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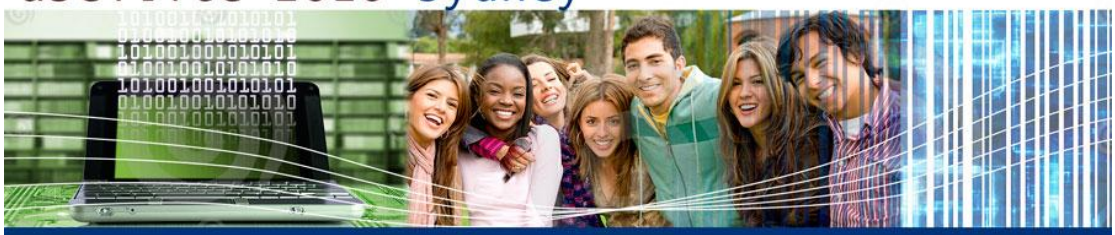

Indicators of engagement

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Student engagement has become synonymous with the measurement of teaching and learning quality at universities. The almost global adoption of learning management systems as a technical solution to e-learning within universities and their ability to record and track user behaviour provides the academy with an unprecedented opportunity to harness captured data relating to student engagement. This is an exploratory study that aims to show how data from learning management systems can be used as an indicator of student engagement and how patterns in the data have changed with CQUniversity's recent adoption of Moodle as its single learning management system.

Keywords: Student engagement, e-learning, academic analytics, LMS, Moodle, Blackboard.

Introduction

A great deal has been written about student engagement and its importance to universities. Despite the absence of a universally accepted definition of what constitutes engagement, it has been linked to undergraduate academic achievement, student attrition, student retention, student motivation and institutional success. Clearly defining engagement and identifying its measurable components can assist universities in enhancing their efforts towards improving student engagement. Identifying indicators of student engagement allows universities a degree of measurability that can be used to inform and improve upon existing practices. This is especially true when students are increasingly participating in courses that are predominately delivered online without face-to-face interactions with their teachers and peers (Chen, Gonyea & Kuh, 2008).

The widespread uptake of learning management systems by universities has fundamentally changed the environment within which online students engage with their studies. The change in learning environments has also led to changes in the ways that students are engaging with course resources, teaching staff and each other. Distance learning via learning management systems can occur without face-to-face contact between students and teachers and this can mean that traditional measures of student engagement such as class attendance are impossible to gauge (Douglas & Alemanne, 2007). However, learning management systems accumulate vast amounts of data on student behaviour that can be used to inform and improve online student engagement. This study reports on the initial exploration of existing institutional data sources, such as the Moodle learning management system, as vehicles for providing indicators of student engagement in online undergraduate education.

Engagement

In higher education, engagement has become a catch-all term most commonly used to describe a compendium of behaviours characterising students (Krause, 2005). It has even been suggested that student engagement could be used as an indicator of institutional teaching quality (Kuh, 2001). But what is engagement and how can it be measured? Measuring engagement and its link to learning is challenging and this is especially true when the term engagement is often used in broad terms to describe a range of behaviours that learners exhibit (Bulger, Mayer, Almeroth, & Blau, 2008). An investigation into what engagement is, and factors that influence engagement, is required before metrics for its measurement can be determined.

Most of the research into measuring student engagement prior to the widespread adoption of online, or web based classes, has concentrated on the simple measure of attendance (Douglas & Alemanne, 2007). While class attendance is a crude measure, in that it is only ever indicative of participation and does not necessarily consider the quality of the participation, it has nevertheless been found to be an important variable in determining student success (Douglas, 2008). However, it could be said that class attendance is used as a metric for engagement, simply because it is one of the few indicators of engagement that are visible, or external to the student. For example, student motivation is often linked closely with engagement and has been defined as an internal state or condition that activates behaviour and gives it direction (Huitt, 2001). Participation could be seen as an indicator of behaviour activated by a student's motivation and is measurable in online education, albeit with the same limitations concerning the quality of the participation. While participation is evidently an important aspect of student engagement, engagement is a broad construct that encompasses more than just participation.

Defining engagement

Stovall (2003) suggests that engagement is defined by a combination of students' time on task and their willingness to participate in activities. Krause and Coates (2008) say that engagement is the quality of effort students themselves devote to educationally purposeful activities that contribute directly to desired outcomes. Additionally, Chen, Gonyea and Kuh (2008) say that engagement is the degree to which learners are engaged with their educational activities and that engagement is positively linked to a host of desired outcomes, including high grades, student satisfaction, and perseverance. Other studies define engagement in terms of interest, effort, motivation, time-on-task and suggest that there is a causal relationship between engaged time, that is, the period of time in which students are completely focused on and participating in the learning task, and academic achievement (Bulger, et al., 2008).

