact of the project will be largely determined by the uptake of the primary resources produced, the handbook and the Loop Tool itself. There has been a very positive response to this project, and a number of requests for the tool have already been received so the team members are optimistic about future impact. It is expected that the higher education community will respond well to the strong conceptual framing of the project, the accessibility and usefulness of an analytics tool, and the practical advice the team has compiled about how individuals can use learning analytics in pedagogically informed ways.

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Chapter 1 – Project Context and Aims

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.

The aim of this project was to "complete the loop" by returning meaningful data to teachers to inform teaching and learning interventions. The idea of creating a tool to bridge a gap in the feedback loop between teachers and students was inspired by Laurillard's (2002) Conversational Framework. This framework proposes that students' learning processes need to be supported by an iterative loop of interaction, dialogue and feedback between teachers and students. A learning interaction begins when a learning activity is designed and

presented by a teacher to students. The students then engage with the activity (e.g. read a learning resource, participate in a discussion, etc.) using their current understanding of the topic. This produces a form of feedback to the teacher on which they can reflect and act. It may be that the teacher decides to re-present material, provide some form of remediation, or provide further feedback to students. This action initiates a new loop or cycle.

Learning analytics can play a part in this conversational feedback loop by providing teachers with information about students' activities and engagement with learning tasks so they can reflect on student learning processes. This information can be used by teachers to provide feedback to students or as evidence to inform changes and improvements to learning resources and/or learning design. It can be used to provide interventions for all students in a course or to identify individual students who may be at risk of failing. The conversational framework provides a way to consider how learning analytics can be used to support both students and teachers in creating a better environment for learning.

Chapter 2 – Overview of the Project Phases

The project was conducted in three phases. The first phase explored teachers' views on how learning analytics helped them address known difficulties or problems with teaching and learning online. In Phase 2 a web-based analytics tool was developed – the Loop Tool – which provides teaching staff with reports of meaningful, useful, analysed data about students' learning interactions with specific learning tasks (designs), compatible with the most commonly used learning management systems in Australia (Blackboard and Moodle). In Phase 3 the web-based analytics tool developed in phase two was trialled in three large undergraduate subjects, one subject each at The University of Melbourne, Macquarie University and University of South Australia.

Phase One

The first phase of the study sought to explore teachers' perspectives on how learning analytics could be used to help address teaching and learning issues or problems relating to the online learning environment. The aim of this phase, and the interviews completed during it, was to:

1. 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 environments; and

2. Provide information to inform the design specification of the web-based analytics tool.

A total of 12 interviews were held with teachers, four from each of the three participating universities. A purposive sampling approach was adopted to ensure a spread of disciplines (e.g. arts, sciences, professions) and class sizes (e.g. less than 50, 50-100, more than 100). Table 1 presents a summary of course details for each participant.

Participants were asked to describe the learning designs they use in their course at both a macro (i.e. course structure and curriculum) and micro (i.e. design of particular learning tasks) level. They were then asked to explain how they used technology-based tools to support these learning designs. This was followed by an exploration of any issues or problems that the teacher or their students face in the classroom and/or in online learning environments. Participants were then asked to consider ways that learning analytics could be used to address these problems.

As teachers often have difficulty articulating their needs in relation to learning analytics, examples of learning analytics reports and dashboards were used as prompts for participants to consider ways in which existing and new types of analytics could address their teaching and learning problems. The interview concluded with a discussion of the

actions that participants could take, and would be prepared to take, in response to the analytics to address the educational issues and problems they identified.

Table 1. Course Details for Recruited Participants

Discipline	Year level	Class size	Digital resources	Discussion board	Lecture capture	Online quizzes	Turnitin	Facebook	Computer aided learning	Online survey	Wiki	Blog	Twitter	Clickers	Virtual classroom
Arts (Education)	PG	30			X		X			X					
Arts (History)	UG	160	X		X						X				
Arts (Criminology)	UG	140	X		X		X								
Arts (Anthropology)	UG	1200	X	X	X	X	X	X		X					
Professions (Law)	UG & PG	70	X	X	X	X	X								
Professions (Accounting)	UG	450	X	X	X	X									
Professions (Property)	UG	300		X	X	X					X				X
Sciences (Statistics)	PG	40	X	X	X										
Sciences (Marine Biology)	UG	50	X	X								X	X		
Sciences (Physiology)	UG	570		X	X			X	X			X		X	
Sciences (Biology)	UG	250-300	X	X		X		X	X						
Sciences (Maths)	UG	400-600	X	X	X										

Phase Two

The second phase of the project comprised of the planning and development of the Loop Tool. The Loop Tool was developed to integrate teachers' pedagogical intent, as articulated by their learning design, with students' learning processes, as captured through learning analytics. Design principles were established to guide the development of a tool that combined knowledge from previous literature and tools with the findings from the interviews conducted on the first phase of this project. Based on these principles, the Loop Tool was created with two main components: the pedagogical helper tool and the learning analytics tool. The pedagogical helper tool is responsible for supporting teachers to articulate the connections between pedagogical intent, learning design and learning technologies used. The output of the pedagogical helper is a map to guide teachers when interpreting data from the learning analytics tool. In turn, the learning analytics tool presents data from the learning management system, highlighting important aspects related to the learning design of each course.

There are four main influencers on the design of the Loop Tool. The first one is Diana Laurillard's conversational framework (Laurillard, 2002), with the recognition that learning involves bilateral interaction between teachers and students. The second and related notion is that fundamental to understanding learning with learning analytics requires an idea of the pedagogical design that underpins the activities and tasks that students are engaging in online. This is essential to make meaning from any data gathered. Third, the Loop Tool is at the same time fuelled and constrained by the particular affordances of technology-based tools that teachers and students are using. This includes the functional affordances of technology-based tools and the learning management systems within which they are embedded, which determine the types of data that can be returned and used in the Loop Tool. Finally, findings from the interviews conducted during the investigation phase of this project with teaching academics across the participating institutions resulted in a conceptual framework. This conceptual framework highlights the integration of different types of analytics (temporal, tool specific and cohort dynamics) and learning and teaching context so educators can provide support to students.

