



Learning analytics: a bottom-up approach to enhancing and evaluating students' online learning

Final Report 2014

University of New England

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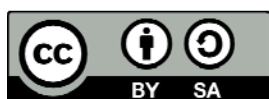
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List of acronyms used

ANZAM	Australia and New Zealand Academy of Management
LMS	Learning Management System
OLT	Australian Government Office for Learning and Teaching
UNE	University of New England

Executive summary

This project explored the potential for enhancing students' learning experiences by utilising data from a learning management system (LMS) in an innovative way to inform practice. It closely aligned with the OLT Seed Project Priority Area: Innovation and development in learning and teaching, including in relation to the role of new technologies.

Identified outputs:

- a critical evaluation of the assumption that analytics can be utilised at the subject level to inform teaching practice in real time leading to lower attrition, increased student engagement and satisfaction, and higher success rates within the subjects; and
- an evaluation of student perceptions on the use of analytics as an indicator for the need for interventions, and the value of the interventions provided.

The project evaluated the effectiveness of utilising learning analytics to inform effective 'real time' delivery of tailored learning resources and activities (interventions) to students identified as being at risk of non-completion or failing selected business subjects offered by distance education at the University of New England (UNE). Three subjects were included in the study, one undergraduate and two postgraduate.

Prior to the commencement of teaching, each subject was reviewed to identify key points during the teaching period where tracking data available in the LMS could be utilised to inform interventions which were considered to be of most value to students. The interventions were then developed specifically for each subject. The lecturer delivering the subject was responsible for managing the interventions and each was personalised to the student (as opposed to automatically generated communications). Across the three subjects, 248 students were enrolled and 90 of these students received at least one intervention.

Student activity following the interventions was reviewed to determine the resulting impact of each prompt. Final results and student evaluation surveys were also examined and compared to the previous year's offering for the same subject. Students were surveyed at the end of the teaching period to determine their perceptions of the interventions including their value and impact on behaviour. The survey was followed by a series of in-depth interviews conducted with students who were part of the project.

Conclusion

This project has demonstrated the value of utilising learning analytics by teaching staff to track students' activities and inform interventions to support students, especially in terms of increasing student satisfaction and engagement. Results related to higher success rates and lower attrition were not significant across the subjects studied.

Recommendations

From the results of this seed project it is recommended that:

- Teaching staff identify and contact 'at risk' students early in the teaching period to increase engagement and assist with problems which may impede their studies.
- Teaching staff utilise learning analytics to inform teaching practice during the period of study.
- Opportunities for more efficient management of interventions be investigated.
- Further research be undertaken to investigate the potential benefits of learning analytics at the subject level.

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1: Background and context

There is increasing pressure, both internal and external, for universities to improve student retention, outcomes and satisfaction. The use of learning analytics in real time to track students' activity in learning management and related systems has the potential to inform interventions aimed at addressing these concerns.

With data capture becoming more prevalent and customisable, higher education institutions are following a business intelligence system approach to capture and analyse data to provide support and flexible options for students (Fisher, Valenzuela & Whale, 2012). The New Media Consortium describes learning analytics as "an emergent field of research that aspires to use data analysis to inform decisions made on every tier of the educational system" (New Media Consortium, 2013, p. 24). However, Siemens and Long (2011) make a clear distinction between academic and learning analytics:

Learning analytics is more specific than academic analytics: the focus of the former is exclusively on the learning process. Academic analytics reflects the role of data analysis at an institutional level whereas learning analytics centers on the learning process (which includes analyzing the relationship between-learner, content, institution and educator) (p. 2).

Learning analytics is generally accepted as being at the level of the school or department and the learner, rather than at the institutional level. Lodge identifies levels of analysis including engagement with course material, course satisfaction and academic capacity at the micro level which uses the LMS as the significant data source (Lodge, 2012, p. 824). Learning analytics is focused on the data students leave behind in the learning process, and utilises this learner activity or 'traces', to improve success for students through provision of support or adaptive learning processes. "A concern with improving learning is foundational within the field of learning analytics" (Clow, 2012, n.p). Clow (2012) further suggests that "learning analytics data should focus on the valued aspects of the learning process" (n.p). Lodge (2012) argues that "any approach to managing student attrition should not just be about keeping students in higher education, it should be about enhancing learning outcomes" (p. 823).

