Online Student Engagement

New measures for new methods.

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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 enrolling in courses that are predominately delivered online without face-to-face interactions with their teachers and peers.

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 seeks a broad definition for engagement that is contextually appropriate for a multimodal university like CQUniversity. It then unpacks the definition into component parts that are compared with a well-known model for good practice in higher education to assist in assuring the definition's validity. The study then reports on the initial exploration of existing institutional data sources, such as the learning management system, as vehicles for providing indicators of student engagement in online undergraduate education. A range of factors that influence student engagement in online courses are identified from the literature and assessed against institutional data to explore their influence against online student engagement.

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). Furthermore it has been said that at a certain level of analysis, engagement is taken to provide a singularly sufficient means of determining whether students are engaging with their study and university learning community in ways likely to promote high-quality learning (Krause & Coates, 2008). 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. While it is not possible to provide universally accepted interpretations for the elements that comprise the definition, it is possible to provide an overview of their meanings.

Active Learning

Active learning is generally defined in the literature as any instructional method that engages student in the learning process, and requires students to perform meaningful learning activities and think about what they are doing (Prince, 2004). It has also been described as the process of talking, writing, relating to and reflecting

on what is being learned, rather than passively receiving information (Chickering & Gamson, 1987). The core elements of active learning are student activity and engagement in the learning process (Prince, 2004).

Collaborative Learning

Collaborative learning, as the phrase implies, recognises that learning is collaborative and social, not competitive and isolated. "Working with others often increases involvement in learning. Sharing one's own ideas and responding to others' reactions sharpens thinking and deepens understanding" (Chickering & Gamson, 1987, p. 2). Prince (2004) defines collaborative learning as any instructional method in which students work together in small groups toward a common goal. Some authors have suggested that collaborative learning encompasses cooperative learning, which has been described as a structured form of group work where students pursue common goals while being assessed individually. Prince (2004) refers to collaborative learning and cooperative learning as two distinct entities with different philosophical roots. In either case the core element is the emphasis on student interactions rather than learning as a solitary activity (Prince, 2004). Communication between students and between staff and students is a fundamental requirement for collaborative learning (Veerman & Else, 2001).

Learning Community

Linked with collaborative learning and communication is the remaining element of the Coates (2007) engagement definition, which suggests that students need to feel legitimated and supported by their university learning community. A broad interpretation defines community as the result of interaction and deliberation by people brought together by similar interests and common goals (Rovai, 2002). This is especially important in a distance-learning context as dropout rates tend to be higher in distance education programs than in face-to-face programs (Rovai, 2002). It has also been theorised that students will increase their levels of satisfaction and the likelihood of persisting in a college program in they feel involved and develop relationships with other members of the learning community (Tinto, 1993 Cited in Rovai, 2002). Others have said that feelings of community are known to significantly affect online learning performance and that community is an essential part of successful online education (Black, Dawson, & Priem, 2008). It is clear from the literature that participating in a learning community is an important part of online education and subsequently, is an important part of the engagement definition.

While the component parts of the Coates (2007) definition for engagement are well represented in the literature, comparing the definition as a whole against a known framework for good practice in education affords an extra degree of validation. The seven principles framework by Chickering and Gamson (1987) is closely associated with student engagement and aspects of the Australasian Survey of Student Engagement were developed using the seven principles framework (Australasian Survey of Student Engagement, 2009; Macquarie University, 2009).

The Seven Principles

Chickering and Gamson's (1987) seven principles of good practice is a framework for institutional improvement and has been referred to as a guiding light for quality

undergraduate education representative of a philosophy of student engagement (Puzziferr-Schnitzer, 2005). The seven principles are also contextually appropriate for CQUniversity as they are listed as part of the 2010 teaching and learning plan and form part of a strategy for increasing student enrollments and retention through improved student engagement (CQUniversity, 2009). The following table illustrates the alignment between the Coates (2007) definition of student engagement and Chickering and Gamson's (1987) seven principles of good practice in undergraduate education.

Table 1. Alignment of Coates' (2007) definition of engagement and Chickering and Gamson's seven principles of good practice in undergraduate education

Element of Coates' (2007) definition of engagement	Chickering and Gamson's (1987) seven principles of good practice in undergraduate education
Active and collaborative learning	2. Develops reciprocity and cooperation among students. 3. Uses active learning techniques.
Formative communication with academic staff.	1. Encourages contacts between students and faculty.
Involvement in enriching educational experiences	5. Emphasises time on task. 6. Communicates high expectations
Feeling legitimated and supported by university learning communities	1. Encourages contact between students and faculty. 2. Develops reciprocity and cooperation among students. 4. Gives prompt feedback.

The Coates definition of engagement

The Coates (2007) definition of engagement and its constituent components is generally representative of the literature and even forms part of the Australian Survey of Student Engagement of which, more than half of all Australian and New Zealand universities are participants (Australasian Survey of Student Engagement, 2009). The three main elements of the engagement definition, active learning, collaborative learning and learning community are well represented in the literature and provide a granular breakdown of what constitutes engagement. Identifying the granular elements that constitute engagement reduces the abstraction of the definition and can assist in providing aspects of engagement that can be measured. How these components of engagement can be measured depends on the learning environment within which student engagement is going to occur as the learning environment facilitates the interactions learning requires and also dictates the metrics of 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).

