Enhancing Distance Education Student Outcomes Utilising Learning Analytics:

A Case Study

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ABSTRACT

In this paper we identify strategies, informed by learning analytics, which lecturers can adopt at the subject level to ensure students have the best possible opportunity to successfully complete their studies. This approach also has the potential to enhance outcomes for the institution through increased student satisfaction and decreased attrition. Our aim is to identify key points in the teaching period for interventions that will have the most impact on student outcomes and describe appropriate interventions. We focus on one particular subject as a case study, however, our findings are likely to be generalisable across a range of subjects and disciplines.

Keywords: business education; e-learning; learning environment / climate; performance standards / measures / assessment

INTRODUCTION

In the current higher education climate the theme of this conference, managing for volatility and instability, is equally relevant to universities as it is to other kinds of organisations. Not only are universities expected to prepare students to operate successfully in this environment, but they must also respond to the volatility and instability in the higher education sector. One way universities have responded to this rapidly changing environment is through the use of analytics. They are increasingly following the approach adopted by business intelligence systems to capture and mine data in order to tailor support and provide learning flexibility for students.

In this paper we consider strategies, informed by learning analytics, that lecturers can adopt at the subject level to ensure students have the best possible opportunity to successfully complete their studies. The adoption of these strategies will also have the potential to enhance outcomes for the institution through increased student satisfaction and decreased attrition. The aim of our research was to identify key points in the teaching period for interventions that will have the greatest impact on student outcomes and to design appropriate interventions. We focus on one particular subject as a
case study, however, our findings are likely to be generalisable across a range of subjects and disciplines. The paper is divided into four parts: First, we provide a brief overview of learning analytics, second, we describe the subject that is the focus of our case study and provide an analysis of students’ results together with their activity in the learning management system (LMS) and, finally, we identify interventions for future offerings of the subject.

The aim of this study was to draw on data easily accessible from the LMS to identify key points for interventions and to formulate these interactions with students at critical points in the teaching period. These interventions, to be incorporated in the next offering of the subject, are intended to assist in keeping students on track, reduce attrition and increase their chances of success in terms of final results. An evaluation will be conducted following the interventions to assess their effectiveness.

LEARNING ANALYTICS

As data capture becomes more prevalent and customisable, educational institutions are following the approach adopted by business intelligence systems to capture and analyse data to provide more informed support and learning flexibility for students. Many institutions employ some form of analytics to examine student cohorts and predict demographics to better focus efforts in developing strategic direction as well as analysing data to identify 'at risk' students who may need additional support to be successful in their studies.

Analytics, according to Elias (2011) and Shum and Ferguson (2011) applies business intelligence principles and tools to academia focusing on building systems to enable the capture and interpretation of data to predict appropriate services which may be useful to individuals and optimise learning. Two distinct forms of analytics can be utilised by educational institutions – academic
analytics and learning analytics. Siemens and Long (2011, p. 2) make a distinction between these two forms of 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).

The use of learning analytics is becoming more prevalent in educational institutions where learner data and behaviour tracking can inform learning and teaching practice. The 2012 Horizon Report identifies learning analytics as an emerging environment for higher education in the next 2-3 years (NMC, 2011). According to Ferguson and Buckingham Shum (2012, p. 1),

[1]earning analytics shift the perspective from that of the institution gathering data about learners in order to inform organizational objectives, to that of providing new tools for the learner and teacher, drawing on experience from the learning sciences with the intention of understanding and optimizing not only learning but also the environments in which it takes place.

For Brooks, Greer and Gutwin (2012, p. 1), “[t]he goal of learning analytics is to provide insight into learners based upon their activity in e-learning systems”. The use of these technologies is common in universities in the developed world, however, there is little evidence of their effectiveness in improving student outcomes (Phillips, Maor, Cumming-Potvin, Roberts, Herrington, Preston, Moore & Perry, 2011, p. 1). Moreover, the projects discussed in the literature commonly fail to use the data to inform teaching and learning practice in real time. In order to realise its potential, Siemens and Long (2011, p. 3) argue that “[a]nalytics in education must be transformative, altering existing teaching, learning and assessment processes, academic work and administration”.