A basic tenet of the research into engagement is that students' activity, involvement and effort in their learning tasks is related to their academic achievement. While there does not appear to be a single definition for engagement, the following definition represents an aggregation of the literature. Engagement is seen to comprise active and collaborative learning, participation in challenging academic activities, formative communication with academic staff, involvement in enriching educational experiences, and feeling legitimated and supported by university learning communities (Coates, 2007). This definition suggests that engagement is the amalgamation of a number of distinct elements including active learning, collaborative learning, participation, communication among teachers and students and students feeling legitimated and supported. At a fundamental level, these elements are dependent on a range of interactions such as interactions between teachers, students and content. It could be said that the online learning environment facilitates the interactions required for learning and therefore have an influence on student engagement. It could also be said that measuring student participation within a learning environment and contrasting this measure with student results can provide an approximation of student engagement.

Learning environments

Because the method of course delivery defines the environment in which the students engage with their learning, it is a key consideration when discussing student engagement. Some courses are delivered face-to-face; some via a blend of online and face-to-face and others are delivered fully online. In a traditional face-to-face class, students attend lectures and tutorials, and can participate in learning activities while in the presence of the instructor and their peers. A fully online course is typically delivered via the Internet with all the interactions between the learners, content and instructors

facilitated by web based technologies, while blended courses use a mix that involves face-to-face teaching augmented by web or online components.

Learning environments, including online learning environments, encompass the systems and dynamics that facilitate and enable student engagement (Coates, 2006). It is reasonable to assume that the learning environment will have an influence on how students engage with their learning. Aside from the learning environment's influence on the design, building and delivery of courses (Coates, James, & Baldwin, 2005), the demographic of the students choosing online environments for their studies can also be factor that influences engagement. (Dutton, Durron, & Perry, 2002) state that online students are older and are less likely to be enrolled in traditional undergraduate programs but are more likely to be lifelong learning students. They go on to say that online students are more likely to have job or childcare responsibilities, longer average commutes to campus and they are often more experienced with computers (Dutton, et al., 2002, p. 17). All of these are factors can influence the level of student engagement in the rapidly growing area of online learning environments.

As distance learning using web delivery is the fastest growing segment of postsecondary education, it is important to evaluate its effect on learner engagement (Chen, et al., 2008). Distance education via web delivery is typically delivered by enterprise wide learning management systems which have become integral to university teaching and learning environments (Rankine, Stevenson, Malfroy, & Ashford-Rowe, 2009). Learning management systems are software systems that synthesize the functionality of computer-mediated communications software and online methods of delivering course activities and materials (Jennings, 2005). Coates (2005) states that learning management systems influence engagement and despite their widespread use, research into their effect on engagement is still in its infancy.

Learning management systems

Learning management systems (LMS) are at the forefront of the online technologies making a serious impression on patterns of learning and teaching in higher education (Coates, 2006). LMS, also commonly referred to as course management systems (CMS) and virtual learning environments (VLE), are becoming ubiquitous at universities around the world, adding a virtual dimension to even the most traditional campus-based institution (Coates, et al., 2005). In a relatively short time they have become perhaps the most widely used educational technology in higher education, only ranking behind the Internet and common office applications (West, Waddoups, & Graham, 2006). They are being used for presenting online or technology-enhanced classes and it has been said that they influence pedagogy, and therefore engagement, by presenting default formats that are designed to guide instructors toward creating courses in certain ways (Lane, 2009). If LMS are affecting pedagogy, then they are likely to be affecting student study habits, learning and engagement (Coates, et al., 2005).

While LMS have the potential to influence student engagement, research into how they do this is largely in its infancy and is often based on assumptions about campus learning environments (Coates, 2006). It has been argued that the rapid adoption of LMS has occurred in a vacuum of research into their teaching and learning effectiveness (Lopes, 2008). Most, if not all, of the interactions enabled by the LMS are asymmetric, which is where the student is responsible for logging in and engaging with course material without prompting or instruction. This means that students who require substantial instructor direction may have problems with an environment that demands a certain level of self discipline (Douglas & Alemanne, 2007) and this could conceivably influence their confidence and motivation, both of which can influence their level of engagement.

Others have questioned how the LMS is influencing students' confidence and motivation for learning, their understanding of the significance of what they have learned and even if LMS are encouraging increasingly independent and perhaps isolated forms of study (Coates, et al., 2005). This seemingly supports research that suggests that rates of attrition for online students range between 20-50% higher than on-campus students (Shane Dawson, Macfadyen, & Lockyer, 2009). This is possibly because LMS can affect the way students explore and contextualise learning resources as well as the way they receive summative and formative feedback. While the degree to which LMS are affecting student engagement in universities is not clear, the importance of engagement is established in the literature and therefore further research into measuring engagement within LMS is warranted in order to identify and address inhibitors that LMS place on engagement. Fortunately, LMS collect extensive data on how staff and students are using the systems and this could be invaluable for universities endeavouring to

improve teaching and learning quality through the measurement and monitoring of student engagement.