Based on these main influencers, four design principles were created to guide the Loop Tool development. Table 2 presents each of these principles. This table also presents their rationale, tensions to consider, and how they would be operationalised within the project to address these tensions.

It was decided that the Loop Tool would (1) accommodate data from two of the most commonly used learning management systems (LMS) in Australia at the time of writing: Moodle and Blackboard, (2) have two interconnected components: one focusing on learning design and one on presenting learning analytics; (3) present both basic and more sophisticated learning analytics; and (4) allow data to be updated and displayed in a flexible way. More details on the Loop Tool can be found in the next section.

Table 2. Design Principles that Guided the Loop Tool Development

Principle	Rationale	Tensions to consider	Operationalisation
Apply learning analytics to data from common LMSs	- Required by most universities in Australia - Teachers already use LMSs, mainly Moodle and Blackboard	- Moodle and Blackboard have limitations on what data is provided and when - Although Moodle and Blackboard are similar, they have some technical differences	- Develop a tool for both Moodle and Blackboard as similar as possible to each other
Learning analytics must be linked to learning design	- Teachers should acknowledge their learning design before accessing and interpreting analytics	- The terminology associated with technology-based tools may be more familiar to teachers than learning design terminology	- Have a learning design component of the tool that enables teachers to "acknowledge" or describe their pedagogical intent - Link the acknowledgement to a technology-based tool - Use the technology-based tool as a doorway to learning analytics
Accommodate common teaching practices	- Diversity of ways to set up a LMS for the same learning design - Diversity of technology/tools used by teachers	- Some teachers have shown interest in getting basic learning analytics, without a clear connection to the learning design	- Allow basic access/use data to be returned to teacher - Also allow sophisticated activity-based data to be returned to teacher
Provide timely sets of learning analytics data to teachers	- Teachers want learning analytics for particular time periods	- Not clear what is an appropriate and feasible immediacy of learning analytics reports	- Allow a period of time to be specified by the end user

Phase Three

Phase three of the project involved piloting the Loop Tool with three undergraduate courses with large cohorts, one from each of the participating institutions. These pilots took place during the second semester of the 2015 academic year. Each case study focused on how the web-based analytics tool could 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 were interviewed about their experiences using the tool and its usefulness in supporting their understanding and remediation of difficulties in online teaching and learning. The findings from this series of interviews were combined with observations of the tool's use in a specific learning context creating descriptive case studies.

The first case study examined a second-year biomedicine course with an LMS site that contained many learning resources, including those related to a flipped classroom-style course delivery. The teacher was primarily interested in identifying students' patterns of usage of resources during the course, especially examples of resources that students revisited during the semester. The teacher was also interested in identifying students who were falling behind and/or not accessing the online materials. Throughout the semester, the teacher accessed the Loop Tool at least weekly, increasing to several times a week towards the end of semester.

Primarily, the teacher used the tool to check whether students had accessed the computer assisted learning (CAL) tasks in preparation for the flipped classroom sessions. He found that, generally, the students were accessing the CAL tasks in a timely manner, but unexpectedly he also found that students continued to re-visit the CAL tasks throughout the semester. The other main way that the teacher used the Loop Tool was to retrospectively correlate data on performance with access to resources in order to identify "successful" patterns of engagement. He did this in order to plan future interventions. While the teacher said that he didn't take any specific actions during the semester of the pilot, his aim was to observe the behaviour of the cohort as a baseline for intervention for future cohorts. He also mentioned that he referred to the tool during individual face-to-face consultations with six students as a basis for the discussion of study habits.

The second case study involved a third-year education course on designing effective assessment and research-informed processes of evaluation. In addition to the standard course LMS site, students had access to a companion website – the Research Ed site, which provided activities and materials specifically related to the research report assessment. The site also contained online quizzes to check students' knowledge of statistics and other content related to assessment evaluation. The teacher wanted to be able to explore the patterns of access to the support resources for assessment to help inform enhancements to the site for future cohorts.

The teacher used the Loop Tool at three main points across the semester. At the beginning of the semester he used it to become familiar with the functionality. He then accessed it when students had completed the major assessment, to investigate student engagement with the support resources for the assessment. At the end of semester he returned to the tool to do more extensive analyses of the data. He exported student access statistics and performed a regression analysis to see if students' use of resources influenced their performance in the major assessments. Early in the semester he emailed non-engaging students to remind them about the online resources available. For those students who had accessed the assessment information on the main course LMS site, the teacher then monitored their engagement and contacted students to highlight the support resources available. He also used the data when considering appeals to the assessment grade to see if students had engaged with the assessment resources over time or only at the last minute (if at all).

The third case study involved a first-year financial accounting course designed to enhance students' knowledge of the complete accounting cycle. The learning activities were designed to allow students to develop knowledge and skills through readings, lectures, and podcasts and then apply this in a variety of formats, through quizzes, tutorial presentations, workshop activities/tests and examinations. The teacher wanted to see what LMS resources students were using and when students were accessing them. In particular, he was interested in which resources were used frequently, and which were used infrequently. He was also interested in seeing when students were accessing resources in relation to specific assessment items to identify successful access patterns.

The teacher accessed the tool each week for the first two weeks of semester, but then more sporadically after that. His main focus was on looking at patterns of usage of particular resources, especially the timing of access in relation to learning activities throughout semester. He wanted to get a sense of which resources students were and were not accessing for the purpose of reviewing the content made available to students online throughout the course. The teacher was able to give general feedback to students; for example, he was able to provide guidance to students about resources that were important but not many students had accessed. He indicated that he wanted to incorporate more of this type of feedback in future offerings of the course to promote the most important resources in a timely manner.

All three pilot teachers were satisfied with the usefulness of the tool and found it fairly easy to use. Two of the teachers noted that it took a bit of time at first to understand what particular data meant in the context of their LMS design. A few limitations were identified including the delay in the update of data into the Loop Tool and the size of tables of data in the tool for LMS sites with large amounts of resources (including resources that were no longer in use). Several suggestions were made to improve the Loop Tool including more specific information on specific pages that individual students accessed, the ability to export

raw data from the tables to statistical packages, and the ability to group students and resources together.

For more detail on these pilot case studies see the Loop Handbook.

