More than one pathway to success: Lecture attendance, Lectopia viewing and exam performance in large Engineering classes.

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Abstract: *This study aimed to create an understanding of how Engineering students use online lecture recordings (Lectopia) as a part of their learning toolkit, so as to better assist staff concerned about the negative consequences of introducing Lectopia into their course. Online surveys were given to third year civil and chemical Engineering students, twice throughout the semester, recording both quantitative and qualitative data regarding the amount of lectures attended, the reasons for non-attendance, the amount of Lectopia viewed, and the usefulness of Lectopia. The answers to these questions were related to exam marks for each student. The results show that the effects of viewing Lectopia and Lecture attendance interact; i.e. neither variable alone can explain student marks, and that both are comparatively effective forms of student engagement. However, lower grades were found for students who both attended most lectures and viewed over half of the Lectopia. Analysis of student comments suggests that this was due to factors such as ability to concentrate in class and clarity of the lecture. Together with lecture attendance and Lectopia viewing, these factors are described within a 'student engagement model' of learning, which is presented in contrast to the implicit 'student attendance' model currently underpinning beliefs regarding the importance of lecture attendance to student learning.*

Introduction

Within Australian universities, digital recording and streaming of lectures has become a standard component of the resources provided to students through e'learning sites such as Blackboard. This study forms part of a larger project aimed at encouraging the uptake of web-based technologies and blended learning options within the School of Engineering at the University of Queensland. Teaching staff need evidence that lecture recordings (i.e. Lectopia) will assist or at least will not diminish student learning, and that major attrition in lectures will not occur because of Lectopia being used in Engineering classes (where Engineering students have a reputation for taking a very pragmatic approach to learning). However, the data that has been collected thus far is inconclusive. On the one hand, Lectopia has been shown to be well utilised and appreciated by students across Australia (McNeill, Woo, Gosper et al, 2007) including students at the University of Queensland (ITS project office, University of Queensland, 2008). Results of many studies show that students use recorded lectures for checking over notes, reviewing difficult concepts, for exam revision and for listening to missed lectures (see Gosper, Green, McNeill et al, 2008). On the other hand the evidence shows that in general, lecture recording (henceforth referred to using the term 'Lectopia') is tolerated rather than liked or embraced by lecturers. While Lectopia is seen as useful for ESL and externals students and for exam revision, there is some skepticism in terms of its benefits (Birch & Burnett, 2009) e.g. *I have no real indication of whether students learn just as well.*. (Gosper, Green, McNeill et al, 2008, p. 23). Second, there is some fear that use of Lectopia may cause students to not bother attending lectures (Chang, 2007; Phillips, McNeill, Gosper, et al. 2007). Finally, there is some skepticism regarding the

usefulness of modern teaching and learning initiatives in hard courses (Burnett & Meadmore, 2002). This is particularly true in Engineering and other STEM courses. As one lecturer in our study has stated *we go to these workshops, learn about the latest method, bring it back here, try it out, and it fails*. There seems to be a pervasive belief that technologies and methods that take students away from the lecture theatre will reduce the opportunities students have for putting in the mental effort that is required for understanding the complex concepts embodied by the engineering disciplines.

Given the fears, some concrete data is needed either to confirm or to alleviate them. If we turn to the literature, we find various pieces of the Lectopia-Attendance-Performance puzzle have been addressed. The effects of Lectopia on performance have been shown to be both neutral (Smeaton & Keogh, 1998) and positive (Ordoñez 2001; Young & Gibbings, 2007; Gosper, Green, McNeill et al. 2008). The effects of Lectopia on attendance have shown to be positive (Barker & Fothergill, 2005) neutral (Massingham & Herrington, 2006), and negative (Gosper, Green, McNeill et al., 2008). The effects of attendance on performance have been shown to be both neutral (Hyde and Flournoy, 1986) and negative (Massingham & Herrington, 2006). All of these studies have tested various combinations of the 3 important variables: attendance, Lectopia viewing, and exam performance, some gathering perceptions and some collecting numerical data. The evidence thus far is inconclusive, and somewhat confusing. Furthermore, very little of the data is from Engineering; for example, in Gosper et al (2006), only 7% of the students came from maths, physics, engineering or IT.

Some hard evidence is required from the Engineering disciplines, and in addition, the existing literature needs an organisational framework. In order to help to clear up the uncertain state of the evidence, we will first make explicit some of the implicit assumptions underpinning the evidence given in the aforementioned studies. We assert that a uni-dimensional sequential chain of events, that we will call a 'Student Attendance Model' (see Figure 2), is assumed by lecturers when considering the effects of Lectopia on their students. Proponents of this model would assert that the availability of Lectopia will affect attendance, which affects engagement, which affects students understanding, which will effect student performance. The fear is that increasing the availability of Lectopia will ultimately reduce exam performance.