Whilst 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 say that 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 (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 student engagement 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, 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 (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 (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). This project is using the process of academic analytics to identify some of these "indicators of

learning" as they apply to student engagement by comparing LMS usage information and grade performance. 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 (Dawson & McWilliam, 2008) and it is this gap that academic analytics proposes to fill.

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 an LMS can used by an institution to improve teaching and learning (Beer et al., 2009). Data from CQUniversity's Blackboard LMS database, 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.

The scope of this study into student engagement has been reduced to undergraduate online 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 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.

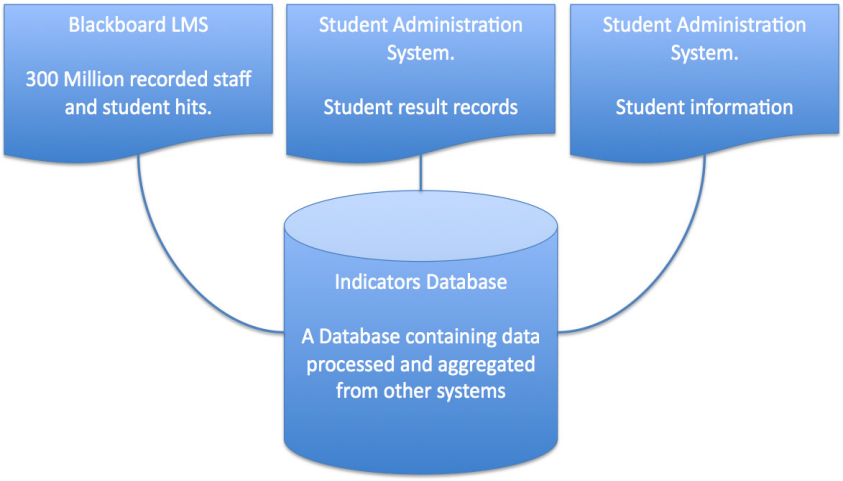


Figure 1. Data source aggregation.

The Blackboard LMS used in this study was commissioned at CQUniversity in 2004 and is due for retirement at the end of 2009. During this time it has recorded almost every staff and student click within the system and this equates to over 300 million recorded clicks. There were a total of 4722 courses delivered via the Blackboard LMS between 2004 and 2009. 2674 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 2674 courses that contain undergraduate online students whose typical source of interaction with their instructors, peers and instructional material, is via the Blackboard LMS. The two additional systems, shown in figure 1, relate to student administration and simply provide student grade, gender, age and other demographical information specific to each student.

The Blackboard activity database holds over 300 million records that each contain the user, course and location of every mouse click within the system. An example of one of these records can be seen in appendix A. The scanning 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 was summarised and aggregated into two relational databases using a series of scripts. One database contained summary information on the 2674 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 91284 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 (H09/10-064), students and courses were de-identified when the course and student databases were populated.

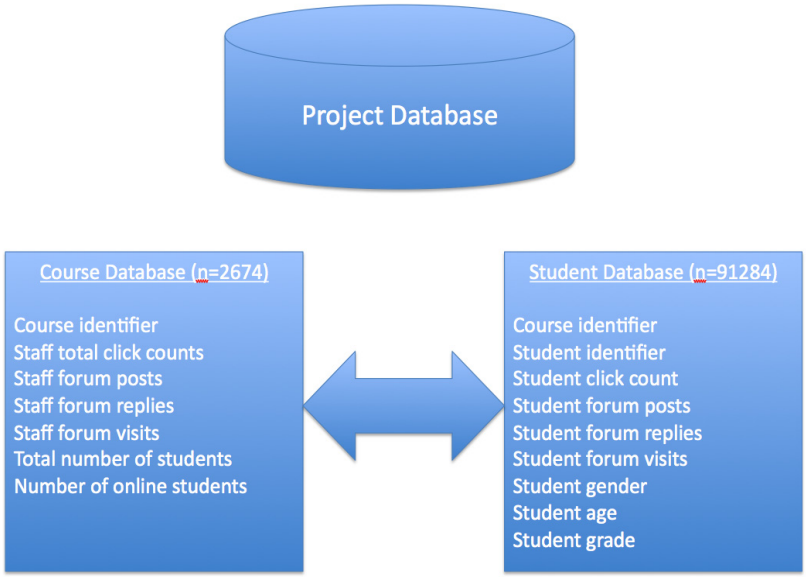


Figure 2. Aggregation of course and student data.

The aggregation of data in this way allows data 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 (Dawson & McWilliam, 2008). This paper is an exploration of how data captured by CQUniversity's LMS, combined with data from student administration systems can help inform teaching and learning in relation to engagement and its influencing factors. However, academic analytics and the captured LMS data itself have some serious limitations that require consideration.

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.

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 (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. 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 which 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 table (table 2) and the associated figure (figure 3) 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. Table 2 includes the number of students, click count average, standard deviation and the grade groups proportion of the total cohort. 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).

Table 2. Online undergraduate student clicks grouped by grade.