Chapter 3 – Project Outputs and Findings

Project Outputs

The project outputs included the Loop Tool, a technical framework, a handbook, a workshop series, academic publications and presentations, and a website where all project material is available.

The Loop Tool

The Loop Tool is an open-source online application that allows teachers to access data from learning management systems in an easy and meaningful way. Users may have two levels of access to the Loop Tool: administrator and educator. The administrator can create new users and grant access to them for specific courses, create courses to use the Loop Tool, and create events for each course. The educator profile can have access to one or more courses, which have been determined by the administrator. Once educators have logged into the Loop Tool, they can visualise all the courses to which they have access. Each course has a link to the Pedagogical Helper Tool and to the Learning Analytics Tool.

The Pedagogical Helper Tool provides a system for educators to create a visualisation of the association between the learning design and the technologies used in their course (Figure 1). The learning design of a course is articulated by its different learning objectives, learning activities and learning resources. The Pedagogical Helper Tool allows the creation of a map linking learning design (represented by learning objectives and learning activities) with learning analytics (represented by the learning resources available in the LMS). This map should provide guidance to educators when exploring data in the Learning Analytics tool. The connections created between learning objectives, learning activities and learning resources can be exported as a table in a word document.

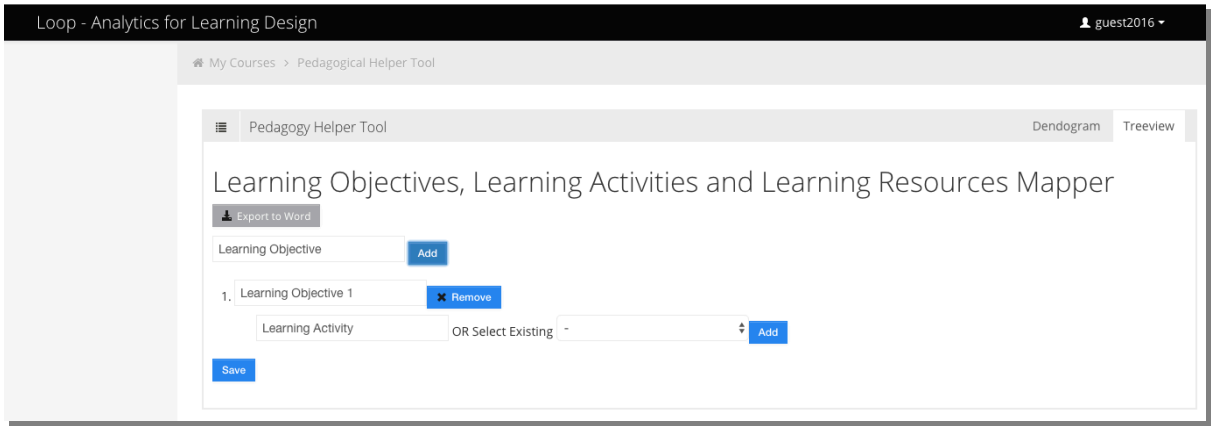


Figure 1. Pedagogical Helper Tool.

The Learning Analytics Tool provides an interface to display LMS data to teachers in a meaningful way. There are three main sections: course dashboard, course access, and students. The course dashboard presents a summary of students' interaction with the LMS

over different weeks or an overall view of the whole course (Figure 2). The course access section presents access data for the content, communication and assessment resources in the LMS. The students section allows users to drill down to specific students and explore their interactions with the LMS throughout the course (Figure 3).