Concerns about the use of learning analytics include suggestions that it may lead to a reduction in the personal role of lecturers in supporting and challenging students to improve learning (Siemens and Long, 2011). These authors also caution that utilising learning analytics may revert learning to behaviourist approaches (Siemens and Long, 2011). A constructivist approach, as described by Laurillard (2002) for example, relies on how students interact with knowledge - not necessarily something which can be quantified. Lodge and Lewis (2012) caution that "[t]he amount of time students spend on the LMS is not an indication of deep or surface learning" (n.p). 'Learning to learn' is another skill that may be at risk if students are disempowered through the application of learning analytics (Shum & Ferguson, 2011). Elias (2011) notes that "[a]ccumulated knowledge related to areas such as learning theory, sound pedagogical practices, building knowledge communities, student motivation, and student retention is also essential in learning analytics" (p. 14).

While analytics is increasingly utilised at an institutional level with success (see University of Purdue: Course Signals – Spotlight for Success; University of New England: Early Alert Program), the application of learning analytics as a bottom-up or lecturers-led approach is less obvious in reported research and, we suggest that this approach goes some way to addressing the concerns raised about the use of learning analytics.

When viewed from a bottom-up perspective the link between the application of learning analytics with learning design and the role of lecturers is highlighted. In previous research (Fisher, Valenzuela & Whale, 2012; Lockyer & Dawson, 2011) the impact of learning design on the usefulness of the data provided by learning analytics has been identified. The

learning design of a subject needs to incorporate key points, particularly early in the teaching period, where learning analytics will provide meaningful data to inform support or intervention strategies initiated by lecturers that have the potential to influence student behaviour and outcomes.

Learning designs articulate a sequence of learning activities, what resources are used by learners engaged in those activities, and how the teacher or other participants in the experience support the learning activities (Lockyer & Dawson, 2011, p. 153).

Learning analytics provides data related to students' interactions with learning materials which can inform pedagogically sound decisions about learning design. As Lockyer and Dawson (2011) point out "learning analytics takes up where learning design finishes in the educational experience continuum" (p. 153).

Rationale

Our review of the literature on the use of analytics in higher education demonstrated that most research has focussed on evaluations of the effectiveness of practice at the end of the teaching period and/or provides generalised interactions prompted by key identifiers developed from historical student activity. However, the use of analytics to inform teaching approaches and real-time interactions between lecturers and students at the subject level is less common.

Online delivery of subjects is increasingly common, however, this method of learning and teaching creates particular challenges in supporting students throughout the teaching period. With more than 80% of students enrolled at UNE studying by distance education facilitated through a LMS, this project explored an innovative approach to addressing this problem.

This seed project aimed to achieve what Siemens and Long (2011, p. 3) identify as the real potential of learning analytics: "Analytics in education must be transformative, altering existing teaching, learning and assessment processes, academic work and administration". The objective was to use learning analytics to identify key indicators and points in time during the teaching period where personalised contact with students may be beneficial. These indicators were used to inform teaching practice including targeted, direct interactions between lecturers and students aimed at encouraging increased student engagement and providing further assistance in their learning. These interactions consisted of a set of interventions managed by lecturers (hence a bottom-up approach). They were personalised and not simply computer generated and invited students to contact the teaching staff for further support.

The project investigated the value of these interventions by measuring engagement levels of students and comparing student completion and success rates with previous offerings of the subjects. Students' perceptions of the use of this data to prompt interactions as well as the usefulness of the interventions to their learning was also explored. This project is an example (on a small scale) of innovation and development in learning and teaching which has the potential to be extended to a wide range of disciplines and subjects.

2: Project outcomes and impacts

The key outputs identified for this project were:

- a critical evaluation of the assumption that analytics can be utilised at the subject level to inform teaching practice in real time leading to lower attrition, increased student engagement and satisfaction, and higher success rates within the subjects;
- an evaluation of student perceptions on the use of analytics as an indicator for the need for interventions, and the value of the interventions provided.