While opportunities exist for achievement of these important benefits for students, there are also potential costs involved in the use of analytics. Ethical issues are a common concern in the collection and use of student data, privacy, stewardship and information sharing; staffing of programs to manage and create or implement appropriate analysis programs can be inhibitive and require organisational support; and lack of consideration for contextual factors which cannot be applied in an analytic program must be considered.

This study involved manual interpretation of data, which is feasible for one unit of study, and there are generalisations which can be inferred from this analysis. However, analysis on a wider scale would be costly and time consuming and generalisations are not always appropriate due to contextual factors (as identified above). As the use of analytics matures, data gathering will be automated thus providing a rich source of data that can be utilised. Siemens and Long (2011) also pose concerns relating to 'gaming of the system' in terms of measurement of teacher effectiveness which they suggest may not lead to the promotion of meaningful learning. Analytics may devalue the personal role of teachers and tutors in stretching and challenging learners (Siemens & Long, 2011). These authors also highlight issues such as a risk of returning to a behaviourist approach to learning (Siemens & Long, 2011), while Shum and Ferguson (2011) caution that analytics may contribute to disempowerment of learners by reducing 'learning to learn' skills and result in an acceleration of the commercialisation of education. Campbell, DeBois and Oblinger (2007) raise the issue of student choice in terms of participation while 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). In this project we have kept these potential problems in mind in designing our interventions.
METHODS

In order to structure our project, we drew on the approach identified by Siemens (2011, n.p.) which involves the use of analytics to make predictions based on historical student activity and, drawing on these predictions, we have undertaken a process of adaptation, personalisation and intervention to enhance learning and teaching in the next offering of this subject. This approach also incorporates Clow’s (2012, p. 1) “Learning Analytics Cycle” which identifies four steps: identifying learners; generating data; using this data to produce metrics, analytics or visualisations; and using the outcomes to inform interventions thereby closing the loop and beginning a new cycle of learners, data, metrics and interventions.

The research questions that guided our study were:

1. “What inferences can be drawn from an analysis of students’ outcomes in the first two assessment tasks that could inform subsequent offerings of the subject?” In order to answer this question we compared the marks students achieved for each assessment task and compared this to their final marks in order to identify key points where interventions are likely to be most effective.

2. “To what extent is participation in the LMS a predictor of overall achievement in the subject?” In order to answer this question we extracted the logs of activity for a sample of students and compared the level of activity with marks achieved by these students.

Historical data from the 2011 offering of this subject was analysed in two ways: First, the data relating to participation and achievement in relation to the first two assessment tasks was compared with each other and to overall final results in the subject; and, second, the content access and usage patterns of students were analysed in relation to the five highest achievers (final mark >80%) and the five lowest performers (final mark 40-49%). This approach is consistent with the view of Siemens and Long (2011) regarding the intent of learning analytics to centre on the learning process (which includes analysing the relationship between learner, content, institution and educator).
CASE STUDY: PROFESSIONAL ETHICS

Description of Subject

The subject which is the focus of this project, Professional Ethics, is a compulsory postgraduate subject in a business degree offered by the University of New England via distance education. All the learning materials (with the exception of the prescribed textbook) were provided through the LMS, so internet access was vital for participation. Students were advised of this requirement prior to enrolment, therefore it can be assumed that they were comfortable with this mode of delivery.

We focused on the first two assessment activities: an optional online activity (Activity) weighted at 5% to be completed between weeks 2 and 4 and a compulsory online multiple choice test (Test) weighted at 15% at the end of week 6. We chose these two assessment tasks as they are scheduled early in the teaching period and have quite low weightings so that poor performance in one or both of these tasks would not prevent a student from successfully completing the subject. In addition, the Activity was designed to scaffold the material covered in the Test. Since the material covered in these two tasks forms the basis for the second module of the subject, it is essential that students develop a sound understanding of this content.

Student Demographics

The cohort of students in 2011 was typical for this subject. The initial enrolment was 141 and all students were studying by distance education. Most of the students were mature aged (70% were aged between 30 and 49) and were working full-time. The gender balance was almost even. Students were undertaking either a graduate certificate or masters level university degree to further their careers through obtaining a qualification which allows them to become full members of a professional body in their field. Many of the students were from non-English speaking backgrounds and most (73%) had not completed tertiary studies previously, although they had completed an
advanced diploma from TAFE and had at least two years’ full-time, relevant work experience. Rather than being inhibitors, in this case study, these challenges are seen as providing a motivation for developing an intervention program, as these characteristics often contribute to the likelihood of attrition and reduced success in tertiary studies (Gabb, Milne & Cao, 2006).