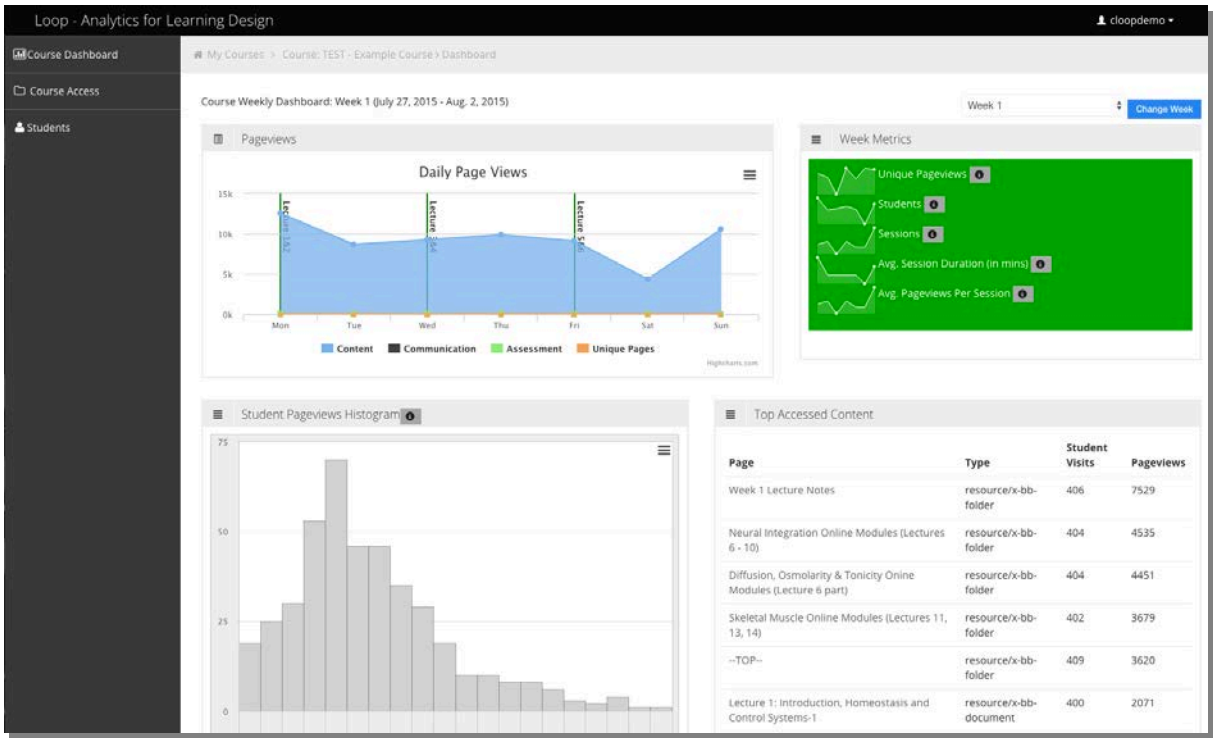
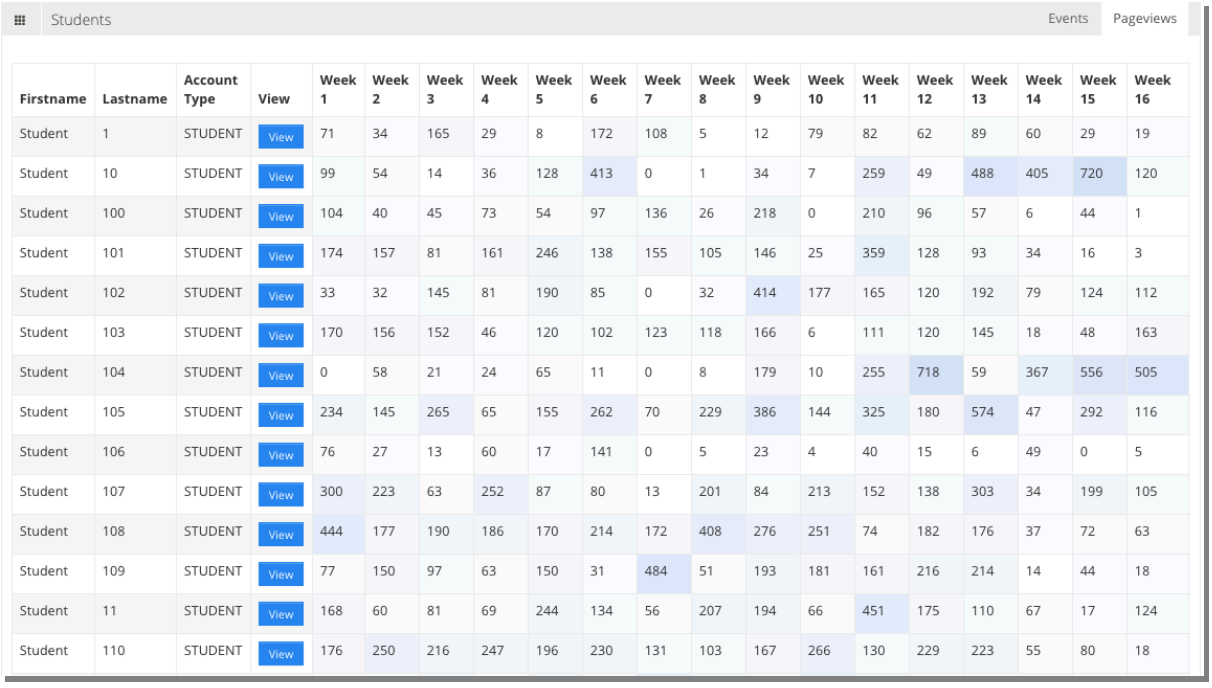


Figure 2. Dashboard at the Learning Analytics Tool.



Firstname	Lastname	Account Type	View	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15	Week 16
Student	1	STUDENT	View	71	34	165	29	8	172	108	5	12	79	82	62	89	60	29	19
Student	10	STUDENT	View	99	54	14	36	128	413	0	1	34	7	259	49	488	405	720	120
Student	100	STUDENT	View	104	40	45	73	54	97	136	26	218	0	210	96	57	6	44	1
Student	101	STUDENT	View	174	157	81	161	246	138	155	105	146	25	359	128	93	34	16	3
Student	102	STUDENT	View	33	32	145	81	190	85	0	32	414	177	165	120	192	79	124	112
Student	103	STUDENT	View	170	156	152	46	120	102	123	118	166	6	111	120	145	18	48	163
Student	104	STUDENT	View	0	58	21	24	65	11	0	8	179	10	255	718	59	367	556	505
Student	105	STUDENT	View	234	145	265	65	155	262	70	229	386	144	325	180	574	47	292	116
Student	106	STUDENT	View	76	27	13	60	17	141	0	5	23	4	40	15	6	49	0	5
Student	107	STUDENT	View	300	223	63	252	87	80	13	201	84	213	152	138	303	34	199	105
Student	108	STUDENT	View	444	177	190	186	170	214	172	408	276	251	74	182	176	37	72	63
Student	109	STUDENT	View	77	150	97	63	150	31	484	51	193	181	161	216	214	14	44	18
Student	11	STUDENT	View	168	60	81	69	244	134	56	207	194	66	451	175	110	67	17	124
Student	110	STUDENT	View	176	250	216	247	196	230	131	103	167	266	130	229	223	55	80	18

Figure 3. Student section at the Learning Analytics Tool.

The source code for the Loop Tool is available as open source via the GitHub repository at: https://github.com/looptool/download

Technical framework

The technical framework provides an explanation of each aspect of the Loop Tool and a step-by-step guide on how to install the Loop Tool. It is presented as an appendix in the handbook. A key requirement of the Loop Tool was to provide easy visualisations for teaching staff to view course access by content item and LMS tool use. The Loop Tool therefore requires the log files and an export of the course structure from either Blackboard or Moodle LMS. IMS-CP Export files are required from Blackboard and the course export format is required for a Moodle course.

The Loop Tool is made up of the following two components: data warehouse and dashboard. The data warehouse is in MySQL. Log and course export zip files are processed and both Moodle and Blackboard data is stored in a single schema. Quiz and forum data is also extracted from the course export zip files. Content and tool items are categorised into Content, Communication and Assessment. The data warehouse implements a star schema design to allow queries by week and day to easily be made. The schema also contains tables that cache all major data components of the dashboards. The Dashboard is built with the Django web application framework. The dashboard retrieves cached data from the MySQL database and displays the weekly, overall and content, communication, assessment and overall student dashboards. There are also individual student and content item/tool dashboards.

Handbook

The handbook entitled “Completing the Loop: Returning Meaningful Learning Analytic Data to Teachers” outlines the main aspects of the project. It brings together the activities and outcomes of the last two years of work by the project team into a resource for teachers and learning analytics specialists. In addition to outlining the theory behind our approach, the handbook provides a manual for how to use the Loop Tool. Also included in the appendices is the technical framework on how to implement the open source Loop Tool. The handbook can be downloaded from the project’s website at: http://melbourne-cshe.unimelb.edu.au/completing-the-loop.