Academic analytics

A fortunate effect of the almost ubiquitous adoption of LMS for online course delivery in universities, is their ability to track and store vast amounts of data on student and designer behaviour (Heathcoate & Dawson, 2005) . Typically, LMS record all actions made by users once they are logged into the system and this data is subsequently stored in an associated database. The process of analysing institutional data captured by an LMS for decision making and reporting purposes is called academic analytics (Campbell, Oblinger, & DeBlois, 2007) and it has been shown that analysis of captured LMS data is directly relevant to student engagement, evaluating learning activities and can usefully answer other important questions (Shane Dawson & McWilliam, 2008).

The quantity and diversity of the data accessible to higher education institutions is now making it possible to exploit more fully the potential of academic analytics in order to inform a range of key activities within the academy, from strategic decision-making to instructor teaching practices. The challenge for higher education institutions is no longer simply to generate data and make it available, but rather to readily and accurately interpret data and translate such findings into practice (Shane Dawson & McWilliam, 2008).

While there is a growing interest, there is minimal research into how information generated by university systems can be harnessed in the design, delivery and evaluation of learning and teaching practices (Beer, Jones, & Clark, 2009). It has also been said that although academic analytics cannot measure learning, it does allow researchers to assess trends such as the relationship between LMS use and grade performance as well as other things that may provide credible proxies for actual learning, or at least interesting indicators of learning (Caruso, 2006). Although LMS accumulate vast quantities of data on staff and student behaviours within the system, they often lack appropriate tools to extract and interpret the captured data (Shane Dawson & McWilliam, 2008) and it is this gap that academic analytics proposes to fill. This study is using the process of academic analytics to identify "indicators of learning" as they apply to student engagement by comparing LMS usage information and grade performance.

According to Caruso (2006), the fundamental measure of student experience with an LMS is the degree to which students use the system. This appears to align with the historical precedent where class attendance is used as a metric for measuring face-to-face student engagement (Douglas & Alemanne, 2007). In a face-to-face learning environment, quantifying every student utterance and action is almost impossible in a large class. However, an LMS hosted learning environment enables every mouse click by every student within the system to be automatically tracked for analysis at a later date. It could be said that this actually expands on what was available in the face-to-face learning situation. However, this creates another problem as LMS record every mouse click by every user and there are often thousands of users. This generates enormous quantities of data that has to be aggregated and analysed against a backdrop of educational effectiveness in order to provide meaning to the data.

Methodology

This study into engagement has been enabled by a broader, CQUniversity sponsored project called the Indicators project that is looking at ways that data captured by university systems, including the LMS, can be used by an institution to improve teaching and learning (Beer, et al., 2009). Data from CQUniversitys LMS databases, the student administration system's grade database and the student administration system's demographic database (Figure 1) has been summarised and aggregated into a homogenised database that facilitates the querying of previously disconnected data. It should be noted that while most of the work on the Indicators project to date relates to the Blackboard LMS at CQUniversity, this is predominately due to the local context where, until the recent adoption of Moodle, Blackboard was the main LMS in operation. The Indicators project is about cross-platform and cross-institutional comparisons of LMS data and, at the time of writing, Moodle data was largely unavailable.

The scope of this study into student engagement has been reduced to undergraduate online only students in order to reduce the influences of factors that cannot be measured using captured LMS data.

For example, face-to-face students may receive answers to their queries verbally during tutorials whereas predominately online students may post questions to LMS discussion forums. LMS data will show a record of the online student's query but not the face-to-face student's query. Therefore, it is proposed that by reducing the sample to only undergraduate online students, variables that are not captured by the LMS are minimised as much as possible. The following figure (Figure 1) shows how the data from various university systems is aggregated into a single location.