Grade	Student Count	Click Count average	Standard Deviation	Percentage of total cohort
HD	8777	782.39	1095.61	9.62%
D	19180	714.91	924.12	21.01%
C	21128	562.89	718.52	23.15%
P	17584	437.04	585.45	19.26%
F	24615	176.51	311.12	26.97%

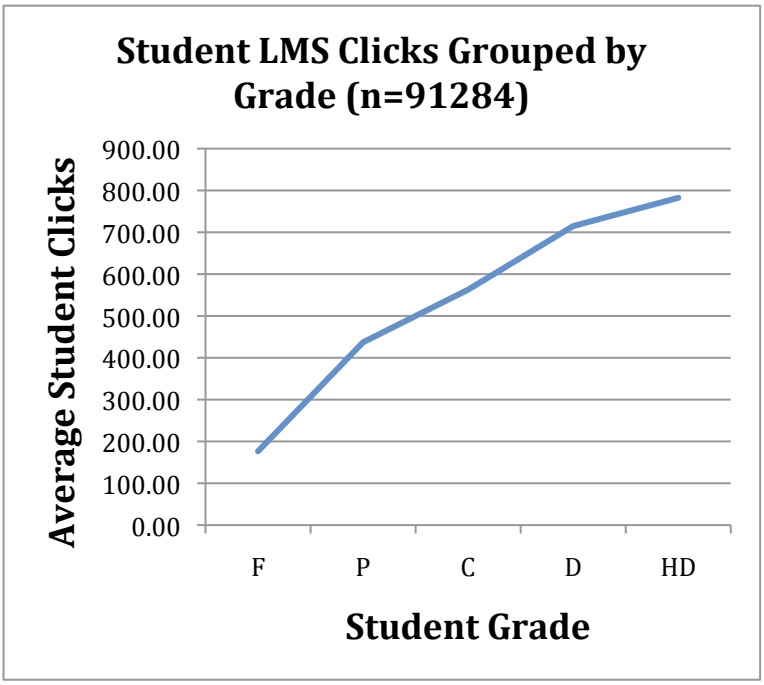


Figure 3. Average student clicks on the LMS grouped by grade

Table 2 and Figure 3 show a general correlation between the number of clicks by students within the LMS and their resulting grade across a large sample size that consists of 91284 online undergraduate students. However there is also a high standard deviation for each grade group 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 3) 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 (n=91284), 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 3 is significant in that it can be compared against factors known to influence engagement to determine the variable's influence. Using the results in figure 3 as a baseline, the following sections analyse some of the factors identified in the literature that have been said to influence student engagement. Whilst it is by no means a comprehensive list of factors that can influence LMS participation it does provide some degree of validation to both the use of LMS data in this fashion, and the method by which the LMS data is analysed.

Factors influencing student engagement in online courses

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, course design, class size, age and gender (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 as a contributing factor to student engagement in the LMS hosted courses (Vrasidas & McIsaac, 1999). The following sections show how LMS data can demonstrate changes in student participation rates based on the influence of factors identified in the literature that are known to influence student engagement. They show how teacher discussion board participation, course design, class size, student gender and age are all factors that can influence student engagement within LMS courses.

Teacher Participation in LMS Discussion Forums

Collaborative learning, cooperative learning and learning communities are all unpinned by communication between people. The main mechanism, via which communication is facilitated by an LMS, is through the use of class discussion forums. The number of posts and replies that students make on the discussion forums is quantifiable and while this could be seen as an indicator of engagement, it does not include students, sometimes referred to as lurkers, who visit the forums without making a posts or replies. It has been argued that students' participation in class discussion forums can be used as a predictor of student sense of community (Dawson et al., 2009) which forms part of the Coates (2007) definition of engagement.

The first of the seven principles suggests that good practice encourages contact between students and faculty (Chickering & Gamson, 1987) and other research has suggested that there is a significant correlation between student motivation and their participation in LMS discussion forums (Dawson et al., 2009). This is reinforced by Black et al. (2008) who state that collaboration between students and online teachers is necessary to effectively cultivate a thriving online community (Black et al., 2008). Others have said that interactions between teachers and students is a pivotal factor influencing student attitude in online learning (Tomei, 2006). A simple indicator of student-faculty contact is the presence of staff posts and replies in LMS hosted discussion forums. The following data was extracted based on the teaching staff for the courses involved having made posts or replies to the class discussion forum. It shows the average number of clicks made by students' grade groups in courses with and without staff contributions to discussion forums.

Table 3. Student grades and average clicks for discussion forums with staff posts and replies (n=45424).

Grade	Student Count	Hit Count average by students	Standard Deviation
HD	3996	1145.44	1281.77
D	10083	962.69	1048.92
C	11076	744.09	820.96
P	8907	582.11	684.61
F	11362	245.66	384.16

Table 4. Student grades and average clicks without staff posts and replies on discussion forums (n=30856).