Workshop series

The project team is currently in the middle of presenting a workshop series across five states of Australia: New South Wales, Queensland, Western Australia, Victoria, and South Australia. The aim of these workshops is two-fold. The first aim is to examine the concepts of learning analytics and learning design, including their association and applicability to teaching and learning practice. The second aim is to provide a hands-on experience for participants to apply this knowledge using the Loop Tool. In these workshops, teachers, educators and learning analytics specialists have the opportunity to explore and reflect on

the use of learning design and learning analytics in their practice. Participants also have the opportunity to learn more about and interact with the Loop Tool using an unidentified dataset of one of the case studies.

The duration of each workshop is approximately two and a half hours. The program is presented below in Figure 4. The introduction clarifies terms such as learning analytics and learning design, and how they are connected. The first activity consists of a group discussion for participants to share the learning design of their courses and how they are represented in learning management systems. Then, one of the case studies is presented in order to illustrate how the Loop Tool can be used. The second activity consists of a group discussion for participants to consider some questions related to learning and teaching that they would like to ask about the course that has just been presented. At this point, the Loop Tool is presented to participants, including details on how to access a de-identified dataset that participants can explore. The third and the fourth activities ask participants to explore the tool and answer specific questions about the case study using the tool. The workshop concludes with recommendations related to the use of learning analytics and learning design in learning and teaching, and comments on future directions of the project and the Loop Tool.

10:00	Welcome
10:05	Introduction to the "Completing the Loop" project
10:20	Activity 1 – Learning design activity
10:30	Introduction to the case study
10:40	Activity 2 – Group discussion about the case study
10:55	Pedagogical helper tool
11:05	*Break*
11:25	Learning analytics tool
11:40	Activity 3 – Exploring the learning analytics tool
12:00	Activity 4 – Group discussion about the case study
12:20	Future directions and concluding remarks

Figure 4. Example of a workshop program for the Completing the Loop project.

Academic publications and presentations

Academic publications and presentations about the Completing the Loop project and its findings were constant throughout the duration of the project. Academic publications were accepted in internationally renowned conferences, such as the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE) and Learning Analytics and Knowledge (LAK) conferences. The list of these publications is presented below:

1. Bakharia, A., Corrin, L., de Barba, P., Kennedy, G., Gasevic, D., Mulder, R., Williams, D., Dawson, S., & Lockyer, L. (2016). A Conceptual Framework linking Learning Design with Learning Analytics. Proceedings of the sixth international conference on learning analytics and knowledge (LAK'16) in Edinburgh.

2. Corrin, L., Kennedy, G., de Barba, P., Bakharia, A., Lockyer, L., Gasevic, D., Williams, D., Dawson, S., & Copeland, S. (2015). Loop: A learning analytics tool to provide teachers with useful data visualisations. In T. Reiners, B.R. von Konsky, D. Gibson, V. Chang, L. Irving, & K. Clarke (Eds.), Globally connected, digitally enabled. Proceedings ascilite in Perth 2015 (pp. 409-413).

3. 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).

Presentations of the project were conducted as part of different events, usually as invited presentations. These included:

1. Corrin, L. (2016). Completing the Loop: A tool to return meaningful learning analytics data to teachers. ACODE 70 Workshop, Charles Sturt University.

2. Corrin, L. (2016). Learning analytics: delivering meaningful data to teachers and students, Information Technology Foundation for Education Conference, Estonia.

3. Kennedy, G., Corrin, L., & de Barba, P. (2015). Providing meaningful learning analytics at to teachers: a tool to complete the loop. In M. Hillier (Host), Transforming Assessment Webinar. Recording available at http://transformingassessment.com/events_9_december_2015.php

4. Lockyer, L. (2015). Completing the Loop: Returning meaningful learning analytic data to teachers. Project presentation at Macquarie University Learning and Teaching Week.

5. Kennedy, G., Corrin, L., Lockyer, L., Dawson, S., Williams, D., Mulder, R., Khamis, S., Copeland, S. & de Barba, P. (2014). Completing the loop: returning learning analytics to teachers, Australian Learning Analytics Summer Institute, University of Technology Sydney

Two journal articles are currently under preparation for submission. These include:

1. Findings from Phase One: "Teacher's needs and wants of learning analytics in higher education". To be submitted to the British Journal of Educational Technology.

2. Findings from Phase Three: "The Loop Tool: Three case studies". To be submitted to Computers & Education.

Website

The website created for the Completing the Loop project coordinates all outputs mentioned above and contains details on the project and project team. The website is available at http://melbourne-cshe.unimelb.edu.au/research/edutech/completing-the-loop

Project Findings

Advancement of Existing Knowledge

The Loop project has made several contributions to the advancement of existing knowledge in learning analytics and how universities can use student learning data to improve teaching and learning. When the project began there was only limited literature available on teachers' needs in terms of learning analytics. Many of previously developed learning analytics tools made little or no reference to the pedagogical design of learning activities. The Loop project aimed to build a learning analytics tool that acknowledged the importance of learning design in the interpretation of learning analytics. In doing so an outcome of the project has been the development of a conceptual framework bringing together learning analytics and learning design (see Figure 5). Within the framework, the teacher plays a key role in linking the teaching and learning context with the analysis of the data to inform decision making around feedback and course design. Bringing together teachers' enacted practice (i.e., learning designs) and different types of analytics in a framework like this can inform the development of analytics tools to provide more meaningful representations of data for teachers.