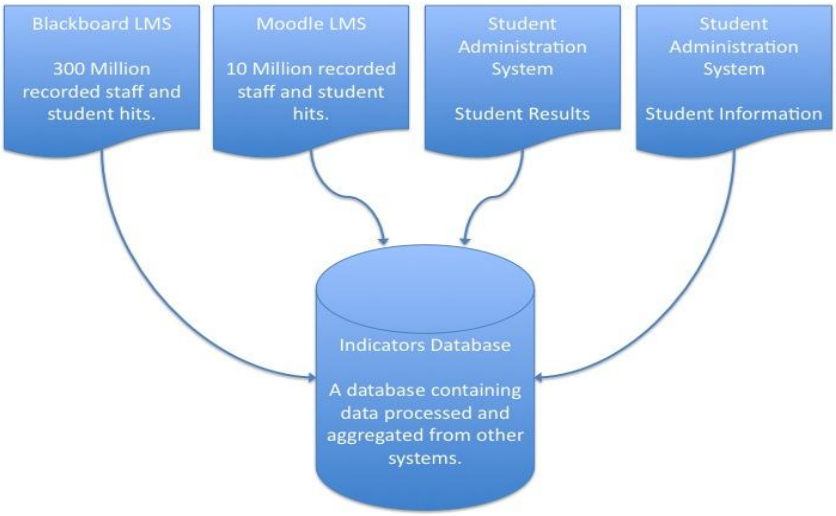


Figure 1: Data source aggregation

The Blackboard LMS used in this study was commissioned at CQUniversity in 2004 and has been retired in February 2010. The Moodle LMS was piloted during 2009 and has become the single LMS in use at CQUniversity as of 2010. Both of these LMS have recorded almost every staff and student click within the system and this equates to over 310 million recorded clicks since 2004. There were a total of 4722 courses delivered via the Blackboard LMS between 2004 and 2009 while the Moodle LMS contributed 40 courses to this study during the 2009 pilot. 2714 of these courses were undergraduate courses that contained one or more online students where an online student is defined as someone who is studying via distance without significant face-to-face instruction. The focus of this study is on these 2714 courses that contain undergraduate online students whose typical source of interaction with their instructors, peers and instructional material, is via the LMS. The two additional student systems, shown in Figure 1, relate to student administration and simply provide student grade, gender, age and other demographical information specific to each student.

Both Blackboard and Moodle have activity databases that record the user, course and location of every mouse click that occurs within the system. The processing of this number of records is time consuming so courses that were not undergraduate courses and courses that had no online students were filtered from the data set to reduce query execution times. Staff and student activity in the remaining 2674 courses for Blackboard and 40 for Moodle were summarised and aggregated into two relational databases using a series of scripts. One database contained summary information on the courses such as student numbers, staff activity counts, staff discussion forum activity counts and other database indexing information. The second database held course contextual information on each of the 92799 undergraduate online students involved in this study. Information on each student such as course, activity counts, grade, age, gender and forum activity counts were held in this database. It should be noted that in accordance with the terms of this projects ethical clearance students and courses were de-identified when the course and student databases were populated.

The aggregation of data in this way allows it to be analysed in ways that have not previously been possible (Beer, et al., 2009). As an example, captured LMS data can now be compared with student grade information to ascertain the value of certain LMS activities or features in relation to student success. Additionally the captured LMS data can be analysed across time to provide longitudinal information on how staff and students' usage of the LMS changes over time. The ability of the LMS to

record detailed activity data makes it possible to exploit more fully the potential of academic analytics in order to inform teaching and learning (Shane Dawson & McWilliam, 2008). This paper is an exploration of how data captured by both CQUniversity's LMS, combined with data from student administration systems can help inform teaching and learning in relation to engagement as well as providing comparisons in student behaviour between Blackboard and Moodle. The first step in making use of LMS usage data to identify factors that influence student engagement within them is to establish a baseline of student activity that can then be used to highlight variations from this baseline.

LMS indicators of engagement

The core components of active learning are student activity and engagement in the learning process (Prince, 2004). It could be expected that students who are actively engaged in their LMS hosted courses would visit the LMS more frequently and for longer periods of time than students who are less engaged. It would seem reasonable to expect that, generally, students who are more actively engaged in LMS courses should receive higher grades than students who are less engaged.

As an example of how LMS data might be indicative of engagement, the following figure (Figure 2) groups students based on the final grade they achieved for their course. From there, the average number of clicks within the LMS course is calculated for each of the grade groups for the entire sample of 91284 online, undergraduate students using the Blackboard LMS and 1515 online undergraduate students using Moodle. The assumption made here is that click count is an indicator of student participation where student participation has been said to be an important predictor of engagement and student success (Prince, 2004).

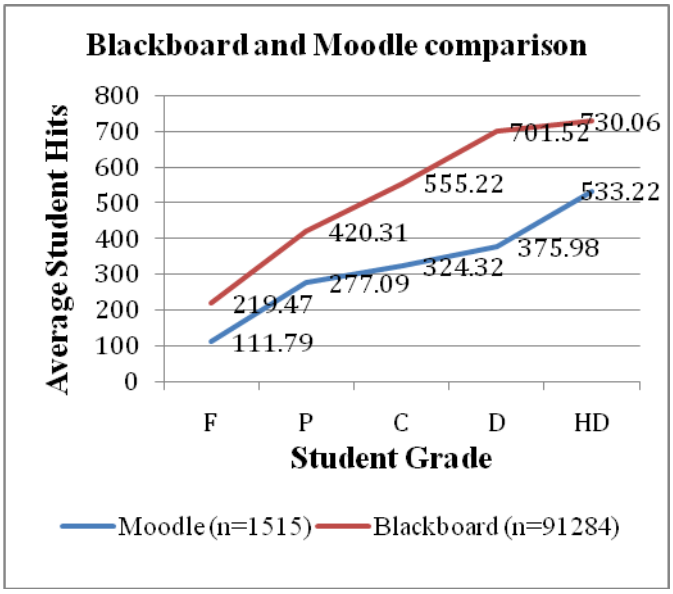
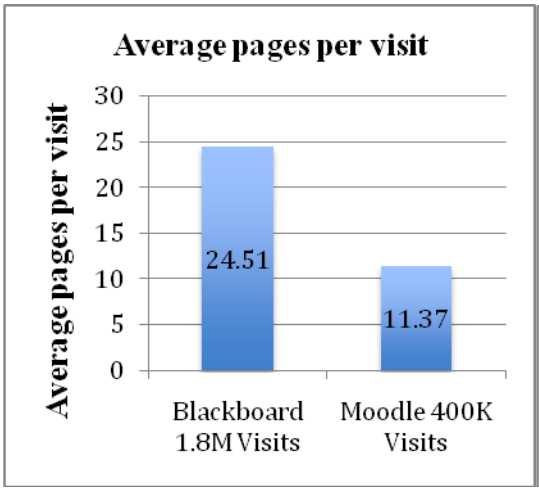