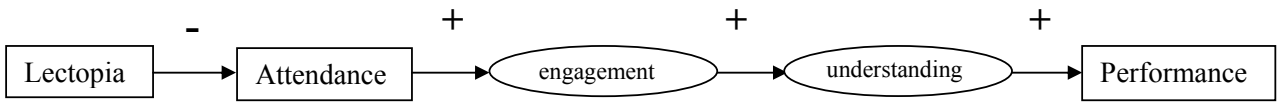

Figure 2: The Student Attendance Model.

We suggest that the Student Attendance Model is incomplete, and is based on false assumptions. First, the full sets of links within the model have not been established within a single study. For example, the amount of Lectopia viewed was not included in Massingham & Herrington's (2006) study. Furthermore the model is based on casual links which have been questioned in the literature, such as the assumed causal link between attendance at lectures and understanding. While the availability of lectures has been shown to reduce class attendance, *The 'traditional' lecture ... is limited in promoting student learning* (McKinlay, 2007). Furthermore, the model is based on the belief that sitting in class is more engaging than viewing lectures at home, which is often not the case in large didactic lectures. Finally, the assumption regarding the causal link between Lectopia availability and lecture attendance stems from the all or none thinking that Lectopia is used by students who don't come, and not by those who do come. However, the way that students use the technology is not all or none. For example, many students use Lectopia in addition to lecture attendance, to help revise for exams, to review complex materials, and to work at their own pace (Gosper, Green, McNeill et al., 2008).

To help to move the situation forward, the Student Attendance Model needs to be replaced with a more realistic model which we call the 'Student Engagement Model'. This model puts lecture attendance in its place with several other routes to engagement available within the traditional course structures in Engineering, such as attending tutorials, discussing content with peers, and viewing

Lectopia (see Figure 3). This framework is consistent with the recent student engagement literature which suggests that engagement is paramount to learning and that there are many ways of engaging students in learning (Krasue, 2005; Kuh, Kinzie, Schuh et al, 2005). The important aspect of engagement that is referred to in Figure 3, is the 'switching on' of a student's effortful thinking processes, which we assert is the most important aspect of student engagement, without which, understanding cannot occur.

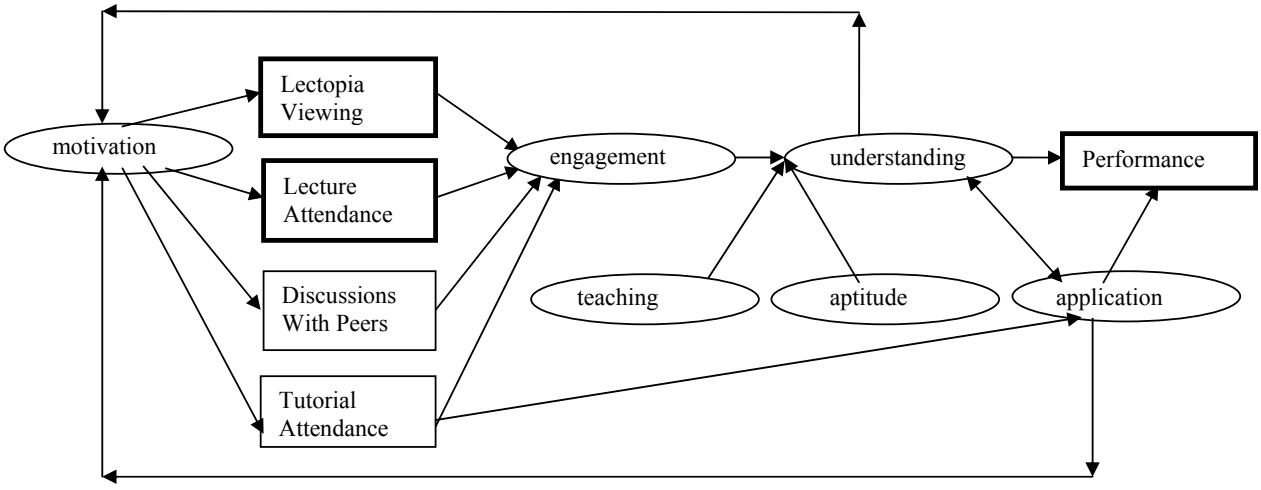

Figure 3: The Student Engagement Model.