Strategies

This project explored the use of learning analytics by the lecturer to enhance students' online learning experience and satisfaction in one undergraduate and two postgraduate subjects with a combined enrolment of 248. All subjects were offered in the first teaching period in 2013 and two were taught exclusively online via a LMS. The third subject was taught in both fully online and on-campus modes, however, the study was limited to students enrolled via the fully online mode.

The project began with a review of the learning design of the subjects prior to the commencement of the teaching period to ensure there were key points at which learning analytics could be employed to identify students who met criteria deemed to put them at risk of not succeeding in the subjects.

Learning analytics were utilised to inform interventions, including the offer of additional support, for students meeting these defined criteria. We focused on behaviours early in the teaching period so there was sufficient opportunity for targeted students to succeed in the subjects. The behaviours identified were: no (or limited) access to the learning materials in the first two weeks of the teaching period, non-participation in an early learning activity, no access to assessment tasks two weeks prior to due dates and non-completion or low grades in an early assessment task.

Of the 248 enrolled students, 90 were identified as meeting one or more of the above behaviours and received interventions. Twenty of these students were contacted twice and two were contacted three times.

Results

Key points and behaviours targeted

Intervention 1: First two weeks of Trimester – no access to the LMS and learning materials for over seven days.

Intervention 2: Early assessment tasks – reminders prior to due date and poor results or non-completion.

Intervention 3: Major assessment tasks – limited or no access to assessment information for over seven days prior to the due date.

The interventions and timing varied across the subjects as each subject had a different set of assessment tasks and due dates.

For students who met the criteria identified, personalised interventions were developed and implemented by the teaching staff responsible for the delivery of the subject.

Table 1 below summarises the results of each intervention.

Table 1: Results of Interventions (adapted from Whale, Valenzuela and Fisher, 2013, p.909).

Behaviour	Intervention	Result
No access to LMS for over seven days during first two weeks of the trimester	<p><i>INTERVENTION 1</i></p> <p>43 students were contacted to remind them to set up study plan and check if there were issues</p> <p>The subjects involved were:</p> <ul style="list-style-type: none"> - MM110 – 17 students contacted - GSB731 – 9 students contacted - GSB751 – 17 students contacted <p>17 Students were contacted by phone and 26 by email</p>	<p>MM110 – all 17 had multiple access</p> <p>GSB731 – multiple access by 8 (one student planned to withdraw)</p> <p>GSB751 – multiple access by 15 (two students indicated they planned to withdraw when contacted)</p> <p>Across the three subjects 30 of these students successfully completed</p>
No access to LMS for over seven days before assignment due day of an early non compulsory assessment task	<p><i>INTERVENTION 2.A</i></p> <p>Personal emails were sent to students to remind them about the first assessment due date and to offer additional support</p> <p>The subject involved was: GSB751 – 18 students contacted</p>	<p>Two students replied thanking the lecturer for getting in contact with them</p> <p>Only nine students subsequently attempted this optional activity, however, 16 of the 18 students contacted successfully completed the subject</p>
Did not complete or did not receive full marks for the early non compulsory assessment task	<p><i>INTERVENTION 2.B</i></p> <p>Personal emails were sent to students to offer additional assistance</p> <p>The subject involved was: GSB751 – 22 students contacted</p>	<p>20 of these students went on to successfully complete the subject</p>
No access to LMS for over seven days before assignment due date of a major assessment task	<p><i>INTERVENTION 3</i></p> <p>Personal emails were sent to 14 students to remind them about the first assessment due date and to offer additional support</p> <p>The subject involved was: MM110 – 14 students contacted</p>	<p>Three students replied thanking the lecturer for the information</p> <p>Five students subsequently submitted the assessment and successfully completed the subject</p>

While it cannot be claimed that the interventions were the sole cause for the completion rates above, student responses to the survey suggest that they were beneficial in increasing engagement and keeping them on track. Results in terms of higher success rates and lower attrition were less clear as we had insufficient data to make meaningful comparisons with past offerings of these subjects. At the end of the teaching period we reviewed students’

outcomes. Of the 90 students who received interventions, 55 successfully completed, 16 withdrew prior to census date, 7 withdrew post-census, 7 did not complete and 2 failed.

