Academic Indicators: data mining as reflective practice

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In fulfilment of the requirement of PPV of the MLM at CQUniversity

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Executive Summary

Learning Management Systems (LMS) are important tools in the university context and much money, time and resources have been spent in developing, utilizing and maintaining the LMS. Data, like hit counts, resource utilization, discussion participation, and LMS features that support student engagement, is obtained by applying some simple scripts, data mining, to the LMS backend database. At CQUUniversity data could potentially be used to inform aspects of academic practice to engage students by utilising some common features of the LMS in a way that supports student engagement. This study focussed on how an academic interacts with the LMS, how the LMS is used by students, and how these interactions create involvement. Staff interaction with students seems to be one of the key factors in student engagement.
Introduction

Learning Management Systems (LMS) are important tools in the university context and much money, time and resources have been spent in developing, utilizing and maintaining the LMS. These systems assist instructors to administer courses by providing access to content, discussion forums, assignment uploads, grade entry, and other features. Staff facilitating teaching and learning currently use Blackboard for their teaching though there seems to be little use of the LMS to aid in the improvement of pedagogy, or any future planning for teaching and learning. Data, like hit counts, resource utilization, discussion participation, and LMS features that support student engagement, is obtained by applying some simple scripts, data mining, to the LMS backend database. This data is utilized to aid in the reflection of pedagogical practices in alignment with usage statistics. At CQUniversity data could potentially be used to inform aspects of academic practice to engage students by utilising some common features of the LMS in a way that supports student engagement.

There is some evidence (Beer, Jones & Clark, 2009; Malikowski, Thompson & Theis, 2007; Gonzales, 2009) that LMS systems are not being used to their best advantage. They are, in the vast majority of cases, used only as a data repository. Academics use the LMS as a convenient mode of delivering lectures in digital form and then disseminating this to their respective students to make hard copies. If academics had to be categorized in terms of LMS usage, it would be that they are very much content centred though this may be a limitation of the current LMS. Yet, the supposition is, that academics put time and effort into the delivery of their courses, aiming to get the best possible outcome for their students that they can, given the limitations of the management systems we are currently using. Linking LMS usage to engagement, “the time, energy and resources student devote to activities designed to enhance learning at university” (Krause, 2005, p. 3), will aid in reflecting on academic practice and could potentially facilitate engaged teaching, moving the academic from the centre, incorporating real world examples, incorporating reflective methodologies, and shifting the emphasis in teaching from content to dialogue (Hollander, Saltmarsh, & Zlotkowski, 2002).

Researchers seem to look at inherent student qualities that tell part of the story about how students become engaged with the LMS, and with the academic (Ainley, 2004) though there has been research into involvement (Krause, 2005; Goldspink, Winter & Foster, 2008). This study focussed on how an academic interacts with the LMS, how the LMS is used by students, and how these interactions create involvement. Fresen (2007) in researching web-based learning identified staff interaction with students as one of the key factors in student engagement. Dawson and McWilliam (2008, p. 27) also point out that it is not only staff interaction that is crucial, “the quantity of ‘teacher presence’ and quality of ‘teacher presence’ are influencing factors in developing and maintaining student online engagement.”

Reflecting on staff interaction, examining an academic’s approach to teaching and what features they adopt within the LMS will be of some benefit, though
these two need to be allied to ‘use’ of the features within the LMS to give some idea of interaction that may explain in some small way staff/student interaction and engagement. In summary, the method taken in this study is that, an academic’s approach to teaching + Feature adoption + Use = involvement (a key factor in student engagement according to Krause, 2005)

**Project**

This project is a self-evaluation and exploratory study of what has occurred through time in the researchers courses using data mining as a technique of enquiry and exploration. Three courses were examined over time; Course 1, 2005 - 2009, Course 2, 2007 - 2009, Course 3, 2006 - 2009, a total of 1029 students in the student cohorts of fail (F), pass (P), credit (C), distinction (D), and high distinction (HD). The study:

1. Examined the academic’s courses coming to some understanding of the researcher teaching methodology
2. Examined the LMS features and what has been adopted by the author
3. Examined the use of the communication tools within the site using hits data to see what is occurring in these course sites in terms of content files, forums, hit counts, and grade

**Methodology**

At CQUniversity a substantial amount of data is available in the backend of the LMS database. The data has been saved in a form accessible via a SQL command, which is designed to manipulate and retrieve data stored in relational database products, such as Blackboard. The data has been stored since 2004 through to 2010 and the author estimates that there are over 300,000,000 hits stored in this site. The study has been conducted using a purely quantitative analysis of the data within, what can be classed as, a very complex educational setting. The patterns revealed by the data queries reveals relationships between users and the LMS; and patterns of behaviour between users, each other, content, and communication pathways.