Grade	Student Count	Click Count average by students	Standard Deviation
HD	3251	224.03	405.39
D	6076	270.34	465.43
C	6688	248.01	385.67
P	5740	207.46	325.15
F	9101	77.92	145.76

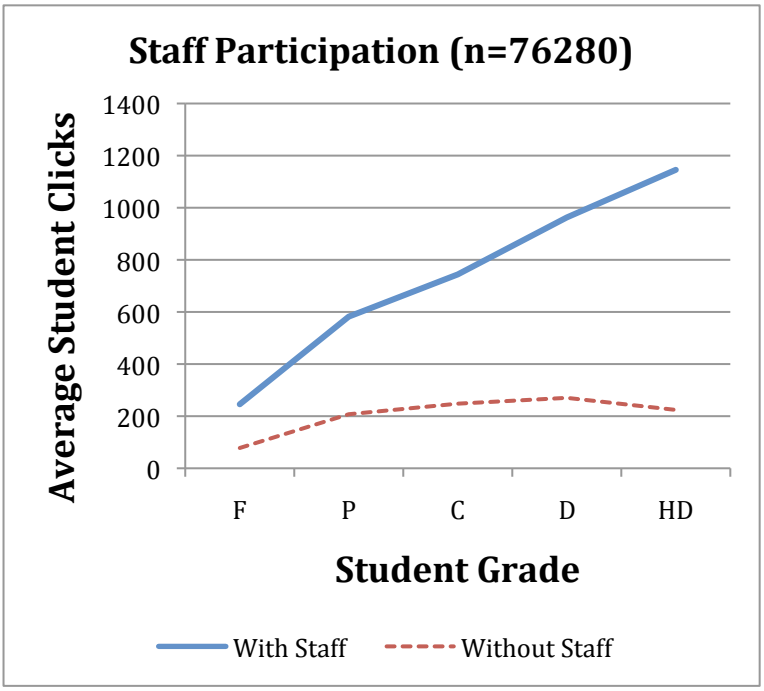


Figure 4. Student average grades and clicks with and without staff participation in discussion forums.

The 45424 students in table 4 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 make posts or replies to the class discussion forums. Additionally, the failure rate for students in courses with staff discussion board participation as calculated from table 4, 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-contextualised representation of what transpired within these courses prevents a definitive causal relationship to be established. However, it is an indicative of a pattern that suggests that staff participation in class discussion forums has a positive influence on student engagement.

This also aligns with both the first of the seven principles that suggests good practice encourages contact between students and faculty (Chickering & Gamson, 1987) and the Coates (2007) engagement definition that suggests that collaborative learning and a sense of learning community are both factors that influence student engagement.

Course Design

Vrasidas and McIsaac (1999) stated that the structure of an online course influences the degree of interaction and participation exhibited by students. The following table and chart compares the average click count for each grade group for three undergraduate courses that underwent a course redesign by an instructional designer at CQUniversity. The author of this was involved in the redesign of these courses and notes that the teaching staff, assessment and underlying resources did not change as a result of the course redesign. However, the overall course structures changed significantly as activities were replaced with group work components that were introduced to facilitate and encourage more interaction between students as well as between students and teaching staff.

Table 5. Undergraduate flex student click count. Pre and post course redesign.

	Pre-Course Redesign		Post-Course Redesign	
Grade	**Number of Flex Students**	**Click Count average**	**Number of Flex Students**	**Click Count average**
HD	48	729.81	11	2884.18
D	81	578.51	36	1892.64
C	57	475.05	42	1503.43
P	50	560.16	32	957.97
F	50	155.37	20	628.00

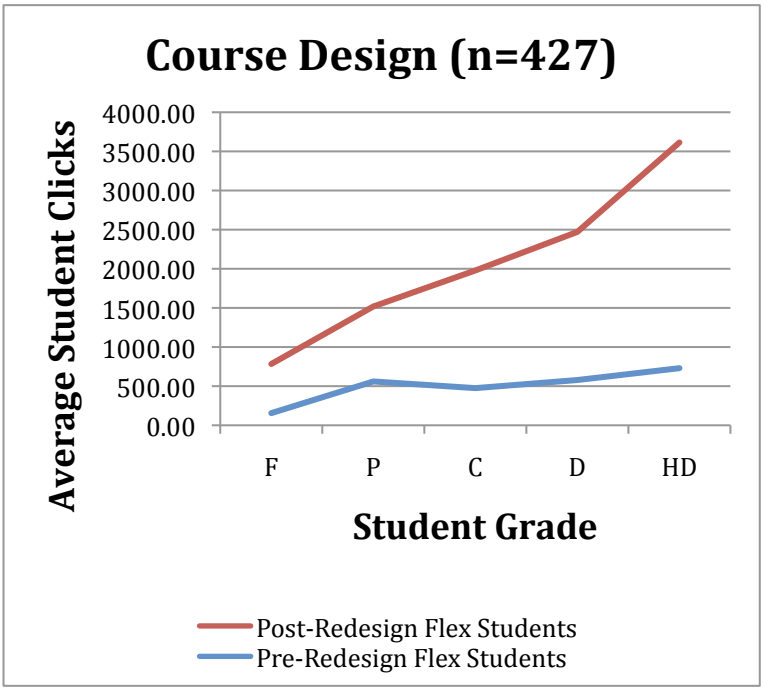


Figure 5. Click count versus grade averages pre and post course redesign.

Figure 5 shows a significant contrast between the participation rates of students in the three courses before and after a course redesign by an instructional designer. Student engagement increased significantly following the implementation of the new course design and at least one of the courses that was redesigned reported a significant reduction in its associated student failure rate (Kofoed & Muldoon, 2008). So while course resources, teaching staff and assessment remained constant, the design of the courses was changed to facilitate a more collaborative learning

approach which increased student engagement and a reduced the rate of student failure. These patterns would tend to confirm that online course design has an influence on student engagement based on indicators provided by captured LMS data.