RESULTS AND DISCUSSION

Analysis of student results

A total of 141 students enrolled in the subject, of whom 10 withdrew prior to submitting any assessment tasks and a further eight students did not complete all compulsory assessment tasks. Of the 123 students who completed the subject, 117 passed and 6 failed. Table 1 below summarises students’ marks for the Activity, Test and final mark, and Table 2 provides a comparison of the final results for students who did and did not complete the optional Activity.

Insert Table 1 here

Insert Table 2 here

Inferences can be drawn from participation and achievement in each task. Students who completed the Activity (scheduled early in the teaching period) were more likely to successfully complete the subject (91%) compared to students who did not complete the Activity (72%). However, it is not possible to establish that there was a direct causal connection between completing the first assessment task and withdrawal from the subject. We did not investigate the reasons for non-continuation and students would have decided for a variety of reasons that they would withdraw from the subject early (and receive a refund of fees). What is relevant is that only five students (3.8%) who completed the Activity failed to complete the subject. Moreover, only five of the 106 students who did complete this Activity went on to fail the subject while two of the 18 students who
did not do the Activity failed. Based on these results it is plausible to claim that completion of this task is a good indication of students’ likelihood of successfully completing the subject.

As the Activity was designed to encourage students to engage with the material that was the focus of the Test (and scaffold the learning for the remainder of the subject), it is reasonable to expect that those students who completed the optional activity would have performed better in the Test than those who did not. Students who completed the Activity achieved a higher average mark for the Test (79%) than students who did not do the Activity (73%). In addition, students who completed the Activity received a higher average final mark, 66%, compared to 58% for those who did not. Completion of the Activity, therefore, was related to success in the subject.

Similarly, the Test can be considered an indicator of future success in the subject. Nine students failed the Test and only three of these students successfully completed the subject. These three students achieved marginal final marks (50, 52, and 52%). The 30 students who achieved Test marks of less than 65% achieved an average final mark of 54.5%.

Based on this information, two key points for interventions aimed at enhancing student success can be identified. These are especially important as they relate to content which underpins the remainder of the subject. Below we have identified the interventions to be undertaken in the next offering of the subject:

1. Interventions with students who do not complete the Activity may reduce attrition and improve success rates in the subject.
   - Provide a private discussion space for these students to discuss content related to the Activity
   - Personal contact from the lecturer to identify issues which may be alleviated to encourage continued participation in the subject
2. Intervention with students who fail the online Test may increase opportunities for successful completion of the subject.
   
   • Host an online video conference to reiterate important aspects of the subject which were covered in the online test
   • Provide a private discussion space for these students where further explanation can be provided and questions answered by the lecturer
   • Provide additional resources to enhance understanding of key concepts

**Analysis of access and participation**

This part of the project ensures that learning analytics has a focus on learning. "It is not sufficient to treat big data and analytics as useful only for evaluating what learners have done and for predicting what they'll do in the future. Analytics in education must be transformative, altering existing teaching, learning and assessment processes..." (Siemens & Long, 2011, p. 3).

The analysis involved investigating logs of activity for 10 students in the subject. Five of these students achieved a final mark of 40-49% and five achieved a final mark higher than 80%. The logs for each of these students were collated from the beginning to end of the teaching period. In reviewing the access logs and data in terms of results, similarities in access, type of access and participation can be identified.

In brief, students who received a grade of 80% or higher were consistent in their activity in the subject while those who were low achievers demonstrated random access. The high achievers accessed materials online regularly and in sequence (in topic order). Accessing the materials online is important as the content included online readings and resources as well as multimedia resources to enhance content. All of these students completed the Activity and accessed the forums regularly.
Four of the five students accessed the podcasts. All of these students demonstrated a consistent approach to working through the material for the duration of the teaching period.

Students in the lower achievers group were much more random in terms of activity and participation. Two of the five did not access the subject at all until after the third week of the teaching period and only one student completed the Activity. Materials were accessed irregularly and in some cases rarely, although the printable topic notes document was viewed, so this material could have been read offline. However, the printable notes did not provide links to the additional online and multimedia resources. Three of the students in this group did not access the podcasts at all and the other two students only accessed two of the 12 podcasts provided throughout the subject.