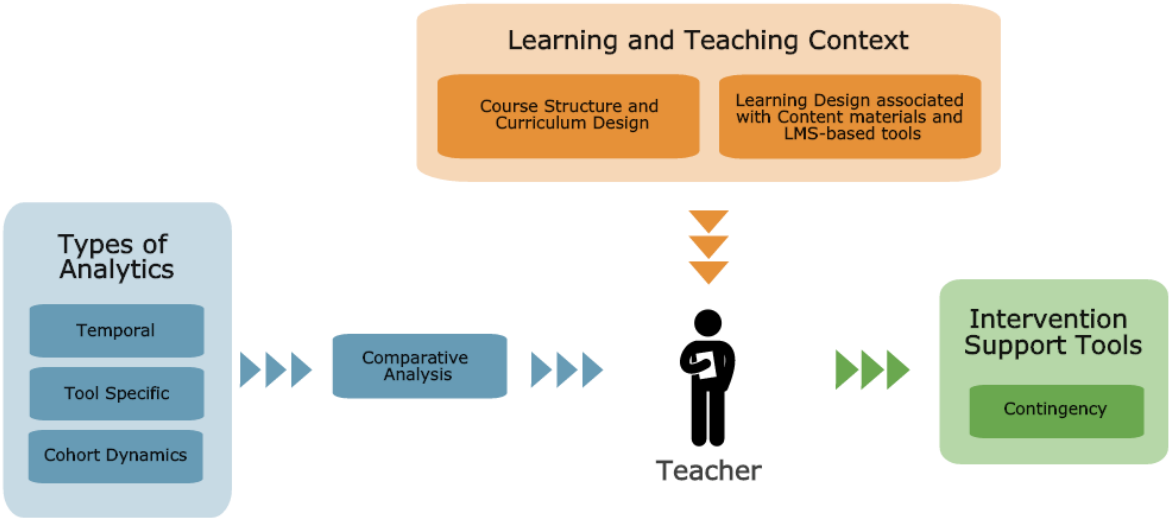


Figure 5. The learning analytics for learning design conceptual framework.

The current research with university teachers also revealed some fundamental tensions for the project, and with learning analytics more generally. First, while teachers were creating engaging learning activities for students in their courses, in the main, most of the deeply engaging, interactive elements of these designs were not delivered, captured or reflected through the LMS course sites because they were offline. Activities that students were asked to complete online were generally routine and transactional. Therefore the potential of learning analytics to capture students' engagement with interactive learning tasks is largely unrealised. A second tension in this project was that the difficulties identified by the teachers who were interviewed didn't align well with the challenges envisioned by the project team. Teachers' were more interested in using learning analytics for more fundamental purposes like determining engagement profiles, exploring patterns of clusters of students, and understanding the relation between patterns of engagement and performance.

An active area in current educational technology research and development is integrating the fields of learning design and learning analytics so that valid, robust interpretations of student activity can be made. The pedagogical helper component of the Loop Tool was designed to encourage this explicit connection. The technical development of the Loop Tool and its use in the pilot studies also exposed a range of factors that impact on the quality of the analytics data that are displayed. These include the ways teachers structure their courses in the LMS (both a 'macro' and 'micro' levels) and the choice of technological tool to support a given learning activity. These issues raise questions about the reliability and validity of learning analytics data, particularly when comparisons are made across courses or systems.

A central ambition of this project was to develop a learning analytics tool that would allow teachers to interrogate students' interaction with their online courses to create insights that

were actionable. This aim was somewhat hamstrung by technical issues associated with real-time data feeds. The question also arose about what constitutes a legitimate action, and for whom, based on the analytics provided by the Loop Tool. It is unclear what thresholds of student interactions with learning materials should prompt intervention actions and then what forms such interventions should take. This indicates the need for institutions to have in place clear guidelines about appropriate actions which are based on learning analytics data.

An observation from this project is that while there has been a rise in awareness of learning and academic analytics within universities, there is still a relatively limited understanding of how data in institutional systems can be used and for what purposes. Clearer articulation of the possibilities of learning analytics in supporting and enhancing teaching learning and assessment are needed. A grand challenge for the field is to be able to translate these possibilities into concrete, understandable and actionable proposals about how learning analytics can be used by university teachers everyday. Learning analytics also have the potential to serve as an important tool to stimulate interest in the scholarship of teaching and learning. This would hopefully have the multiple advantages of increasing the understanding of how digital learning environments work and are working for teachers and students, supporting teachers to reflect on and improve their professional practice, and providing evidence that can help to improve students' learning process and outcomes.

Disciplinary and Interdisciplinary Linkages

The project team has established linkages across the discipline areas of education, educational technology, learning analytics, psychology, cognitive science, academic development, computer science and data mining. The project was greatly enhanced by the inclusion of the expertise of Dragan Gasevic (computer science, educational technology, learning analytics) and Aneesha Bakharia (software engineering, learning analytics).

The project did not have the creation of disciplinary and interdisciplinary linkages as a central aim. However, it is expected that through the project's outcomes, and specifically, through the use of the Loop Tool, the project will foster linkages between a range of academic discipline areas and the fields of educational technology, learning analytics and the scholarship of teaching and learning.

Factors to Success

A number of factors contributed to the success of the projects, which include:

- Regular correspondence and communications between team members. Team meetings were held on a regular monthly basis between all team members. While critical in terms of providing a mechanism to allow all team members to contribute to the development and realisation of the project, it obviously also provided a practical focus for the project team's effort. Team meetings allowed the team leader

to communicate the status of the project and its components, and plan for the short- and mid-term activities the team needed to engage in. A formal agenda and minutes were taken to ensure a record of activities was kept.

- The core of the team was based in one location and this allowed more regular formal and informal meetings. In addition, when components of the project were being planned and implemented (e.g. case studies, software development), separate team meetings were organised around these components.
- Having a shared collective understanding of what was trying to be achieved generally, and across the components of the project was essential to success. While there was not always agreement about what needed to be done in the project, in general there was a shared understanding of the direction the project was heading, when a collective decision had been made.
- The project team had a diverse set of skills and considerable expertise in a range of areas. Capitalising on this diversity in completing components of the project was essential to the project success and allowed the team to share workload.
- The project team received significant support from their local institutions, generally, and particularly in interactions with learning technology systems. Support was also received from other Universities in Australia, particularly in hosting workshops that were critical to dissemination.
- The success of the project was in part due to project team members engaging in dissemination activities – formal and informal presentations – early on.
- The Office for Learning and Teaching (OLT) was understanding about the inevitable difficulties that cropped up and provided a project extension to allow the momentum of the work to continue.
- A key to success was the dedication, engagement and commitment of the project team.