A word of caution about LMS data; the data is limited to hit counts from staff and students, it can tell us the number of features within a course, it can display when these were accessed and by whom, it can give us an indication of grade versus hits, and it can tell us a lot about user behaviour within a system but it is an indication only. University policy, institutional bias, technical issues, staff development activities, cultures within disciplines, the difference in pedagogy between disciplines, the development of the system itself, and the tools that create the online space, both for content and for communication, have some bearing on the system. Utilising the data as it stands does not give indication of intention nor does it give a ‘definite’ answer.

A systems scan of designer and user behaviour within ... [LMS] can never describe in full how designers and users are engaging with the use of online environments for teaching and learning ... Therefore, utilising a systems view to codify designer and user behaviour is ‘indistinct’, but can
play in the refinement, ratification, and benchmarking of broader evaluation strategies (Heathcote & Dawson, 2005, p. 3).

Getting the data to inform a lecturer’s teaching approach aids in formulating ways to open up dialogue to enhance the student’s learning journey by providing lecturers, the researcher included, access to resources that create a sense of community, where learning is part of the social sphere. As Palloff and Pratt explain an important part of the learning process is the “interaction among students themselves, the interaction between faculty and students, and the collaboration in learning that results from these interactions” (Palloff & Pratt, 1999, p. 12).

Discussion

Conceptions of teaching

Gonzales (2009) paper examined a small number of academic members teaching online postgraduate courses and applied Kember and Kwan’s (2000) Teaching Approach. Kember and Kwan’s (2000) approach is based on two broad, though linked, teaching points of reference; teacher centred/content-oriented' which include two conceptions of teaching (‘teaching as imparting information’ and ‘teaching as transmitting structured knowledge’); and ‘student-centred/learning-oriented’, which also includes two conceptions of teaching (‘teaching as facilitating understanding’ and ‘teaching as promoting intellectual development/conceptual change’) (p. 300)(Figure 1)

Figure 1: Approaches to teaching. Source: Kember and Kwan (2000, p. 476)
Approaches to teaching

Based on this information, Gonzalez (2009) reached the conclusion that there are two broad approaches to teaching, what he classed as “informative/individual learning focused” and ‘communicative/networked focused’ (Table 1). What Gonzales (2009) created was a model/framework that could classify academics of online education as similar to, or different from, on campus educators. What was not discussed in his paper was how such a framework could be used to develop pedagogical strategies that could enhance an academic’s teaching so that they could move from a content oriented approach to a learning oriented approach.

Gonzales (2009) has developed the following two dimensions with which to examine features that support communication, and which aid in the development of student engagement (Table 1).

Table 1: Dimensions delimiting approaches to online teaching – (Gonzalez, 2009: p311)

<table>
<thead>
<tr>
<th></th>
<th>Informative/individual learning focuses</th>
<th>Communicative/Networked learning focused</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity of use</td>
<td>Small range on media and tools used to support learning tasks and activities (mainly sources of information with small opportunities for interaction and communication)</td>
<td>Wide range of media and tools used to support learning tasks and activities (with emphasis on interaction and communication)</td>
</tr>
<tr>
<td>Role of the teacher</td>
<td>Select and present information</td>
<td>Design spaces for sharing and communication. Support the process.</td>
</tr>
<tr>
<td>Role of the students</td>
<td>Study individually information provided</td>
<td>Participate in a process of knowledge building</td>
</tr>
</tbody>
</table>

Allied with the Dimensions, that give some idea of the features adopted and utilising Kember and Kwan’s (2003) study, Gonzales (2009, p. 311) demonstrates that;

Regarding the relationship between approaches to teaching ... using the web ... it was found that the lecturer having a ‘content-centred’ approach to teaching ... can be defined as ‘informative-individual learning focused’; while those having a ‘transitional’ or ‘learning-centred’ approaches would have an approach to teaching with the web defined as ‘communicative-networked learning focused’.
The way forward is to develop data mining routines, which would place courses, and their teachers’ within the above dimensions, specifically looking at what features in the LMS are adopted, and whether or not they support student engagement. Using Gonzalez (2009) model, it should be possible to data mine Blackboard for courses which fit into the two broad dimensions by examining the content of the courses as to media tools present, resources allocated by lecturer, lecturer involvement with course and discussion forum (if any), and student involvement with content, discussion forum and other media tools used.

The aim would be to look at the type, and variety, of tools and media within a site to see if they:

1. Are used solely for information dissemination
2. Are used to encourage interaction and communication between students and teachers, and between students and students
3. Are a combination of content and communicative focussed features

**Gonzales problem**

While Gonzales (2009) is looking at Approaches to Teaching, and formulated, what appears to be a way of examining the academic’s teaching preferences, he attached no empirical significance to the outcomes. What is lacking in his research is some conclusion about whether or not being a ‘content’ focused or a ‘communicative’ focussed academic has any bearing on becoming a better tutor, and more importantly, whether or not being one or the other has any significance to better teaching and, therefore, greater student engagement.