The Student Engagement Model (SEM) is illustrated here in order to highlight the multiple cyclical pathways of student experiences that lead to engagement, understanding, and subsequently to student performance. (The full theory and rational for the Student Engagement Model will be described in a further paper). The SEM questions the assumption that face-to-face attendance at lectures is the only important variable determining a student's engagement with the course material, and suggests that Lectopia viewing may play a comparable role. This assumption needs to be tested by collecting data that relates individual performance both to the amount of lectures attended and to the amount of Lectopia used. Such data will allow us to test the SEM assertion that the analysis of student performance is at least a two-dimensional rather than a one-dimensional issue. Furthermore, it will allow us to test whether Lectopia is a useful aid for student learning and a useful substitute for lectures within the Engineering cohort. If so, we would expect that exam marks for students who use Lectopia only will be no worse than marks for students who attend lectures only. Furthermore, we would expect that Lectopia will be utilised by students to improve their understanding of course content rather than merely as a replacement for lecture attendance.

Method

Students in a third-year Civil Engineering course (fluid dynamics) and a third-year Chemical Engineering course (thermodynamics) were given Lectopia recordings in addition to lecture attendance, as study options throughout the semester. Online surveys were given midway and at the end of semester, asking about the amount of lectures attended, the reasons for non-attendance, the amount of Lectopia viewed, the reasons for viewing Lectopia, and students' impressions of Lectopia. Marks from the mid-semester exam for the Chemical course and for the end of semester exam for both courses were related to survey responses. Exam results were compared between groups of students categorised into 4 groups, comprising students who: 1. used half or less of the Lectopia and came to 75% or more of the lectures, 2. used 75% or more of the Lectopia and came to half or less of the lectures, 3. both used Lectopia and came to Lectures 75% or more of the time, and 4. who hardly did either. Finally, the number of students attending lectures was counted throughout the semester to see if attendance diminished due to Lectopia.

Results

Altogether, 142 students answered the mid-semester survey (75 Civil, 35 Chemical) and 91 answered the end of semester survey (67 Civil, 24 Chemical). Students who responded to the survey had similar exam averages and standard deviations to their entire cohorts, and thus can be said to be fairly representative of their class groups. Since only 22 students repeated the survey, the mid-semester and end of semester survey respondents were treated as two different groups. According to the self reports in the survey, lecture attendance decreased (from 82% to 71%) and Lectopia viewing increased (from 41% to 49%) from the middle to the end of semester groups. (According to our head-counts, attendance for the entire Civil class varied between 40% and 85%, more than the self-reports in the surveys. However, we will accept the self reports as being reliable enough for the purposes of the analysis.) For both the Civil and Chemical class groups, Lectopia was used heavily throughout the semester by at least one quarter of the class, and this increased to half for the end of semester Civil group. Half of the chemical class hardly used Lectopia throughout the semester.

Uni-dimensional analysis

The simple relationships were investigated first, showing that these types of analyses are incomplete. For example, for Civil Engineering students, there were significant negative correlations between viewing Lectopia and final exam marks for both the mid semester group ($r = -.27$ $p=.01$ $N=83$) and the end of semester group ($r = -.27$ $p=.02$ $N=69$). However, when the 8 top performing students, most of whom watched 0-10% of Lectopia were removed, then these correlations disappeared. Furthermore, the distribution of final marks showed that the students who attended either the most or the least lectures did the best, while those who attended ¼-¾ of the lectures did the worse. These results show that, when used in isolation, neither Lectopia viewing not lecture attendance can predict exam performance.

Two-dimensional analysis

The effects of both lecture attendance and of Lectopia viewing on marks were analysed together using a two way analyses of variance. The 91 students who responded to the end of semester survey were divided into the four groups: High Lecture, High Lectopia; High Lecture, Low Lectopia; Low Lecture, High Lectopia; and Low Lecture, Low Lectopia. Exam marks for each group were compared with the marks for the other groups, with the effects of student ability (GPA) removed before the comparisons were made. For the Chemical engineering class, since all students attended over half of the lectures the mid-semester results only contained 2 groups: High Lecture, High Lectopia, and High Lecture, Low Lectopia**.** For this class, those who watched Lectopia had a mid-semester mark about 8 points higher (72%) than those who did not watch Lectopia (64%). For the analysis of the final exam marks, both courses were combined by converting exam marks to standardised Z-scores (described by a normal distribution with a mean of 0.0 and a standard deviation of 1.0).