Students who had received interventions were surveyed at the end of the teaching period in order for us to assess whether the students believed the interventions influenced their behaviour and whether they believed the interventions had an impact on their learning experience. This survey had a response rate of 20.69% and respondent feedback is described below.

Initial prompt

Students who had not accessed (or had very limited access to) the LMS in the first two weeks of the teaching period were contacted by phone or, if they could not be contacted by phone, an email was sent addressed to the student using their first name and signed by the lecturer. Table 2 below summarise students' responses.

Table 2: Student responses to initial prompts

	Strongly disagree (%)	Disagree (%)	Neither agree or disagree (%)	Agree (%)	Strongly agree (%)
The initial prompts regarding getting started were useful in motivating me to commence my studies	0	8.3	8.3	58.3	25.0
The initial prompts regarding getting started encouraged me to contact the lecturer	0	8.3	33.3	41.7	16.7
The initial prompts regarding getting started made me feel that the lecturer was approachable	0	0	16.7	50.0	33.3

Overall, responses to this initial prompt demonstrated that this intervention was positively received by the majority of students and suggests that it was successful in encouraging engagement with the learning materials early in the teaching period. Responses to the second and third statements also suggest that social presence – “the ability of participants to identify with the community, communicate purposefully in a trusting environment, and develop inter-personal relationships by way of projecting their individual personalities” (Garrison, 2009, p. 352) – was enhanced for most of these students since 58% of students felt encouraged to contact the lecturer and 83% expressed the view that the lecturer was approachable.

Messages from the lecturer

There were three points at which this intervention was implemented. First, for students who did not complete the non-compulsory early task which had a weighting of 5%, second, for students who received $\leq 60\%$ in the online test (which was worth 20% of the final mark), and third, for students who had not accessed the assessment task two weeks prior to the due date. Each student was sent a personalised email from the lecturer which contained an invitation to contact them to discuss any problems they were experiencing. Table 3 below summarise students' responses to these messages.

Table 3: Student responses to messages from the lecturer

	Strongly disagree (%)	Disagree (%)	Neither agree or disagree (%)	Agree (%)	Strongly agree (%)
Messages from the lecturer were useful in terms of keeping on track in my studies	0	0	8.3	58.3	33.3
Messages from the lecturer motivated me to continue with my studies	0	0	16.7	50.0	33.3
Messages from the lecturer encouraged me to check the online learning system more often	0	0	16.7	58.3	25.0
Messages from the lecturer encouraged me to participate more often in the forums/ discussions	0	0	25.0	50.0	25.0
Messages from the lecturer were useful in terms of preparing for my assignment tasks	0	0	8.3	41.7	50.0
Messages from the lecturer made me feel that lecturer cares about my progress	0	0	0	50.0	50.0

Overall, students' responses suggest this intervention was positively received by the majority of students. Notably, over 90% of students reported that the contact from the lecturer assisted in keeping them 'on track' with their studies and was useful in preparing for assignments. All students responded that they felt the lecturer cared about their progress. This table suggests that social presence was also enhanced.

Interactions with the lecturer

This section of the survey probed students' perceptions of the effect of the interventions described above on their learning experience in the subject.

Table 4: Student responses to interactions with the lecturer

	Strongly disagree (%)	Disagree (%)	Neither agree or disagree (%)	Agree (%)	Strongly agree (%)
The interactions with the lecturer improved my learning experience	0	0	8.3	58.3	33.3
The interactions with the lecturer made me feel more satisfied with the subject	0	0	16.7	41.7	41.7

We were pleased that over 90% of students responded that their learning experience was improved by the interactions with the lecturer and over 80% indicated that the interventions make them feel more satisfied with the subject.

Figure 1 below summarises the results across the three different subjects. The difference in responses may be due to the level of students' previous study experience. Respondents in MM110 and GSB731 had completed fewer subjects than students enrolled in GSB751 suggesting that the interventions may have been most effective for less experienced students. Further research involving a larger sample is needed to confirm this.