Other factors that Gonzales (2009, p. 313) identifies that impact on teaching, and on the academic, are ‘institutional influence’, ‘nature of the student, ‘curriculum and subject’. For instance, Gonzales (2009) did question whether or not teaching in ‘hard’ disciplines, such as the sciences (maths, physics, chemistry, engineering and their connected discipline areas), is different to teaching in ‘soft’ disciplines (arts, journalism, cultural studies, education), and whether this is actually part of the discipline, though the terms of his research could not be verified. In other words, Gonzales (2009) attributed nothing ‘good’ or ‘bad’ to the data that he gathered. Nowhere in his research does he state that being a content focussed academic, or being a communicative/student focussed academic is either a good thing or a bad thing. However, the implication of this data is that being a ‘communicative/networked focussed’ (student focussed) academic is a ‘good’ thing to be.

Questioning the data, and coming to a conclusion about the ‘fit’ of an academic to the Dimensions, is not enough, it just tells researchers where the academic ‘fits’ within a continuum between content and student focussed. It does not tell if this is ‘good’ in terms of pedagogy, teaching, learning, or student engagement. What this study proposes is to link the Gonzales (2009) two dimensions with two other factors, the adoption of LMS features (Malikowski et al, 2007), and how the features are used; and then look for links that imply involvement. If it can be shown that an academic is student focussed, and that this is linked to positive student outcomes it would give credence to Gonzales (2009) Dimensions.
LMS features adoption

Gonzales (2009) mentions 'Intensity of use' within which there is a wide range of media and tools, or not, and ‘resources’, web space as data repository, or web space communication enhancing (see Table 1, p. 3) as two of the factors that academics adopt depending on their teaching approach. To examine the features within a LMS, a model was developed by Malikowski et al (2007, p. 167) which proposes five LMS research categories; “transmitting course content;... evaluating students;... evaluating courses and instructors;... creating class discussions;... and creating computer based instruction”. The aim is to map out how the LMS is used, and in what way features are adopted over time. Malikoski et al’s (2007) conclusion is that the most prominent use of the LMS is to transmit content to students.

Examining Malikowski et al’s (2007) model (Figure 2) in more detail the LMS was divided into three categories, ‘most used, moderately used, and rarely used’, of which they indicate that the most used is content, and transmission of that content to students

Since ... [LMS] ... are used by most instructors to transmit content, this category was placed at the top of the flowchart, at Level 1, suggesting that instructors transmit content when they first use a ... [LMS] ... features for evaluating students or creating discussions are adopted much less often than transmitting content, so the flowchart suggests categories containing these features are adopted after instructors have transmitted content in a...[LMS] (Malikowski et al 2009, pp. 168-169)

Figure 2: Flowchart of LMS research categories (Malikowski et al 2007, p. 168)
Looking at the specific university context here at CQUniversity, Beer et al (2009) moved to simplify the five categories down to three. The result is an adapted Malikowski model (Figure 3). Data mining procedures were run on the Blackboard LMS used at CQUniversity categorizing the LMS features into one of five categories, grouped into the same levels used by Malikowski et al (2007). Within the three levels LMS features were categorized into each of the levels.

Figure 3: Flowchart of LMS categories from Malikowski et al. 2007 adapted by Beer et al (2009, p. 62)

- Level 1: the most widely used of the LMS system is content transmission that consists of content/files, announcement, and gradebook;
- Level 2: consists of creating class interactions (chat, forums, email) and evaluating students (quizzes and drop box);
- Level 3: consists of evaluating courses and instructors (surveys) and computer-based instruction (some quizzes and adaptive release).

What is most interesting about this data is Malikowski et al (2007) found that more then 50% of courses, at any institution, use the LMS only to transmit content, files, announcements and gradebook.

Given that Gonzales (2009, p. 322) states that “the lecturer having a ‘content-centred’ approach to teaching … can be defined as ‘informative-individual learning focused’ there is, according to Malikowski et al (2007), at CQUniversity over 50%, of all courses that are content oriented, with a corresponding fall in courses that are high on communication practise, which would indicate that courses are not being designed to facilitate and create engaged learning spaces.

Of course, looking at this data does not tell the whole story about what is going on. Though it is indicative that something is happening in which academics as a whole are content focussed, demonstrating that the LMS is not being used to its full potential, and that the communication aspect of the LMS is also not being
used to its full potential.

**Student Involvement**

If the aim of the LMS is to be only a data repository then it works at that level, though underlying the adoption of features, and academic experience in teaching and learning is the notion of student involvement/engagement.

Student engagement is generally considered to be among the better predictors of learning and personal development ... The premise is deceptively simple, perhaps self-evident: The more students study or practice a subject, the more they tend to learn about it. Likewise, the more students practice and get feedback on their writing, analyzing, or problem solving, the more adept they should become (Kuh, 2003, p. 25).

The underlying principle is that the academic ‘should’ use tools and media that support learning tasks, and that are used to support activities, “with an emphasis on interaction and communication” (Gonzales, 2009, p. 311).