Figure 2: Blackboard and Moodle average hits per grade comparison

Figure 2 shows a general correlation between the number of clicks by students within each LMS and their resulting grade across a large sample size consisting of 91284 online undergraduate students for Blackboard and 1515 for Moodle. However, there is also a high standard deviation for each grade group on both systems that is indicative of the degree of variance or volatility in the mean result. This indicates that while the clicks average is calculated from a large population size, there is a large degree of variation between the minimum and maximum values that contribute to the mean which would be expected from such a large sample across a diverse range of courses and disciplines. Whilst the degree of variation in the data is significant, this is mitigated somewhat by the sheer size of the population and in any case, is not as important as the trend indicated by the data (figure 2) which identifies a correlation between engagement, as indicated by clicks, and academic achievement as indicated by grade. Additionally, and due to the large population size, the results have been determined to be statistically significant.

While a causative relationship between LMS clicks and engagement has not been established, there is a general correlation between the number of student clicks on LMS courses and their resulting grade. Despite the fact that learning is more complex and diverse than a representation of student clicks on a web site can possibly demonstrate, the shape or pattern of the correlation in Figure 2 is significant in that it can be used as an indicator of student engagement as well as providing a comparison between the two different LMS.

Figure 2 shows a significant difference between the two systems. For example, students receiving high distinctions in Blackboard had an average number of hits of 782, while students using Moodle averaged 533. This would tend to align with the fact that Moodle incorporates a flat interface design (University of Minnesota, 2009) as opposed to the Blackboard version used at CQUniversity. The Blackboard 6.3 user interface requires the students to click into subfolders in order to access course tools and materials which equates to increased navigational distance when compared to Moodle. This potentially means that the adoption of the Moodle LMS has reduced the navigational load on the student by reducing the number of clicks required to access their course tools and materials. To further highlight this effect the following figures are taken from the web server logs of both Moodle and Blackboard and show a comparison between the average number of pages visited per user per session and the average time each user spent on the two sites.



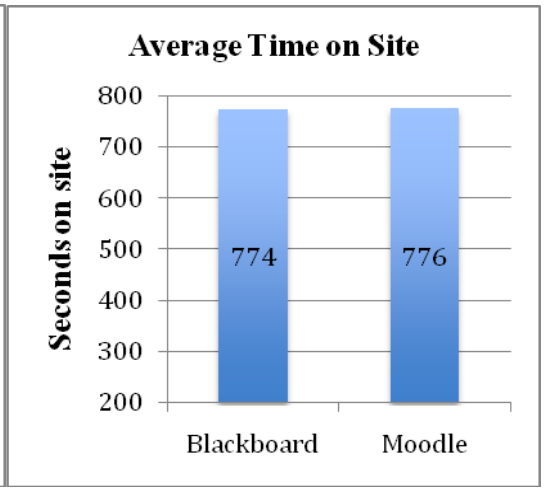


Figure 3: Average pages per visit per user **Figure 4: Average time spent on site by users**

The average number of pages per visit per student (Figure 3) could be interpreted as an indication of the ease which information can be accessed within the web site. Moodle's less hierarchical and more linear user interface means that the student has less navigation steps between themselves and the information they are seeking. So while the average time on site (Figure 4) is almost the same between Moodle and Blackboard, the students are visiting far fewer pages on Moodle and, although further research is required, it could be inferred that they are spending more time with the information and activities provided by the Moodle system. Without further research examining why this is the case a number of possible explanations could be possible For example, it might be that Moodle is responding more slowly than Blackboard, or that the students are getting lost in terms of where to go because of the need to scroll or become familiar with a new system. It should be noted that, generally, data captured by the LMS can identify the 'what' but more in depth research is required to determine why it has occurred.

Figure 2 showed a distinct correlation between student activity on the LMS and their resulting grade where student activity could be seen as indicative of engagement. However, there are a host of factors identified in the literature that can influence the way that students participate in online courses. These include a broad range of factors such as teacher participation in discussion forums, student age, student gender, class size and course design (Vrasidas & McIsaac, 1999). Other factors such as students' prior experience with computer mediated communication cannot be measured using LMS data alone, but it is known to be a contributing factor with student engagement in LMS hosted courses (Vrasidas & McIsaac, 1999). While the following figure (Figure 5) relates only to the Blackboard LMS at CQUniversity, because the comparison with Moodle is currently being investigated, it shows the

influence of instructor discussion board presence has on student engagement as indicated by LMS participation.