Our analysis of access and participation leads to the conclusion that students are more likely to achieve if they:

- Access all materials, in sequence and with regularity
- Access additional resources (video clips and podcasts)
- Access and participate in forums
- Complete the Activity

Results of this analysis will be used in Trimester 3, 2012 to identify ‘at risk’ students by monitoring access (or lack of access) through the early part of the teaching period and a set of interventions will be put in place:

- Monitor consistency and regularity in access to highlight potential risks in not maintaining study pattern
- Contact students who have not accessed materials by the end of week 2
- Emphasise the importance of a podcasts in the teaching materials and discussion forums
CONCLUSION

The benefits of learning analytics are identified by Siemens and Long to include providing insight into learners and their behaviours; improvement in decision making and allocation of resources; providing interventions to ‘at risk’ students; timely responsiveness; and enabling innovation and transformation of educational programs and teaching and learning practice (2011, p. 2). Shum and Ferguson (2011) also suggest that analytics can provide the identification of contextual factors which influence learning enabling individualised recommendations for resource allocations and the promotion of learning networks.

This case study demonstrates how learning analytics can be utilised to achieve the benefits identified above, particularly in relation to ‘at risk’ students who may benefit from tailored interventions to improve their understanding and chance of success. The use of interventions based on learning analytics also increases accountability in that the attainment of learning outcomes can be clearly identified and retention may be increased both of which Campbell et al. (2007) identify as being important in terms of meeting public expectations. In summary, the use of analytics will provide data to enable a rapid response in the form of interventions to improve teaching and learning.

The strategies adopted in this case study are intended to support ‘at risk’ learners through focused and interventions by the lecturer, as opposed to computer-generated prompts which make more generalised suggestions for assistance. This personalised approach increases social presence in the online environment and thus engagement in the learning process. It provides an opportunity for students to engage in a focused environment in order to enhance understanding of, and engagement with, the subject content thus increasing their potential for successful completion.
REFERENCES


Table 1: Students’ results for the Online Activity, Online Test and Final Mark

<table>
<thead>
<tr>
<th>Achieved mark</th>
<th>Online Activity</th>
<th></th>
<th>Online Test</th>
<th></th>
<th>Final Mark</th>
<th></th>
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<tbody>
<tr>
<td>mark ≥ 85%</td>
<td>89</td>
<td>80.2</td>
<td>61</td>
<td>46.6</td>
<td>1</td>
<td>0.8</td>
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<tr>
<td>mark between 75% and 84%</td>
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<td>10.8</td>
<td>26</td>
<td>19.9</td>
<td>21</td>
<td>17.1</td>
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<tr>
<td>mark between 65% and 74%</td>
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<td>5.4</td>
<td>25</td>
<td>19.1</td>
<td>47</td>
<td>38.2</td>
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<tr>
<td>mark between 50% and 64%</td>
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<td>3.6</td>
<td>10</td>
<td>7.6</td>
<td>48</td>
<td>39.0</td>
</tr>
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<td>mark &lt; 50%</td>
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<td>9</td>
<td>6.9</td>
<td>6</td>
<td>4.9</td>
<td></td>
</tr>
<tr>
<td>Total Enrolment</td>
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<td>100.0</td>
<td>131</td>
<td>100.0</td>
<td>123</td>
<td>100.0</td>
</tr>
<tr>
<td>Withdrew from subject early</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Did not complete subject</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Total Enrolment</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Achieved mark</td>
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<td>%</td>
<td>No.</td>
<td>%</td>
<td>Total</td>
<td></td>
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<tr>
<td>Achieved mark ≥ 85%</td>
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<td>1</td>
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<td>1</td>
<td>2.3</td>
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<td></td>
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<td>37.84</td>
<td>5</td>
<td>11.6</td>
<td>47</td>
<td></td>
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<tr>
<td>Achieved mark between 50% and 64%</td>
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<td>10</td>
<td>23.7</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>Achieved mark &lt; 50%</td>
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<td>4.5</td>
<td>2</td>
<td>4.7</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td></td>
<td>18</td>
<td></td>
<td>123</td>
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