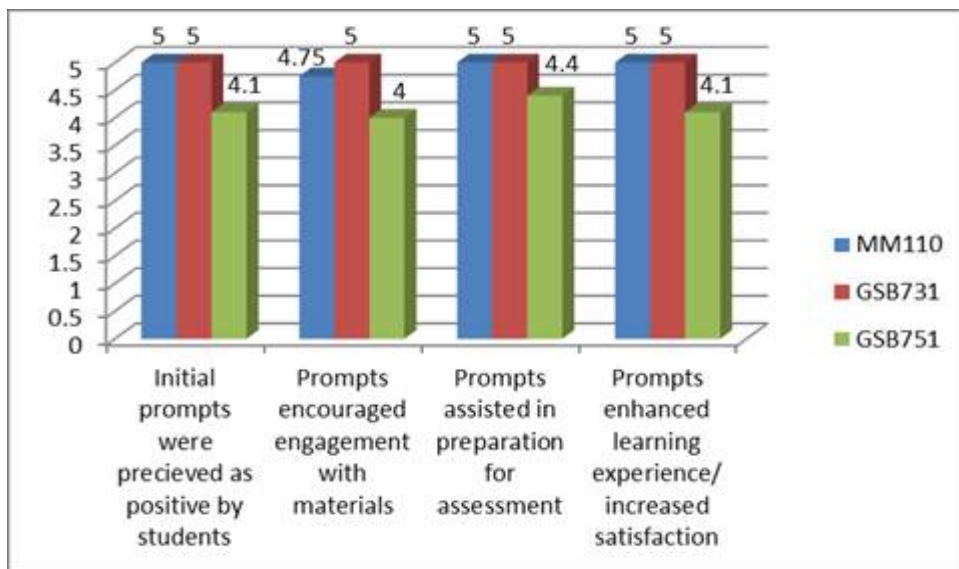


Figure 1: Targeted students survey results (reproduced from Whale, Valenzuela and Fisher, 2013, p. 910).

In order to be able to compare the overall learning experience of students who received interventions with those who did not, we also surveyed students who were not contacted as part of the project. This survey had a response rate of 25.27%.

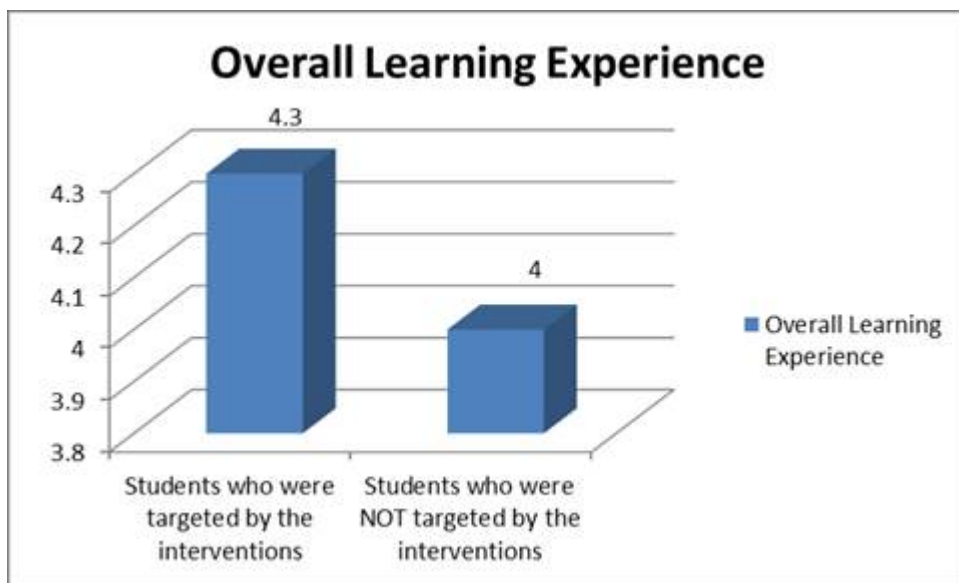


Figure 2: Results of end of trimester survey (out of 5) (reproduced from Whale, Valenzuela and Fisher, 2013, p. 911).