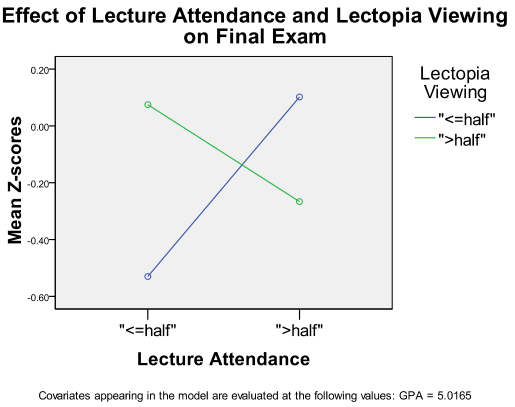

Figure 4: The interaction effect between Lecture attendance and Lectopia Viewing.

The analysis showed a statistically significant interaction between the effects of Lecture attendance and the effects of Lectopia viewing on final exam marks ($F_{(1,86)} = 6.32$; p=.014). The interaction effect of both variables on exam marks is depicted in Figure 4. The 43 students who attended most of the lectures but who watched half or less of Lectopia received the best marks (Z-score = 0.28). These students would have used Lectopia to fill in for an occasional missed lecture, but mostly for reviewing attended lectures for comprehension purposes. However, the 18 students who attended half or less of the lectures but who viewed over half of the Lectopia also received fairly good marks, just above the average class marks (Z-score = 0.02). These students would have relied upon Lectopia for replacing most lectures. Furthermore, of the 25 students who attended half or less of the lectures, the 18 who used Lectopia to replace the lectures did much better than the 7 students who didn't make use of Lectopia. Not surprisingly, these 7 students who went to half or less of the lectures and watched half or less of the Lectopia received the lowest exam marks (Z-score = -0.21). Altogether these results show how Lectopia viewing provided an adequate study resource for students who missed lectures.

However, Figure 4 also shows an unexpected result for the 23 students who attended over half of the Lectures, and who also viewed over half of the Lectopia. These students, who would have used Lectopia to supplement most lectures that they had already attended, were putting in the most effort of all the groups. However, they did *worse* on the exam than those who viewed less than half of the Lectopia (i.e. their group mean was almost half a standard deviation below the class average exam marks; Z-score = -.47). To understand what was going on for these students, the answers to the question: "If you have started using Lectopia, or are using it much more often than before, can you say why?" were analysed. The results showed that the students who got poorer marks in this apparently hard working group were more likely to mention difficulty in seeing, hearing, understanding or paying attention to the lecture when they did attend, e.g. a student in this group who received 33% on the exam stated '*i re watched the lectopia and realised it was great because you could read what was being written on the board more clearly (its often hard to read, out of focus) and you could hear and not be distracted by other people in the audience talking.* That is, although present, these poorer students were not able to concentrate or comprehend most of what was said in the lectures. Reviewing the lecture again did not help them with comprehension.

The results suggest that Lectopia can be used for 3 reasons. First, it can be used successfully for replacing missed lectures. Second, it can be used successfully for reviewing attended lectures when students have understood most of the lecture and then need to fill in parts that were not fully comprehended. Finally, it is used unsuccessfully for reviewing attended lectures when students have been unable to get the basic gist of what was being said in the first place due to not concentrating or others distracting them, or not being able to see or hear what was being said.

Conclusions

The interaction effect found here suggests that the availability of Lectopia does reduce lecture attendance, but not drastically. Furthermore, the results show that attendance and Lectopia viewing are two comparatively effective methods for engaging students in course content. Moreover, the effects of both lectures and Lectopia on exam performance are mediated by other factors such as ability to concentrate in lectures and ability to understand the lecture. Poor results cannot be attributed to poor attendance alone. The Student Engagement Model is thus a more realistic description of the learning process in traditional didactic Engineering courses than the Student Attendance Model. The latter model, justifying current beliefs regarding the importance of lecture attendance to learning, needs to be replaced with an acceptance that there are multiple pathways to success, as evidenced by the data given here. The extensive comments collected from students suggest that Lectopia is well appreciated by students across the entire range of student marks and student attendance. Rather than being used as an excuse for non-attendance, Lectopia was used by most students to review lectures so as to improve their understanding. This finding does not suggest a cohort of disinterested, irresponsible students, but instead, a generation of students using whatever means available, including blended learning, to try to obtain good grades.

This study has helped the lecturers involved to see how Lectopia can be used to give students more control over their learning. In the age of 'student centred teaching practice' and concern for retention of first year students (e.g., Krause, 2005), this tool fits the bill. Students need to be given encouragement to take responsibility for their own learning. To ban the possibility of reviewing the lecture takes this responsibility away from students. In large classes, lecturers cannot answer all of the possible questions. The good news for Engineering staff is that Lectopia can be used to remove some of their teaching burden and give it to the students, who are in fact, wanting to take it on themselves.

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