Class size

Class size has long been recognised as a factor that influences student engagement and student achievement, although its influence within online learning environments is unclear (Hewitt & Brett, 2005; Vrasidas & McIsaac, 1999). The influence of class size on student engagement relates to the increased load for teachers in online learning environments and therefore their ability to adequately facilitate student teacher interactions (Tomei, 2006). Tomei (2006) states that teacher load in online environments increases 14% over teacher load in face-to-face courses and this affects the quantity and quality of their interactions with online students.

In the case of CQUniversity, it is difficult to determine the effect of class size as courses containing online undergraduate students can often be delivered to face-to-face students. This will have an unknown effect on the online students, as these courses will be designed for more than just the online student cohort. Additionally, there may be unknown effects due to large face-to-face class sizes inhibiting teacher's ability to interact with their online student cohort.

Interestingly, the average number of online students in undergraduate courses at CQUniversity is 34 when there is research to suggest that the optimum online class size is somewhere between 10 and 15 (Tomei, 2006). The following table and charts shows the click count averages in each grade group for courses above and below the average CQUniversity class size.

Table 6. Average student clicks before and after course redesigns.

	Below average class size		***Above average class size***	
Grade	**Number of Flex Students**	**Click count average**	**Number of Flex Students**	**Click count average**
HD	2759	499.50	8061	1096.58
D	5034	477.83	17471	966.12
C	5018	362.37	19142	756.97
P	3724	222.83	16349	604.60
F	3171	127.03	14927	392.45

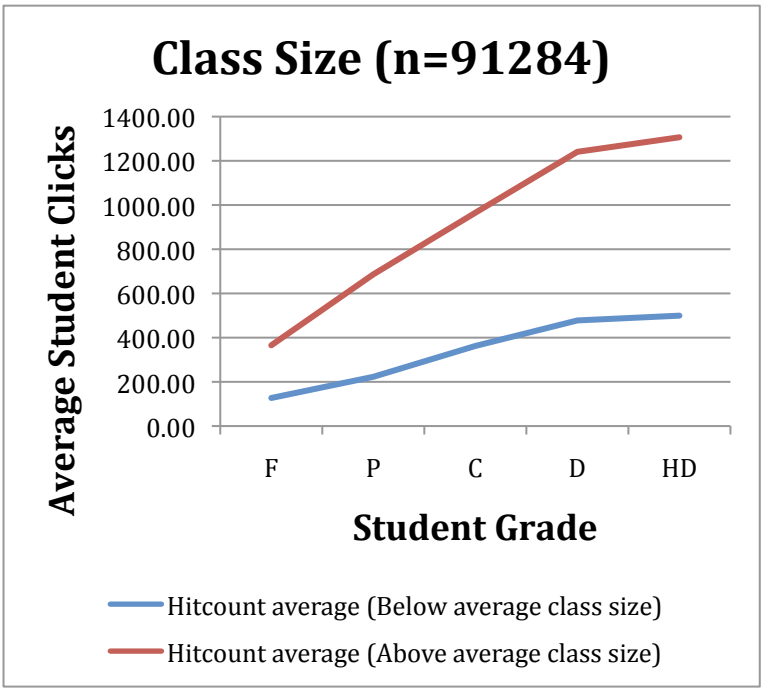


Figure 6. Average student clicks grouped by grade based on class size.

Figure 6 results are surprising in that the literature generally points towards increased class sizes having a negative impact on engagement (Vrasidas & McIsaac, 1999). If LMS click count is representative of engagement, smaller class sizes would be expected to have higher levels of engagement than larger class sizes. However according to figure 6, undergraduate online students in courses with above average class sizes, generally, use the LMS more than students in courses with below average class sizes. A potentially significant influence on the accuracy of the results in figure 6 is that most of the courses sampled also had students other than online students and therefore is not an accurate representation of the entire class. Another hypothesis is that online students in above average class sizes are not receiving enough information via teacher-student interaction and are supplementing this by interacting more with the course content. Irrespective of the reasons for the unexpected results in figure 6 and the requirement for further research into this result, class size does appear to have an influence on student engagement within the LMS.

Student Gender

It has been suggested that gender has some influence on student engagement in online courses. Blum (1999) says that this is due to online female students generally having less available study time than face-to-face female students or even online male students. It has bee said that online male students have been found to be more at ease with learning via technology, but not significantly so (Shaw & Marlow, 1999). Tables 7, 8 and figure 7 displays grade group click averages for male and female online undergraduate students.

Table 7. Male student participation versus grade (n=9182).

Grade	Student Count	Click Count average	Standard Deviation	Percentage
HD	1035	719.33	984.64	11.3%
D	1989	696.19	846.71	21.7%
C	2028	569.24	663.32	22.1%
P	1600	383.54	517.90	17.4%
F	2460	158.87	254.93	26.8%

Table 8. Female student participation versus grade (n=19812).