As can be seen in Figure 2, those students who received an intervention rated their learning experience higher than those who did not, even though the ratings for both cohorts were high.

Following the teaching period, nine follow-up in-depth interviews were undertaken. This sample size was determined by the willingness of students to take part in the interviews. Eight of the nine students were enrolled in GSB751 and one was enrolled in GSB731.

The interviews covered issues related to the process of the interventions and the impact of the interventions, as well as to the use of private information by the university. Thematic content analysis was undertaken to explore the themes and issues emerging from the interviews.

In relation to the interventions, all respondents considered they were appropriate in terms of both their number and timing (e.g., *“it’s [the communications] always helpful, it’s good to have something going on”*, *“it was sufficient without being too much”* and *“the timing was very helpful”*).

When asked about their preferred method of communication with the lecturer, five out of nine respondents mentioned that they preferred to receive messages through the LMS because it is much simpler. Five of the respondents commented that it takes too much time to check emails that are sent to a UNE email address. One surprising result was that eight respondents reported that the interventions had not changed their study patterns, however, five of these students also reported increased communications with the lecturer because of the interventions.

Another aspect that was investigated during the in-depth interviews was ethical issues associated with the use of student information by universities. All nine respondents reported that they did not have any concerns related to the usage of data contained in the LMS (e.g., *“I do not have any privacy problems going on”* and *“I guess the university is big enough and they’ve put appropriate privacy protections in place”*). Interestingly, all nine respondents also said that they did not recall giving permission to the university to use information in the LMS, but they assumed they did so when clicking one of the boxes included in the online enrolment process (e.g., *“I do not recall giving UNE permission”* and *“I suspect I probably did”*).

3: Conclusions

In this project we have demonstrated that when learning design facilitates the meaningful use of learning analytics, it is possible to influence students' behaviour in ways that increase their engagement with the learning materials and their overall satisfaction. The learning design is important in establishing key points, particularly those that occur early in the teaching period, where feedback on student behaviours can highlight opportunities to improve their chances of success and overall learning experience. The project developed personal interactions and did not employ computer-generated communications, although this could be beneficial to reduce the workload impact that resulted from the manual and personalised process used in this project. There would, however, still be a time commitment for teaching staff to facilitate the further support provided to these students. A larger project would be required to further investigate the finding of this project to develop a justification for institutions to provide additional support to teaching staff to engage in higher levels of student contact and support.

Lessons learnt

- The process of tailoring and delivering the interventions proved time consuming.
- While the LMS is able to provide data on student behaviour that has been utilised to target interventions, the lack of sophisticated technological capacity of the system required extensive manual review of the data and determination of interventions required.
- The processes followed during the project have highlighted the type of support that would be most beneficial for teaching staff in providing tailored learning interventions for at-risk students.
- There was a demonstrated increase in student engagement and satisfaction, however, it is unlikely that the resources required to achieve these outcomes could be made available across all subjects taught in the UNE Business School. Our next project will be to identify how the same outcomes might be achieved with fewer resources.

Challenges met

As noted above, the manual processes required to action the interventions have taken more time than anticipated and without the support of the Grant would not have been possible.

4: Dissemination

During 2013 the project team participated in two OLT dissemination events: the eAssessment Scotland 2013 Transforming Assessment conference in August and the Education Research and the Student Learning Experience in Business conference in Melbourne in December. In addition, we produced two refereed conference papers which were presented at ascilite and ANZAM in December 2013.

At least one team member will be presenting a workshop at the Institutional Strategies for Blended Learning: Overcoming the challenges of implementing institution wide innovation in Sydney at the end of March, 2014.

It is anticipated that an article reporting the outcomes of this project will be submitted to a refereed journal in 2014. A workshop for the UNE Business School is planned for early in 2014.

The OLT dissemination events in particular were interactive sessions with an extended timeframe allowing discussion regarding implementation of the strategies employed and consideration of the issues encountered in the project. The workshop to be held in March 2014 as part of the Institutional Strategies for Blended Learning: Overcoming the challenges of implementing institution wide innovation conference in Sydney will provide an opportunity for participants to engage in the processes identified through this project and determine the viability of this approach to their own institutions.