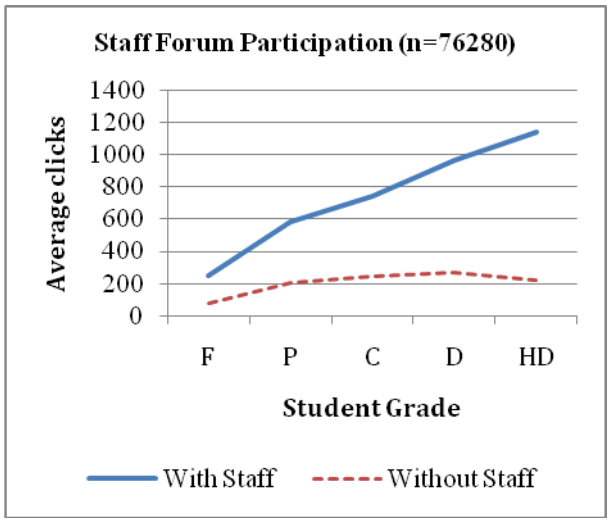


Figure 5: Student participation in courses with and without staff participation in discussion forums

The 45,424 students who participated in courses where the teaching staff made one or more posts or replies to the discussion forums, appear to have a distinctly higher average number of clicks for each grade group than the 30856 students whose teaching staff did not use the discussion forums. Additionally, the failure rate for students in courses with staff discussion board participation as calculated from the data in Figure 5, was 25% as opposed to 29.5% for students in courses where teaching staff did not participate in the discussion forums. The limitations inherit in academic analytics data and the de-contextualized representation of what transpired within these courses prevents a definitive causal relationship to be established. However, it is an indicator or clue that suggests the value of LMS discussion forums to distance students and identifies a need for further research to answer the "why" question.

According to the results in figure 5, student engagement in courses where the staff contributed to discussion forums is higher than courses where the staff did not contribute to discussion forums. This aligns with the first of the seven principles that suggests good practice encourages contact between students and faculty (Chickering & Gamson, 1987) and the engagement definition that suggests that collaborative learning and a sense of learning community are both factors influencing student engagement (Coates, 2007). While the change from Blackboard to Moodle at CQUniversity may mean that discussion forums are easier for staff to install and maintain, and this may lead to an increase in the number of staff employing discussion forums in their online teaching, there is evidence to suggest that the introduction of a new LMS does little to disrupt the pattern of existing teaching practices (Blin & Muro, 2007) as the teaching process depends heavily on the teaching academics. It could be said that, amongst others, the dissemination of academic analytics data can help improve teaching and learning by highlighting information that has previously been unavailable to teaching academics so as to assist in their process of reflection.

Implications and future research

It is important to note that the data above represents an initial exploration of the potential of academic analytics to provide information on student engagement as well as the start of a comparison between Blackboard and Moodle. Teacher participation, course design, class size, student gender and student age are just a small subset of a range of factors that can influence online only student engagement. The range of factors that can influence student engagement within an LMS is vast and contains complex interplays between the factors. While these factors prevent academic analytics becoming a panacea for informing and improving student engagement in online education, it can be a useful indicator of engagement and uses data that is already being captured by existing systems. The following are some

examples of how academic analytics data can be used, and might be used, to inform and improve online student engagement.

Student engagement data from the LMS can be presented to students for informational and motivational reasons. If students can be shown the degree of effort required to pass a particular course matched with an indication of their degree of effort to date, it may lead to enhanced effort by the student. This concept is currently being trialed at Purdue University and has reportedly led to a significant increase in student engagement in courses where the effort tracking system is in effect (Purdue University, 2009). This is one example of the use of real-time LMS data but it can also be useful over long periods of time.

The study of LMS feature adoption by teaching staff over time is important to universities as it is not the provision of LMS features but their uptake that really determines their educational value (Coates, et al., 2005). It has been shown that teaching staff tend to adopt LMS features along a continuum beginning with content dissemination features and moving to more complex features such as quizzes and evaluation surveys over time, as they gain experience with the new teaching medium (Malikowski, Thompson, & Theis, 2007). The features adopted by teaching staff, such as discussion forums, have an effect on student engagement as they form part of the environment in which student engagement occurs. This highlights the importance of teaching staff in LMS hosted courses and potentially highlights the most puissant use of LMS data, which is aiding teacher reflection.

The importance of teacher reflection is well known and it has been said that improving teaching practice cannot be achieved without the teacher converting their teaching experience into knowledge through the process of reflecting upon their practice (McAlpine & Weston, 2004). Academic analytics data can provide information that can show teachers how students are using the system and also, longitudinal LMS data allows the teacher to visualise student behaviours over time. This can show the influence of changes to the course and the influence specific LMS features have against student engagement. This can potentially provide teaching staff with a new tool through which they can reflect upon their practices and see the effect their practices are having on student engagement. Additionally, the type of work being done at Purdue around attempting to improve student use of the LMS through making visible their effort compared to other students may also prove useful in the staff context. For example, a block that shows the staff members contributions to a discussion forum compared to the average for all other courses. If teachers' conceptions of teaching and learning are central to the quality of student engagement, then tools that give visible indications of this relationship may help encourage improvement or change in teacher conceptions.