There seems to be five areas in which students become involved - engaging through class contact, engaging online, engaging with peers, engaging with academics, and engaging with the institution (Krause, 2005). It seems clear that online study would be most beneficial if all of these could be achieved together, and if the LMS would support the engagement of students, and that academics created online spaces that are engagement spaces. Gonzales (2009) makes the premise that utilising features that support what he calls ‘network-learning’ makes a difference in the way that students learn. What difference does it make if the academic is ‘teacher centred/content-oriented’ or ‘student-centred/learning-oriented’?

Tools are provided within the LMS for academics to use to facilitate learning but learning cannot be divorced from the social aspect as teaching and learning occur within a social sphere and within a specific context. Learning is sociocultural in nature, and it is a social activity occurring within a specific timeframe and place (Dyson & Campello, 2003). As well as the place, and the tools used to create learning opportunities, it is the way that academics, and students, use the tools provided that creates opportunities.

... learning is defined as a consequence of members of a community engaging in a given activity. It is assumed that while engaged in the activity the group develops and incorporates knowledge. However, there must be a purpose or motive for such activity. Members take part in the activity because they have mutual objectives they believe will be achieved (Lave and Wênger, 1991, cited in Dyson & Campello, 2003, p. 15).

LMS are, therefore, spaces within which social groups are created, and kept cohesive if the units within the LMS are working together, the tools, the academic, the student and the communication and collaboration spaces. A course within a LMS is such a social activity. Students and teachers are members of a group performing tasks to achieve their objectives. While engaged in the course
members use artefacts such as lecture notes, journals, web pages to perform tasks. A LMS “is one possible artefact that is available to the group. Attributes of the interface should be analysed to identify, for example, how efficient and satisfying the system is to use,... and ... to incorporate variables that reflect the social-cultural component of the teaching/learning activity for which the LMS is intended” (Dyson & Campello, 2003, p. 11).

**Research questions**

There are three broad questions. These are:

- Can an understanding of the patterns, and relational user behaviour, be known by examining the data alone?
- Given that the design of the course is limited by the LMS, and that Malikowski et al (2007) suggests that LMS’ are basically a data repository, what are academics doing to enhance student learning?
- Does the academic, in the way that they develop the course create the environment for involvement by students, a key factor in this study?

Gonzales (2009) focuses on the tools and media within a course that the academic adopts, what he does not do is demonstrate why this is important. At the heart of this study is trying to develop ways of understanding teaching and learning, by focusing on features that the academic ‘thinks’ are important and look at feature adoption that students may use, both for communication, for learning, and for engagement with tasks, peers, and content.

From the academic perspective it should be possible to examine an academic’s adoption of features that foster “communication/networked learning” and to use this to enhance student engagement. Gonzales (2009) has proposed that it is possible to look solely at the features within a course within any given LMS and from this postulate that the academic is either content centred or learning centred.

It has already been shown that there are some problems with the Dimensions model as outlined by Gonzales (2009). Analysis routines can be developed that would place courses, and academics within these dimensions, and this in itself is interesting, though not the whole of what is occurring. Analysis routines can be set up that mine the data for the variety and use of tools within a site (Intensity of use and Resources) grouping different tools available in the LMS into different categories as shown by Malikowski et al’s (2007) adaption (Figure 3, p. 11), and then examine these different tools in terms of engagement. With the data available in the Blackboard database, frequency of use can be examined, and the level of use, and user behaviour, can also be tracked in those same areas.

What can not be taken into account in this data is the increasing use of software freely available, Messenger, Facebook, chat, and other external tools, by academics providing a level of access to other communication tools, working around the problems associated with the limitations that any LMS has in terms of the tools available, and which students can, and will use.
One other measurement that can be made is to measure student and staff activity, hit counts within the web space provided within the LMS, and link these to Gonzales Dimensions, so that we see not only that the academic has adopted additional communication and engagement tools, but also to check whether these tools are being accessed, and more importantly used, by both the staff member, and the students.

Fresen (2007) in examining critical success factors that support web-based learning identified the level of interaction with students as one of the key factors. One way to test this factor was to examine forum activity by all teaching staff within the term. In a study by Beer et al (2009) CQUiversity's courses were divided into four distinct groups and then a SQL query was run using hit counts as the key factor in ascertaining engagement. Within CQUiversity’s context a high hit count is over 3000 hits, a medium hit count is 1000 – 3000 hits, and low hit count is between 100 to 1000 hits, with the super low hit count being below 100 hits. The results showed that there is a clear correlation between forum hits and grades, and between hits on the site and grade. There seems to be a link then between student activity on the LMS and final grades and that this is strongest in courses where the academic has higher participation. The data clearly shows that students in courses with low staff participation average less hits on forums than do their peers in courses were the academic has higher participation (Beer et al, 2009).