Grade	Student Count	Click Count average	Standard Deviation	Percentage
HD	2153	968.86	1131.21	10.9%
D	4479	894.24	1037.18	22.6%
C	4737	709.36	806.86	23.9%
P	4024	587.79	690.02	20.3%
F	4419	224.78	380.58	22.3%

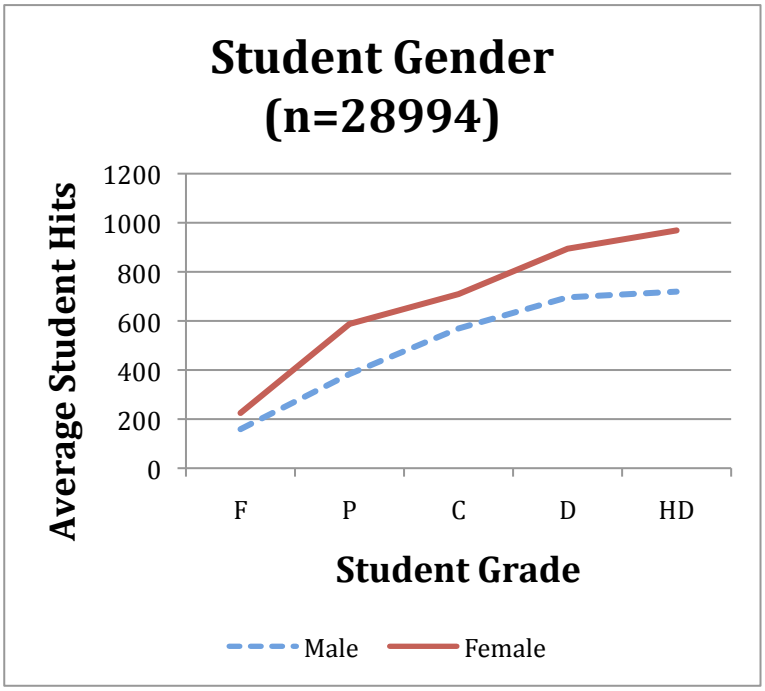


Figure 7. Rates of participation. Male and Female (n=28994)

While the trend that indicates a correlation between the quantity of clicks a student makes within the LMS and their resulting grade is still evident, there is a difference in that the male students sampled, generally recorded less clicks on the LMS than the female students in each grade grouping. The male students also had a higher failure rate than the female students, 26.9% against 22.3%, and showed less variation between the distinction and high distinction grades. Figure 7 indicates that, generally, female students are more engaged in their online courses than their male counterparts and this is somewhat validated by their lower failure rate. However, more research into this result is required as it may not be an equitable comparison as gender can influence the types of courses that students choose. Based on these results, gender appears to have some influence on student engagement. However,

further research is again required in order to explore the meaning of the correlation exposed by the data.

Student age

There is research that suggests that younger students are generally the more computer literate than older students and they are more comfortable learning from web-based tools such as an LMS (Nicholas, 2008; Perkins, Wellman, & Wellman, 2009). The following chart shows the LMS click count for 26743 students grouped by grade for four different age groups. The millennial generation is generally referred to as students born after 1981 (Nicholas, 2008) and is represented in the under 20 and under 30 categories. At the time of writing, not all student ages were available and the following table demonstrates the break down into age categories for the 26743 undergraduate flex students whose ages were available at the time of writing.

Table 9. Sample sizes for each student age category.

Grade	Ages < 20	Ages 20-30	Ages 30-40	Ages > 40
HD	148	1210	975	768
D	334	3023	1667	1328
C	503	3445	1566	1152
P	483	3249	1057	772
F	453	3001	1006	603
Total	1921	13928	6271	4623

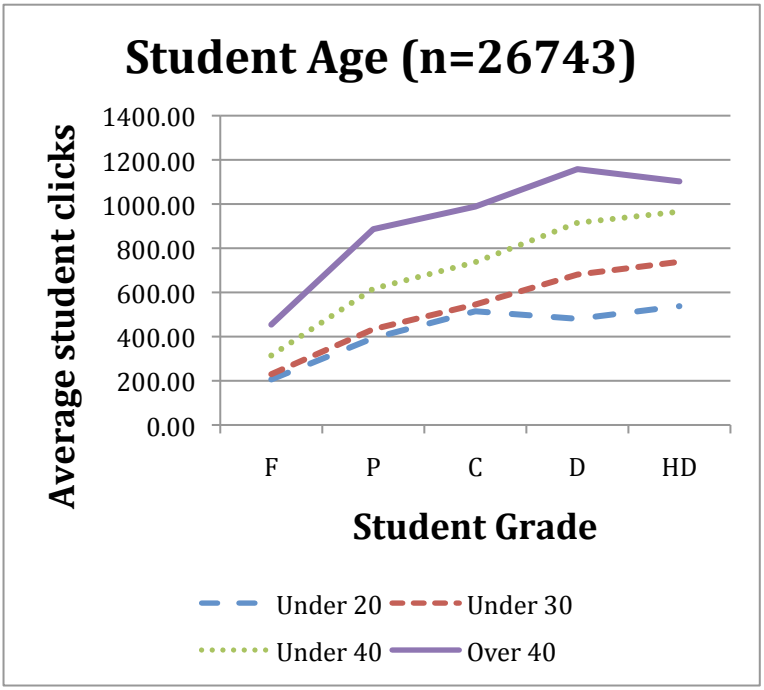


Figure 8. Click count versus Grade by Student Age

Figure 8 generally continues to demonstrate the linear trend between LMS participation and academic achievement for students in differing age brackets. However there are several features to note in this figure that potentially raise questions for future research. The under 20 students achieving a credit grade used the LMS more than the distinction students in the same age bracket while the over 40