Limitations

There are significant limitations to what quantitative evaluations of LMS data can tell us (Heathcoate & Dawson, 2005) as they can only demonstrate correlations within the data. While this study can identify patterns and relationships within the data, it does not indicate the value or significance of these patterns (Seifert, Updated 2004). A systems scan of user behaviour within an LMS can never describe in full how they are engaging in the use of the online environment for teaching and learning (Heathcoate & Dawson, 2005). For example, student grade is not necessarily indicative of learning but is indicative of the students meeting assessment criteria that may or may not be a measure of effective learning. Similarly, class attendance has been used as an indicator for engagement in face-to-face classes (Douglas & Alemanne, 2007) but it does not indicate the quality of engagement or even learning. The same holds true for measuring student participation by click-count within an LMS. While the number of clicks can be measured, it is impossible to determine the learning that has occurred as a result of those clicks but it could be said that counting clicks on course sites over a long period of time, while still limited, is possibly better than counting attendance.

In a complex educational setting there is an interplay of many variables which places significant constraints on what a purely quantitative analysis of LMS data can achieve (Beer, et al., 2009). However, it has also been shown that such analysis is directly relevant to student engagement and can provide useful information on how students are engaging (Shane Dawson & McWilliam, 2008). So while potentially useful in that the analysis of LMS activity data can help reveal patterns and relationships, it can only provide indicators of what is actually occurring. This is important to note as this study is analysing archival data from an LMS and due to the limitations inherit in this approach results should only be interpreted as indicative.

Despite the limitations inherent in the data and in the approach taken by this study it does afford some practical advantages. It uses existing sets of data that typically are not currently utilised by institutions and are often purged at regular intervals to reduce storage requirements (Beer, et al., 2009). Additionally the visualisation of student LMS usage can be automated so as to provide teaching staff and administrators both live and longitudinal representations of how students are engaging with the LMS. Another potential limitation of academic analytics relates ethical concerns around the collection, monitoring and use of LMS data.

The use of databases and hidden surveillance such as web log data-mining, has heightened the public's sensitivity to potential research abuses (Kirkup & Carrigan, 2000). Confidentiality, anonymity, disclosure and informed consent are core to ethical governance around the social sciences (Eynon, Fry, & Schroeder, 2008) and academic analytics appears to link to several, if not all, of these areas. So while it could be said that academic analytics is an emerging trend in higher education, this needs to be tempered with research into the ethical issues relating to the collecting, monitoring and use of staff and student usage information.

Conclusion

Based on increasing requirements for universities to assess their efforts in improving student engagement, and the lack of a clear definition of engagement, this study has suggested a proxy measure for engagement that aligns with what can be practically measured within an LMS. It showed that measuring engagement is difficult and that learning environments influence student engagement. Online learning environments are becoming increasingly common with learning management systems at the forefront of educational technologies used for online course delivery.

This study is an initial exploration of how data captured by learning management systems can potentially be used by the academy for measuring, informing and improving student engagement, as well as for comparisons between LMS. Variables such as teacher participation, course design, class size, student gender and student age are identified as factors that influence student engagement and are factors that require further research before their influence on engagement can be fully understood. This study into student engagement has shown that while universities are not significantly utilizing captured learning management system data to make informed decisions, it has the potential to become an additional resource that can be used to inform and improve student engagement.

References

Beer, C., Jones, D., & Clark, K. (2009). *The indicators project identifying effective learning: adoption, activity, grades and external factors*. Paper presented at the ASCILITE 2009. http://indicatorsproject.wordpress.com/2009/10/09/the-indicators-project-identifying-effective-learning-adoption-activity-grades-and-external-factors/

Blin, F., & Muro, M. (2007). Why hasn't tecnology disrupted academics' teaching practices? Understanding resistance to change through the lens of activity theory. *Computers and Education, 50*(2008), 15.

Bulger, M. E., Mayer, R. E., Almeroth, K. C., & Blau, S. D. (2008). Measuring Learner Engagement in Computer-Equipped College Classrooms. *Journal of Educational Multimedia and Hypermedia, 17*(2), 129-143.

Campbell, J. P., Oblinger, D. G., & DeBlois, P. B. (2007). Academic Analytics. *Educause Review*(July/August 2007).

Caruso, J. B. (2006). Measuring Student Experiences with Course Management Systems. *Educause, 2006*(19). http://net.educause.edu/ir/library/pdf/ERB0619.pdf

Chen, P.-S. D., Gonyea, R., & Kuh, G. (2008). Learning at a distance. *Journal of online education, 4*(3). http://innovateonline.info/index.php?view=article&id=438&action=login

Chickering, A. W., & Gamson, Z. F. (1987). Seven Principles of Good Practice in Undergraduate Education. *AAHE Bulletin*. http://tls.vu.edu.au/learning_and_teaching/guidelines/VU4/Chickering%20and%20Gamson%201987%20VU%204.pdf

Coates, H. (2006). Student Engagement in Campus-based and Online Education http://www.cqu.eblib.com.ezproxy.cqu.edu.au/EBLWeb/patron/

Coates, H. (2007). A model of online and general campus-based student engagement. *Assessment & Evaluation in Higher Education, 32*(2), 121-141.