While the forum tool is only one tool in the LMS it does indicate that increasing academic behaviour influences student engagement. Linking tools to use would then give some idea of not only feature adoption but also of use. Benchmarking courses from one term to another, and introducing a feature such as chat or a discussion forum should highlight a heightened awareness of student engagement. There should be a difference in the hit count ratio between one term and the next, with a corresponding change in results, though this may take a few terms to sort out, and is dependent on the awareness of such communication strategies from the academic perspective.

Blackboard, the principal LMS at CQUiversity tracks the activity of each and every participant in all courses throughout the term. Categorising this information into groups (adding content, using information, forum postings, forum lurking, responding to posts, adding quizzes) then running an analysis on these groups would identify who, is doing what, when, and indicate student engagement; that there been a change in behaviour of the student.

**Data Analysis**

To test the Gonzales (2009) model a query was run examining content within courses at CQUiversity that use the Blackboard LMS. While there is another LMS, Webfuse, at CQUiversity, the researcher was not able to gain access to this data, and while the resulting Blackboard data is useful in looking at indicators of engagement, it is also incomplete, though there is more than four years data in Blackboard for the researcher’s courses. What have not been included in the
data is the Absent fails, Withdrawns, and other student cohorts that do not fit into the High Distinction/Fail grading system.

**CQUniversity**

One of the interesting findings from preliminary research into Blackboard across all university courses (Table 2 below) demonstrates that from 2005 to 2009 (Term 1) the courses with content files has grown 28% over those four years, with the average files per course rising by 18. There appears to be an interesting pattern developing, though more research needs to be done in this area. While the total number of files year by year is increasing the hit counts per student, the total number of times students access the site, has not risen in the same manner as would be indicated by the data. One possible link here is that students are downloading the files, then printing them out to read at a later date.

**Table 2: Content files on Blackboard 2005 – 2009, and average hits per student**

<table>
<thead>
<tr>
<th>Year</th>
<th>Courses with File</th>
<th>Avg files per course</th>
<th>Avg ext. links per Course</th>
<th>Avg hits on files per student</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>50%</td>
<td>10.14</td>
<td>2.46</td>
<td>6.68</td>
</tr>
<tr>
<td>2006</td>
<td>75%</td>
<td>20.21</td>
<td>5.77</td>
<td>9.50</td>
</tr>
<tr>
<td>2007</td>
<td>78%</td>
<td>23.80</td>
<td>9.56</td>
<td>18.45</td>
</tr>
<tr>
<td>2008</td>
<td>71%</td>
<td>23.77</td>
<td>9.95</td>
<td>18.07</td>
</tr>
<tr>
<td>2009(T1)</td>
<td>78%</td>
<td>28.17</td>
<td>14.01</td>
<td>18.52</td>
</tr>
</tbody>
</table>

**Graph 1: Content vs communicative features in all courses in all terms at CQUniversity**

The pattern (Graph 1) that emerges from the data is that content (the blue line) far outweighs communicative practice (the red line) on Blackboard across all courses through 2005 /2009 T1. The majority of academics appear to not utilize the communicative networked focused features within the LMS.
Another example of this is seen in the following data (Figure 4) where the simple query was run asking the question, “How many academics post to discussion forums?”

**Figure 4: Course Coordinators posting to forums**

![](image)

71% of all academics at CQUniversity do not post to the forums in any of the LMS. The figure is staggering even taking into account that some courses are placeholders for Honours, and Masters subjects. The sheer volume of Course Coordinators who do not post even when provided with a forum is an interesting fact. Of course, more research would have to be done to see if any internal or external factors are involved, but it appears to be very significant in light of student engagement. Looking at the researcher’s courses provides an insight into whether the academic’s post, it gives the total quantity of posts, but not the quality of the post, which Dawson and McWilliam (2008) argue are the two factors in forum posts that aid engagement.

**Courses**

**Academic Indicator’s**

Moving away from examining the university context the study focuses on the author’s courses looking at the specifics of a small number of courses within the institution.

**Graph 2: An academic’s replies to Discussion Forums all courses**

![](image)
One of the first things examined within Course 1, Course 2, and Course 3 is the dichotomy between content and communicative practice as outlined by Gonzales (2009). What was examined was that the course had both content and communication features. The result (Graph 2) indicates that there was a high level of communication occurring, which goes against the trend for the whole of CQUniversity where content far outweighs communicative practice at CQUniversity. Results do not follow the trend in the low communicative practice as seen at CQUniversity, with all courses having a Discussion Forum, utilized by both the students and the academic/s. In fact, the use of the forums by the academic seems to be relatively consistent across all three courses.

The placement of content and communication features within the courses examined in this study would indicate that the academic is communication focused. While the academic has posted to the forums and replied numerous times, this result does not examine if these responses in the forums are significant in terms of quality, which Dawson and McWilliam (2008) argue is essential to building student engagement.