References for outcomes:

Fisher, J., Valenzuela, F-R., & Whale, S. (2013, December). *Learning analytics: A bottom up approach to enhancing and evaluating students' online learning*. Presentation at Higher Education Research & the Student Learning Experience in Business (Office of Learning and Teaching Dissemination), Melbourne, Australia.

Whale, S., Fisher, J., & Valenzuela, F. (2013, December). Using learning analytics to inform interventions for "at risk" online students. In *Managing on the Edge. Proceedings 27th Australian and New Zealand Academy of Management Conference*, pp. 1-11.

Whale, S., Valenzuela, F-R., & Fisher, J. (2013, December). Implementing timely interventions to improve students' learning experience. In H. Carter, M. Gosper & J. Hedberg (Eds.), *Electric Dreams. Proceedings ascilite 2013 Sydney*. pp. 908-912.

Fisher, J., Valenzuela, F-R., & Whale, S. (2013, August). *Learning analytics: A bottom up approach to enhancing and evaluating students' online learning*. Presentation at eAssessment Scotland 2013 Transforming Assessment (Office of Learning and Teaching Dissemination), Online. Available from: http://www.transformingassessment.com/eAS_2013/events_30_aug_2013.php

References

- Clow, D. (2012). The learning analytics cycle: Closing the loop effectively. *LAK12*. Vancouver, Canada.
- Elias, T. 2011. *Learning analytics: Definitions, processes and potential*. Retrieved from <http://learninganalytics.net/LearningAnalyticsDefinitionProcessesPotential.pdf>.
- Ferguson, R., & Buckingham Shum, S. (2012). *Social learning analytics: Five approaches*. In Proceedings of the 2nd International Conference on Learning Analytics & Knowledge (LAK12). Vancouver, BC, Canada.
- Fisher, J., Valenzuela, F., & Whale, S. (2012). *Enhancing distance education student outcomes using learning analytics: A case study*. ANZAM. Perth, Australia.
- Garrison, D.R. (2009). Communities of inquiry in online learning: Social, teaching and cognitive presence. In Howard, C. et al (Eds.), *Encyclopedia of distance and online learning* (2nd edn.). Hershey, PA: IGI Global.
- Laurillard, D. (2002). *Rethinking university teaching – a conversational framework for the effective use of learning technologies*. (2nd edn.). London: Routledge Falmer.
- Lockyer, L., & Dawson, S. (2011). *Where learning analytics meets learning design*. Proceedings of the 2nd International Conference on Learning Analytics and Knowledge. United States: ACM.
- Lodge, J. (2012). *What if student attrition was treated like an illness? An epidemiological model for learning analytics*. Proceedings of ascilite 2012: Future Challenges, Sustainable Futures. Wellington, New Zealand.
- Lodge, J., & Lewis, M. (2012). *Pigeon pecks and mouse clicks: Putting the learning back into learning analytics*. Proceedings of ascilite 2012: Future Challenges, Sustainable Futures. Wellington, New Zealand.
- New Media Consortium (NMC). (2013). *NMC Horizon Report 2013 Higher Ed Edition*. Austin, Tx: New Media Consortium. Retrieved from <http://www.nmc.org/pdf/2013-horizon-report-HE.pdf>
- Siemens, G., & Long, P. (2011). Penetrating the fog. Analytics in learning and education. *Educause Review*, 46(5). Retrieved from <http://www.educause.edu/EDUCAUSE+Review/EDUCAUSEReviewMagazineVolume46/PenetratingFogAnalyticsinLe/235017>
- University of Purdue. Course Signals – Stoplights for Student Success.
- University of New England. Early Alert Program.
- Whale, S., Valenzuela, F-R., & Fisher, J. (2013). Implementing timely interventions to improve students' learning experience. In H. Carter, M. Gosper and J. Hedberg (Eds.), *Electric Dreams. Proceedings ascilite 2013 Sydney*. (pp. 908-912).