A number of issues also impeded progress and success, which are summarised below:

- The human research ethics approval to undertake the case study research across the three institutions took longer than expected.
- A significant difficulty encountered by the project was that the technical development of the learning analytics tool took longer than expected due to the complexity of the task. This was in part because the project aimed to design a single tool to integrate with two learning management systems. While this caused a delay in the project it did not impede its overall success.

- Developing a complex software tool was a significant undertaking and was under-resourced by the project team in the original budget. This meant that components of the tool that were planned but were not resourced were not developed. It is likely that these components would have made it more successful.
- The delay in the software tool's development meant the project needed to push back data collection by one session/semester. As a result data collection with some project team members did not occur as planned.
- A number of individuals in the project team took on considerable additional responsibilities in their day-to-day employment over the course of the project. While all project team members maintained a resolute commitment to the project, this unavoidable situation did present challenges.

In many respects these reflections about the project successes and challenges are unsurprising. Complex, interdisciplinary, multi-site projects require considerable effort and attention in the area of project management. Applying the core principles of project management, some of which are touched upon above, will go a long way to ensuring project success regardless of the project team, the institutions involved, or the nature of project.

Link with Other OLT Projects

At the time that the Completing the Loop project was proposed, it related to the OLT priority area of "Innovative use of technology in teaching and learning". It addressed an item within this priority area by proposing a "creative use of existing innovations in learning and teaching in higher education" in that it leveraged existing LMSs and the data they contain to provide evidence to teachers to support their educational decision-making and action. The project built on the outcomes of a previous OLT funded project on the development of a tool to visualise student engagement data led by project team members Shane Dawson and Lori Lockyer *("Seeing" networks: visualising and evaluating student learning networks*). This previous project established the importance of learning design in the use and interpretation of learning analytics outputs, which became a main theme of the Completing the Loop project.

The Completing the Loop project ran in parallel with two large OLT commissioned projects on learning analytics. These were the University of South Australia-led project entitled "*Student retention and learning analytics: a snapshot of current Australian practices and a framework for advancement"* (which included several of the Completing the Loop project team members) and the Charles Darwin University-led project entitled "*Learning Analytics: Assisting Universities with Student Retention*". Both these projects explored the readiness for and implementation of learning analytics in Australian higher education and proposed frameworks for institutional adoption of learning analytics. The findings of these two projects indicated that many Australian universities are still in the early stages of planning

for learning analytics, which makes the release of the Loop Tool very timely for institutions to consider in their forward planning.

In 2014 the OLT funded a project led by the Queensland University of Technology entitled "*Enabling connected learning via open source analytics in the wild: learning analytics beyond the LMS*". This project developed a toolkit, known as the CLA Toolkit, which harvests data about student activity in social networks. As both the Loop Tool and the CLA toolkit are open-source and were initially developed by the same programmer there is potential for integration in the future. This would provide the potential to examine students' patterns of engagement and performance across university-provided learning management systems and externally through third-party social network applications.

Chapter 4 – Project Impact, Dissemination and Evaluation

Impact

The emerging literature in the field of learning analytics as well as the outcomes of the two OLT commissioned audits of learning analytics in Australian higher education indicate a strong climate of change within which this project fits. The impact of the project to date has been set out above in the Project Outcomes and Findings section of the report in terms of outputs, workshops and publications. Future impact and anticipated changes are set out in the table below (Table 3). The main ongoing tool to ensure impact is the project website which will be maintained for at least five years after the project is completed and will ensure access to information about the project and provide a link to the download site for the Loop Tool.

Dissemination

A strategy of ongoing dissemination has been adopted throughout the project. A website was established in 2014 to promote the project and its outcomes. This will continue to be an important dissemination vehicle for at least the next five years. In terms of face-to-face presentations, a work-in-progress paper was presented at the 2014 ASCILITE conference which described the project phases and presented the initial themes that had emerged from the Phase 1 interviews. Subsequent presentations at conferences and interest groups have highlighted the project progress and the outcomes of the project to national and international audiences. A full list of these events is included on page 24-25 of this document. In addition, the project is part-way through a workshop series to be presented across five states of Australia. Further detail about the workshops can be found on page 22-23 of this document.

Evaluation

A number of evaluation strategies were employed throughout the project. Formative evaluation processes included monthly meetings with all members of the team. These meetings had an agenda based on the timeline of the project, and relevant issues raised by team members. Meeting minutes were sent out to the team after each meeting. These documents included not only a summary of the meeting, but also tasks to be completed by specific team members, which fed into the next meeting agenda.

Additional timeline checks and updates were undertaken at critical points in the project to ensure that any issues were addressed and plans and timelines were revised accordingly. Regular updates were also given to the project reference group and their input sought on the project progress. Several meeting were also held with the project evaluator to update her on project progress, especially in the early stages to the project. The project evaluator

has also been present at conference presentations and has maintained regular contact with project team members throughout the life of the project.

The evidence gathered about the impact of the project has been in the form of attendance at workshops and conference presentations, citations of publications arising from the project, and visits to the project website. The project team have also received a number of emails from people who are interested in using the Loop Tool in their own institutions. This includes interest from overseas institutions. As the project draws to a close the project team will continue to monitor these metrics of impact as well as follow closely the adoption of the Loop Tool by institutions. Due to the open-source nature of the Loop Tool, it is hoped that a community can be established to continue the development of the tool into the future.

Table 3. Future Impact and Anticipated Changes Related to the Completing the Loop Project

	Project completion	Six months post-completion	Twelve months post-completion	Twenty-four months post-completion
1. Team members		The development of proposal for further research to build on the outcomes of this project		
2. Immediate students	Enhanced feedback from teachers using the Loop Tool			
3. Spreading the word	Academic publications accepted in high impact journals and presented at international conferences	Sustained high rates of website visits and project material downloads		Academic publications from the project with a high number of citations
4. Narrow opportunistic adoption	Promotion of the discussion around the provision of meaningful data to teachers			
5. Narrow systemic adoption		Inform university-wide learning analytics implementation planning		
6. Broad opportunistic adoption	Inform Australian universities about opportunities for learning analytics		Incorporation of Loop Tool with institutional learning analytics solutions	
7. Broad systemic adoption			Academic publications cited as evidence on using learning analytics across higher education institutions worldwide	

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Appendix A

Certification by Deputy Vice-Chancellor (or equivalent)

I certify that all parts of the final report for this OLT grant provide an accurate representation of the implementation, impact and findings of the project, and that the report is of publishable quality.