One of the most important indicators of involvement in a course is the final grade of the students enrolled (Beer et al, 2009). Linking student user behaviour on the LMS features with grade indicates that there is some link between grade and involvement, though what that link is has not been established. Dawson and McWilliam (2008) found that there were significant differences between the low and high performing students in terms of the number of hit counts, on both the forums and the content. Every course has both content and forums, utilizing two of the three aspects of LMS feature adoption as outlined by Malikowski et al (2007). The academic always utilizes both content and forums to try to create a space where engagement can occur. In no course is email used in Blackboard, nor are any other communication tools, though these are provided outside of the LMS – MSN, chat, email, Facebook, and Twitter. Based on the model by Malikowski et al (2007) the academic established within the LMS a space where discussion, communication, content dissemination, and student engagement could occur.

Course 1
Course 1 is a first year course that is an essential subject for one of the professional programs at CQUniversity. It has been running in its current form since it was developed for Blackboard in 2005. It has only had the one academic
teaching into it, though it does have a team approach to writing content, and evaluation. Most years, markers have been used though the Coordinator has been the same academic.

Running the data-mining query, hit counts on forums and content, on the first of the three courses to be analyzed (Graph 3), demonstrated that content files, and the forums were on a par with each other.

**Table 3: Course 1 - Content and Forum files on Blackboard 2005-2009**

<table>
<thead>
<tr>
<th>Course</th>
<th>Student #</th>
<th>Student %</th>
<th>Content hits</th>
<th>Forum Hits</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>104</td>
<td>16.1</td>
<td>99.585365</td>
<td>120.463414</td>
</tr>
<tr>
<td>P</td>
<td>80</td>
<td>12.4</td>
<td>179.18644</td>
<td>174.083333</td>
</tr>
<tr>
<td>C</td>
<td>162</td>
<td>25</td>
<td>209.36</td>
<td>213.72</td>
</tr>
<tr>
<td>D</td>
<td>213</td>
<td>32.9</td>
<td>335.740932</td>
<td>316.31884</td>
</tr>
<tr>
<td>HD</td>
<td>88</td>
<td>13.6</td>
<td>535.144736</td>
<td>457.032786</td>
</tr>
</tbody>
</table>

The total number of students for Course 1 is 647 with an average of 66 per term. Failure rate is high; an average of 104 students failing the course, 16.1%. The students who failed were also the ones who did not utilize the content nor did they utilize the forums averaging <99 content hit and <120 forum hits compared to <535 content hits and <457 forum hits for the HD student cohort (Table 3).

**Data Analysis**

What is intriguing about this data from this one course is that there seems to be a direct link between student hits and grade (Beer et al, 2009; Dawson & McWilliam, 2008), both in content and in the forums. While this is one of the first year courses it highlights the need for students to engage with the content and the forums, though it seems as though the higher the grade the better the engagement with content and with other students and staff via the forums.

**Course 2**

The second course analysed is another first year course which is an essential specialty course in the suite of courses in the discipline (Graph 4). The course has been run in its present form since moving to Blackboard in 2007. Markers have been used in 2007 though none since that year. The same academic has been the Coordinator, and the content has been written by a discipline team.

**Graph 4: Student Hits for Course 2 - 2007-2009**
Students grading is linked to their participation in the course forum as well as their linkage to the course content.

Table 4: Course 2 - Content and Forum files on Blackboard 2007-2009

<table>
<thead>
<tr>
<th>Course 2</th>
<th>Student #</th>
<th>Student %</th>
<th>Content</th>
<th>Forums</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>54</td>
<td>20.6</td>
<td>120.90566</td>
<td>118.15625</td>
</tr>
<tr>
<td>P</td>
<td>40</td>
<td>15.3</td>
<td>364.3</td>
<td>311.473684</td>
</tr>
<tr>
<td>C</td>
<td>54</td>
<td>20.7</td>
<td>281.296296</td>
<td>220.244897</td>
</tr>
<tr>
<td>D</td>
<td>80</td>
<td>30.7</td>
<td>324.975</td>
<td>293.214285</td>
</tr>
<tr>
<td>HD</td>
<td>33</td>
<td>12.7</td>
<td>396.878787</td>
<td>329.741935</td>
</tr>
</tbody>
</table>

The total number of students for Course 2, since it moved to Blackboard, is 261 with an average of 87 per term. Failure rate is high with 54 failing the course, 20.6%. The students who failed were also the ones that did not utilize the content nor did they utilize the forums averaging <120 content hits and <118 forum hits; compared to <396 content hits and <330 forum hits for the HD student cohort (Table 4).

Data Analysis
While the trends in Graph 4 demonstrate some interesting patterns, especially the dip with the Credit students, identifying the reasons behind these patterns require additional research methods, including surveys. However, the suggested pattern reveals that there is a link between student hits and student grades (Beer et al, 2009; Dawson & McWilliam, 2008). Of course, whether this link is causal requires more research.

Course 3
Course 3 is an advanced course and only available to third year students who must have successfully passed four other courses in the discipline. The content has been written by the academic who is also the Coordinator and tutor, and no other markers have been used in this course.

Analyzing the third course gives a similar pattern to the other two courses (Graph 5). There is a link, though this has not been established as causal, between hits and grade.