students who received a distinction grade used the LMS more than the high distinction students in their age bracket. Additionally, it has been argued that the net generation are more comfortable with online learning in general (Nicholas, 2008), yet they do not appear to use the LMS as much as students in the higher age brackets. This is potentially an important consideration for universities who are increasingly choosing LMS for their online course delivery partly based on an assumption that younger students expect to use technologies as part of their learning (Coates et al., 2005). However, while the data can illuminate correlations such as this, further research is required to identify the causal relationships that are occurring.

Implications and future research

Teacher participation, course design, class size, student gender and student age as just a small subset of factors that can influence online 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 Pudue 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, Thompton, & 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.

Conclusion

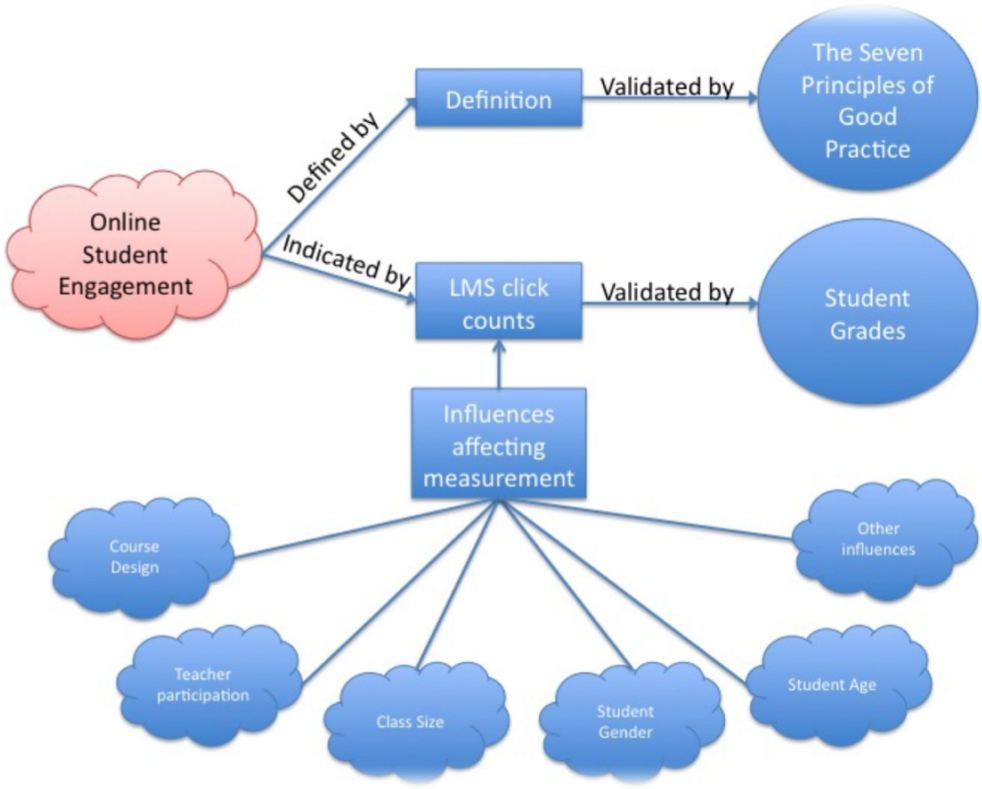


Figure 9. Overview of this study into online student engagement

Based on increasing requirements for universities to assess their efforts in improving student engagement, this study has suggested a broad definition for engagement that aligns with an established model of educational effectiveness in undergraduate education. It showed that measuring engagement is difficult and that learning environments affect the ways that students engage. 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. Variables such as teacher participation, course design, class size, student gender and student age were identified as factors that influence student engagement and were also identified as 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:

Australasian Survey of Student Engagement. (2009). Engaging Students for Success [Electronic Version]. Retrieved January 10, 2010, from http://www.acer.edu.au/documents/AUSSE ASERReportWebVersion.pdf

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. Retrieved January 10, 2010, from http://indicatorsproject.wordpress.com/2009/10/09/the-indicators-project-identifying-effective-learning-adoption-activity-grades-and-external-factors/

Black, E. W., Dawson, K., & Priem, J. (2008, 17 March 2008). Data for free: Using LMS activity logs to measure community in online courses. *Internet and Higher Education, 11,* 65-70.

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. (2007). Academic Analytics. *Educause Article*.

Caruso, J. B. (2006). Measuring Student Experiences with Course Management Systems [Electronic Version]. *Educause*, *2006*. Retrieved October 15, 2010, from http://net.educause.edu/ir/library/pdf/ERB0619.pdf

Chen, P.-S. D., Gonyea, R., & Kuh, G. (2008). Learning at a distance [Electronic Version]. *Journal of online education*, *4*. Retrieved October 21, 2009, from 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 [Electronic Version]. *AAHE Bulletin*. Retrieved July 12, 2009, from 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*. Retrieved October 23, 2009, from 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. *Tertiary education and management, 11*(2005), 19-36.