Name: Professor Richard James, Pro-Vice Chancellor (Academic) Date: 29 July 2016

Appendix B

External evaluator report

Completing the Loop: Returning meaningful learning analytic data to teachers

Background

The aim of this project was to develop a better understanding of learning analytics and the ways in which analytics can be interpreted, applied and actioned by teachers to improve teaching and learning practices. The project sought to identify common problems faced by teachers and students when learning online, to determine the types of learning analytics teachers would find useful to effectively address these problems. The intended deliverables of the project were achieved and include:

- A handbook entitled: "Completing the Loop: Returning Meaningful Learning Analytical Data to Teachers. A Handbook for Educators and Learning Analytics Enthusiasts".
- The Loop tool, an open source software compatible with Blackboard and Moodle.
- A technical framework on how to download and install the Loop tool.
- Six academic publications in internationally renowned conferences in the fields of educational technology and learning analytics [ascilite, Learning Analytics and Knowledge (LAK) conferences, and Australian Learning Analytics Summer Institutes (ALASI)].
- Workshop series entitled "The Loop Tool: Where Learning Analytics meets Learning Design" across five Australian states (Victoria, Queensland, New South Wales, South Australia and Western Australia).
- Website with information about the project and links to the Loop tool, handbook and academic publications:

http://melbournecshe.unimelb.edu.au/research/edutech/completingtheloop

The project brought researchers together from three universities: University of Melbourne (Lead), Macquarie University and University of South Australia. The agreed evaluation methodology was to undertake a review of how the project was conducted and to review the outcomes of the project. The key evaluation questions were:

1. Did the project achieve its stated objectives?

2. Was the project managed and conducted in ways that contributed to project success?

3. How could the processes associated with the project be improved?

The evaluation was to include participation in team teleconferences, participation in reference group meeting, meetings with project leader, project manager and project team members, and analysis of project management documentation and outputs from all three phases.

Evaluation Reflections

The evaluation was to take place between February 2014 and December 2015, but like most collaborative research projects there was an extension to August 2016. It took longer than originally projected to build and test the tool. The project team brought together ten Australian and international experts in learning analytics who had previously worked collaboratively together in addition of an international and national reference group. This was a team fully aware of each other's strengths and capabilities and had clear understandings of the project goals and strategies. The team was supported by a dedicated project manager Paula de Barba.

Formative Evaluation Strategies

In order to determine that the project's aims were achieved and outcomes were delivered, formative and summative evaluation strategies were conducted by the evaluator throughout the research. The evaluator was provided with access to the project team's shared document space on Dropbox and included in all project team communications. The evaluator participated in various communications of the project, including virtual and face to face project meetings and project emails.

Project Management

It has well known that effective project management practice incorporates principles that:

- Identify project requirements
- Establish clear and achievable outcomes
- Balance the competing demands for quality, scope, time and cost
- Manage the expectations of various stakeholders
- Adapt plans to overcome challenges

This project clearly evidenced these project management principles. In particular, the project had clearly defined outcomes and deliverables, and flexibility to fine tune and make adjustments to accommodate challenges. A wide range of stakeholder groups were involved in the project as sources of data. The combined experience of the project team members from working together on an earlier projects was also an obvious asset and strength in their abilities to keep the project performing on scope and to high quality.

Achievement of Outcomes

The three phases of the project involved firstly structured interviews with twelve university lecturers/teachers from the three participating universities designed to understand what types of analytics they would find useful for curriculum design and to assist in addressing any educational challenges faced in their teaching. The second phase was the actual development of an open-source, web based tool (the Loop Tool) designed to visualise meaningful data from learning management systems (Blackboard and Moodle) to assist in creation of learning design. The third and final phase was the testing and evaluation of the Loop tool with teaching staff at each of the three partner universities.

Clearly the development, launch, testing and evaluation of the open source Loop Tool was a significant achievement for the project. As more educators test the tool and review the handbook created from this project, the greater the impact on the advancement of the use of learning analytics in educationally-informed ways. This will enable continuous improvement and expansion of the tool to inform and improve teaching practice.

Identified needs and wants of Australian higher education teaching academics related to the use of learning analytics in their teaching practice, based on twelve in-depth interviews across three Australian universities and available literature. Developed and launched an open source software compatible with the most widely used learning management systems in Australia (Blackboard and Moodle) for teachers to make sense of their learning analytics.

Reached over 600 educators in Australia and worldwide through the delivery of seminars, webinars, workshops and paper presentations related to the project. These highlighted the on the importance of learning analytics and learning design to improve learning and teaching in the higher education sector. Over 1,000 students were involved in the testing of the tool via the three case studies.

A significant finding from the project was discovery of continued tensions of how learning analytics is being used in education. In some cases there is still not clear alignment between educational objectives and design of learning activities and how this is represented through technological tools such as the LMS. Another major finding was the description of the range of factors that impact on data quality of any analytic tool, including how staff structure subjects/courses at both the macro (structure and curriculum) and micro (learning activities) levels. Good learning design is at the heart of good analytic data.

The handbook developed is an excellent introduction and primer on learning analytics and how learning analytics can be implemented in a thoughtful and educationally meaningful manner. The intended audience for the handbook includes academic teaching staff, educational design staff and information technology management and developers.

Six academic conference presentations were conducted a conferences both in Australia and internationally, while the workshop series reached over 600 educators.

One next step in the wider evaluation of the tool would be to gather feedback from students on how they perceive the use of analytics and how the impact for them on their learning.

Summary

The project activities ensured that a large number of stakeholders were not only consulted in developing the findings, but were also engaged with the critical question of how to use learning analytics in meaningful educational ways. This project team was a pleasure to work with due to the experience, respect and willingness of the team to engage with and learn from others. It was a highly competent and well led team that achieved not only its project outcomes but has also extended impact in a range of areas and ways. The relationships that have been formed during this project are a key strength and will be an asset for the endurance of the project work already commenced into the future.