Graph 5: Student Hits for Course 3 - 2005-2009
Table 5: Course 3 - Content and Forum files on Blackboard 2006-2009

<table>
<thead>
<tr>
<th>Course</th>
<th>Student #</th>
<th>Student %</th>
<th>Hits</th>
<th>Forums</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>3</td>
<td>2.4</td>
<td>291</td>
<td>22</td>
</tr>
<tr>
<td>P</td>
<td>13</td>
<td>10.7</td>
<td>547.25</td>
<td>382</td>
</tr>
<tr>
<td>C</td>
<td>22</td>
<td>18.7</td>
<td>1361.3</td>
<td>139.3</td>
</tr>
<tr>
<td>D</td>
<td>48</td>
<td>39.7</td>
<td>1723.75</td>
<td>219.535714</td>
</tr>
<tr>
<td>HD</td>
<td>35</td>
<td>28.9</td>
<td>3401.875</td>
<td>557.869565</td>
</tr>
</tbody>
</table>

Failure rate for Course 3 is low, with only three, 2.4% out of the total number of 121. The average number of students per term is 30 (Table 5). The students who failed averaged 291 content hits and <22 forum hits compared to <3401 content hits and >557 forum hits for the HD student cohort.

Data Analysis

While hit counts on the content and the forums for Course 3 are high, much higher than Course 1 and Course 2, the underlying reason is that this course is conducted solely via the LMS, all of the student contact is via the LMS, all of the assignment preparation is completed via the LMS, and all contact with the Lecturer is via the LMS.

All Courses

Linking final grade to use of the LMS features seems to indicate that there is a link between what is happening on the LMS, the user behaviour, and grade.

Graph 6: Student Hits for all Courses 2004-09

Dawson and McWilliam (2008) argue that grade seems to be an indicator of involvement, though they do not state that there is a causal relationship, but something is occurring. Aggregating all of the academic’s courses into one data set demonstrates that there is a relationship between students’ use of the LMS features and their final grade. Examining the total of all these courses across all terms that they have run on Blackboard (Graph 6) demonstrates that there is a direct link between student hits and grades (Beer et al, 2009; Dawson & McWilliam, 2008) and between student engagement with the forums and grades, which is indicative of involvement with the courseware.
Table 6: Content and Forum files on Course 1, 2, 3 years 2005-2009

<table>
<thead>
<tr>
<th></th>
<th>Student #</th>
<th>Student %</th>
<th>Content Hits</th>
<th>Forum Hits</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>161</td>
<td>15.6</td>
<td>110.627737</td>
<td>116.853333</td>
</tr>
<tr>
<td>P</td>
<td>133</td>
<td>12.9</td>
<td>265.368932</td>
<td>246.466666</td>
</tr>
<tr>
<td>C</td>
<td>238</td>
<td>23.1</td>
<td>290.862433</td>
<td>210.552238</td>
</tr>
<tr>
<td>D</td>
<td>341</td>
<td>33.2</td>
<td>478.544262</td>
<td>297.98305</td>
</tr>
<tr>
<td>HD</td>
<td>156</td>
<td>15.2</td>
<td>1018.142857</td>
<td>442.886956</td>
</tr>
<tr>
<td></td>
<td>1029</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The average failure rate for combined courses is 15.6%, with an average of <110 hit per student on contents and <116 hit per student on the forums. High Distinction students for all courses averaged <1018 hits on content and <442 hits on forums.

Data Analysis
The data clearly indicates that all courses developed by the academic have provided what Krause (2005, p. 13) outlines as ‘opportunities for online discussion, collaboration and interaction’. Yet the high failure rate in all courses would suggest that engagement for some students did not occur.

Academic Hit Counts
Krause (2005) points out that engagement occurs when students involve themselves online, communicate with peers, and interact with academics. The academic, as a facilitator of learning, and as someone trying to get students engaged so that they learn the requisite knowledge, is limited to the online Blackboard LMS.

One possible gauge of success, as outlined by Dawson and McWilliam (2008), is academic hit counts, the number of times an academic visits the site, and the number of times the academic uses the forum. As Course 3 is the only course that is totally online, mediated only via the LMS, all Forums, course content, and assessment submission is online, it is examined in terms of hit counts.

Graph 7: Academic Hits for Course 3 all Terms and Years

Examine the academic hits on the course sites (Graph 7) demonstrate that the academic in 2007 had the highest number of hits since these records have been
kept in Blackboard. Course 3 had almost 10000 hits. In line with the findings by Beer et al (2009) the academic hit counts are in the medium to high category indicating that there may be a possible link between academic behaviour on the LMS and student involvement.

Implications and Future Directions

Kearsley and Schneiderman (1999, p. 1) discuss the nature of engaged learning, learning that leads to student involvement, that involves;

all student activities involve active cognitive processes such as creating, problem-solving, reasoning, decision-making, and evaluation ... students are intrinsically motivated to learn due to the meaningful nature of the learning environment and activities.