CQUniversity. (2009). Draft Learning and Teaching Management Plan 2010 [Electronic Version], *4 November 2010*. Retrieved December 4, 2009, from http://www.cqu.edu.au/academic board/ecab/2009/November%2009/ECAB%20041109%20Item%209%20Draft%20LT%20Management%20Plan%20v4%20041109.pdf

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. (A. L. a. T. Council o. Document Number)

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 for Asynchronous Learning Networks, 6*(1), 20.

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*.

Hewitt, J., & Brett, C. (2005). The relationship between class size and online activity patterns in asynchronous computer conferencing environments. *Computers in Education, 49*(2007), 13.

Huitt, W. (2001). Motivation to Learn [Electronic Version]. *Educational Psychology Interactive*. Retrieved October 31, 2009, from http://chiron.valdosta.edu/whuitt/col/motivaton/motivate.html

Jennings, D. (2005). Virtually Effective: The Measure of a Learning Environment [Electronic Version]. *Emerging Issues in the Practice of University Learning and Teaching*. Retrieved November 1, 2009, from http://www.aishe.org/readings/2005-1/jennings-Virtually_Effective.html

Kofoed, J., & Muldoon, N. (2008). *Educating Gen XYZ : strategies for facilitating active learning and engagement in accounting education.* Paper presented at the Proceedings of 9th International Business Research Conference, Melbourne, Victoria.

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.

Krause, K.-L., & Coates, H. (2008). Students' engagement in first-year university. *Assessment & Evaluation in Higher Education, 33*(5), 493 - 505.

Kuh, G. D. (2001). Assessing What Really Matters to Student Learning. Inside the national survey of student engagement. [Electronic Version]. Retrieved October 22, 2009, from 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 [Electronic Version], *14*, from 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.

Macquarie University. (2009). Student Engagement Principles [Electronic Version]. Retrieved November 15, 2009, from http://www.mq.edu.au/ltc/pdfs/Engagement_Principles.pdf

Malikowski, S., Thompton, M., & Theis, J. (2007). A model for research into course management systems: bridging technology and learning theory. *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.

Nicholas, A. J. (2008). Perferred Learning Methods of the Millennial Generation. *International Journal of Learning, 15*(6), 8.

Perkins, G., Wellman, N., & Wellman, W. (2009). *The Impact of Student Age on Online Learning.* Paper presented at the Society for Information Technology & Teacher Education International Conference, Chesapeake, VA.

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. Retrieved 26th November 2009, from http://news.uns.purdue.edu/x/2009b/090827ArnoldSignals.html

Puzziferr-Schnitzer, M. (2005). *Managing Virtual Adjunct Faculty: Applying the Seven Principles of Good Practice*. Paper presented at the Distance Learning Administration 2005. Retrieved January 10, 2010, from http://www.westga.edu/~distance/ojdla/summer82/schnitzer82.htm

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. Retrieved January 10, 2010, from http://www.ascilite.org.au/conferences/auckland09/procs/rankine.pdf

Rovai, A. (2002). Building Sense of Community at a Distance. *International Review of Research in Open and Distance Learning, 3*(1).

Seifert, J. W. (Updated 2004). *Data Mining: An Overview*. Retrieved January 10, 2010. from http://www.fas.org/irp/crs/RL31798.pdf.

Shaw, G., & Marlow, N. (1999). The role of student learning styles, gender, attitudes and perceptions on information and communication technology assisted learning. *Computers and Education, 33*(4), 11.

Stovall, I. (2003). Engagement and Online Learning [Electronic Version]. *UIS Community of Practice for E-Learning*. Retrieved October 15, 2009, from http://otel.uis.edu/copel/EngagementandOnlineLearning.ppt

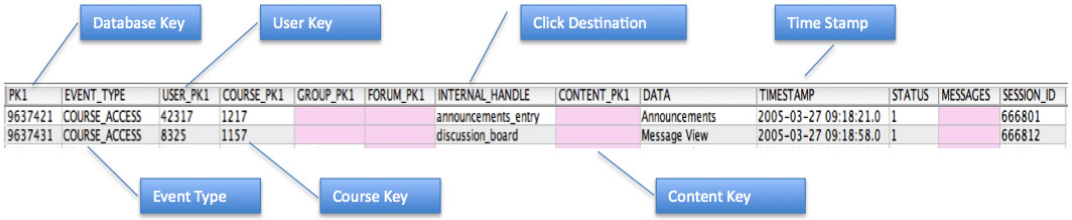
Tomei, L. A. (2006). The Impact of Online Teaching on Faculty Load: Computing the Ideal Class Size. *Journal of Technology and Teacher Education, 14*(3), 10.

Veerman, A., & Else, V.-D. (2001). *Collaborative learning through computer-mediated communication in academic education.* Paper presented at the European Perspectives on Computer Supported Collaborative Learning : Euro-CSCL, Maastricht McLuhan Institute.

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.

Appendix A. Blackboard Activity Database Sample.



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9637421	COURSE_ACCESS	42317	1217			announcements_entry		Announcements	2005-03-27 09:18:21.0	1		666801
9637431	COURSE_ACCESS	8325	1157			discussion_board		Message View	2005-03-27 09:18:58.0	1		666812