Coates, H., James, R., & Baldwin, G. (2005). A critical examination of the effects of learning management systems on university teaching and learning. [Journal Article]. *Tertiary education and management, 11*(2005), 19-36.
Dawson, S., Macfadyen, L., & Lockyer, L. (2009). *Learning or performance: Predicting drivers of student motivation.* Paper presented at the Same places, different spaces. Proceedings ascilite Auckland 2009, Auckland.
Dawson, S., & McWilliam, E. (2008). *Investigating the application of IT generated data as an indicator of learning and teaching performance*: Queensland University of Technology and the University of British Columbia.
Douglas, I. (2008, 14 December 2008). *Measuring Participation in Internet Supported Courses.* Paper presented at the 2008 International Conference on Computer Science and Software Engineering, Wuhan, China.
Douglas, I., & Alemanne, N. D. (2007). *Measuring Student Participation and Effort.* Paper presented at the International Conference on Cognition and Exploratory Learning in Digital Age, Algarve, Portugal.
Dutton, J., Durron, M., & Perry, J. (2002). How Do Online Students Differ From Lecture Students? [Journal]. *Journal for Asynchronous Learning Networks, 6*(1), 20.
Eynon, R., Fry, J., & Schroeder, R. (2008). The ethics of internet research. In N. Fielding, R. M. Lee & G. Blank (Eds.), *The handbook of online research methods* (pp. 18). London: SAGE Publications.
Heathcoate, L., & Dawson, S. (2005). Data Mining for Evaluation, Benchmarking and Reflective Practice in a LMS. *E-Learn 2005: World conference on E-Learning in corporate, government, healthcare and higher education.*
Huitt, W. (2001). Motivation to Learn. *Educational Psychology Interactive*. http://chiron.valdosta.edu/whuitt/col/motivaton/motivate.html
Jennings, D. (2005). Virtually Effective: The Measure of a Learning Environment. *Emerging Issues in the Practice of University Learning and Teaching,* (2005). http://www.aishe.org/readings/2005-1/jennings-Virtually_Effective.html
Kirkup, M., & Carrigan, M. (2000). Video surveillance research in retailing: Ethical issues. *Internation Journal of Retail and Distribution Management, 28*(11), 10.
Krause, K.-L. (2005, 21-22 September 2005.). *Understanding and promoting student engagement in university learning communities.* Paper presented at the Sharing Scholarship in Learning and Teaching: Engaging Students, James Cook University, Townsville.
Kuh, G. D. (2001). Assessing What Really Matters to Student Learning. Inside the national survey of student engagement. http://cpr.iub.edu/uploads/Assessing_What_Really_Matters_To_Student_Learning_(Kuh,%202001).pdf
Lane, L. M. (2009). Insidious Pedagogy: How course management systems affect teaching. *14*(10). http://firstmonday.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/view/2530/2303
Lopes, V. M. (2008). Course Management Systems and Campus-Based Learning. Seneca College.
Malikowski, S. R., Thompson, M. E., & Theis, J. G. (2007). A model for research into course management systems: bridging technology and learning theory. [Research paper]. *Journal of educational computing research, 36(2)*(2007), 24.
McAlpine, L., & Weston, C. (2004). Reflection: issues related to improving professors' teaching and students' learning. *Instructional Science, 28*(5), 363-385.
Prince, M. (2004). Does Active Learning Work? A Review of the Research. *Journal of Engineering Education, 93*(3), 8.
Purdue University. (2009). Signals tells students how they're doing even before the test. http://news.uns.purdue.edu/x/2009b/090827ArnoldSignals.html
Rankine, L., Stevenson, L., Malfroy, J., & Ashford-Rowe, K. (2009). *Benchmarking across universities: A framework for LMS analysis*. Paper presented at the Ascilite 2009. Same places, different spaces. http://www.ascilite.org.au/conferences/auckland09/procs/rankine.pdf
Seifert, J. W. (Updated 2004). *Data Mining: An Overview*. http://www.fas.org/irp/crs/RL31798.pdf.
Stovall, I. (2003). Engagement and Online Learning. *UIS Community of Practice for E-Learning*. http://otel.uis.edu/copel/EngagementandOnlineLearning.ppt
University of Minnesota. (2009). Why Moodle? http://www1.umn.edu/moodle/instructor/why.html
Vrasidas, C., & McIsaac, M. S. (1999). Factors influencing interaction in an online course. *American Journal of Distance Education, 13*(3), 22-36.
West, R. E., Waddoups, G., & Graham, C. R. (2006). Understanding the experiences of instructors as they adopt a course management system. *Educational Technology Research and Development, 55*(1), 1-26.

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http://ascilite.org.au/conferences/sydney10/procs/Beer-full.pdf