The most important part of this is ‘the meaningful nature of the learning environment and activities’. If the environment in which students learn is content focused without consideration of the social aspect of learning then it will remain unsuccessful. This is, perhaps, one of the reasons for the high percentage of failure rates within the courses in this study. Examining the data within Blackboard started the process of seeing whether the researcher is content focused or student focused, and indicates that the researcher is content focussed, but trying other means to correct this myopic educational stance.

One of the major problems with the results is the high number of failures within these courses, 15.6% of the student cohort. The failure rates within all courses shows that there are students not involved, and by examining hit counts alone, other possibilities for the lack of involvement cannot be established. One other weakness of this quantitative study is that hit count does not tell if the hits are quality hits. In the discussion forum, for instance, are the hits, the initial questions, and responses posed by the academic of high academic yes/no type responses. Dawson and McWilliam (2008) posed the view that not only is the ‘quantity’ of academic involvement necessary but also the ‘quality’ of that involvement. More research needs to be done on extracting the meaning of ‘quality’ then analyzing the courses for such ‘quality’.

There are other factors at work in getting students engaged. And clearly the academic is only part of the whole system. Having discussion forums, chats, online content, and peer participation without a mentally stimulating course is incomplete. Having an LMS that delivers content without discussions is incomplete, having an LMS that provides opportunities for peer review, discussion, and involvement is good except that this must be of benefit to both students and staff.

In line with Gonzales (2009) the researcher utilizes a wide range of media tools, using them to support student activity, and provides opportunities for collaboration, and online spaces for sharing. In this, the academic can be classed as a communicative/network focused academic. Partner this with what features have been adopted as outlined by Malikowski et al (2007), and used by the
academic and by the students, aids in creating some understanding what is happening within the LMS.

The research demonstrates that there are linkages between the academic and students, there are linkages between the LMS features and the academic; there are linkages between grade, student behaviour online, academic behaviour online and feature use. What the study does not do is to come to any conclusion whether these linkages are critical and causal or whether they are the casual and accidental.

Future research needs to be conducted using the same quantitative framework examining in detail the different student cohorts (flex students, online students, International campus students); as well as examining Courses 1, 2, and 3 through time comparing the one course over all offerings to see whether there are any differences in the data, between terms and years. In this way a complete understanding of user behaviour can be built up that would aid the academic in the construction of the courses; what works and what does not work.

When the quantitative analyses have been completed a qualitative discursive analysis of the content and discussion forums to see if the academic's creation, and subsequent use of the LMS features, aids in enhancing student involvement.

**Conclusion**

This study posited the view that an academic’s approach to their understanding of teaching, allied with feature adoption within the LMS, and their use by both the academic and the students create involvement, and for Krause (2005) engagement. It has been verified that there is a correlation between academic participation, discussion forums, and grade. The data from mining the LMS in this study demonstrates that the academic has high hit count, between 2300 and 10000 for all courses, demonstrating that there is involvement in the courses offered. Student activity has clearly demonstrated that they are interacting with the LMS and the academic.

The research used two differing researchers (Gonzales, 2009; Malikowski et al, 2007) to frame an initial enquiry into the use of LMS data to identify possible indicators of academic engagement with the LMS, and consequently with students. Three of the researcher’s courses were examined using data mining to quantify the vast amount of data that exists within the Blackboard database. Of particular interest is the concept that by examining the features, adoption and use, within the courses it is theoretically possible to predict if the academic is creating an environment where involvement can occur.

However, the provision of the features alone does not create involvement. Looking at feature adoption and use allied with a teacher’s focus on both content and communication is a better research tool for analysing what is occurring within an LMS. The data has shown that the researcher has a communication focus, has adopted features that support peer communication strategies, and the
hit count reveals that there is a high use of those features by the academic and the students.

Students do not engage with the content, or with other students, and do not engage with the lecturer if they have no motivation to do so, whether intrinsic or extrinsic. What is needed is to create engaged teachers, who create opportunities for learning where student involvement is facilitated. Only the academic can do this, only the academic can create content that starts to build a stimulating intellectual environment; only the academic can monitor the LMS environment and create a social aspect; only the academic can ensure fast, explicit and rigorous expectations; only the academic can provide environments where engagement can happen.

The academic’s particular understanding of their teaching approach, allied with a place within the LMS to create a space for communication, collaboration and content dissemination, a sound understanding of assessment and the need for this to be authentic, helped by the student’s own motivation, is paramount in creating student engagement. The academic is only one part of this interconnected learning. Understanding what is happening within the LMS does create an opportunity for self-reflection and analysis of user behaviour on the part of the academic.

While the purpose of this paper was exploratory in nature it does reflect patterns of user behaviour that highlight the need for future research in this area. Creating the right model for research into academic user behaviour and student engagement is ongoing, but it may establish a statistical relationship of some significance. From this it is theoretically possible to transfer the research data and to apply this data to academic practice, to enhance teaching and learning.
References


