

# **Impacts of a Changing Student Learning Culture on Performance in an Undergraduate Business Maths Course<sup>#</sup>**

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*Web-based technologies are changing the culture of universities; challenging long held traditions of university teaching, students' attendance patterns and ways of learning. Combine this with the relatively recent worldwide trend that more students are finding it necessary to engage in paid work while studying and for longer hours, is it any wonder that class attendance is dropping as students increasingly rely on web resources to learn content? This paper seeks to quantify this phenomenon and the impact of class attendance on academic performance using statistical modelling, based on data from 158 business/commerce undergraduates studying a 2<sup>nd</sup> year business mathematics course at Griffith University in Brisbane. After controlling for maths ability with a pretest, the results showed that reduced class attendance had a strong negative effect on academic performance. Associated with these findings were the different patterns of participation in paid work exhibited by males and females as well as by domestic and international students, and the different attendance behaviour of these groups.*

**JEL Codes:** I21, A22, C50

## **1. Introduction**

There are two major reasons why tertiary educators are seeing fewer students in their lecture theatres and tutorial classes. Firstly, universities, and especially business schools, have experienced an increasing market for their product over the last decade, causing rises in student-teacher ratios. One way that universities have coped with an ever increasing student load is to design many of their courses in flexible delivery mode, thus at the same time also focussing on the needs of learners and providing greater access and choice to education. Secondly, at the same time as these institutions have provided students with more choices beyond face-to-face in the delivery of educational resources, worldwide trends indicate that more and more students are finding it necessary to engage in paid work while studying (Chambers 1992; de la Harpe *et al* 1997; Anderson 2006) thus adding a further reason to absent themselves from classes. These interwoven issues are the focus of concerns amongst academic staff, trying to maintain a high standard of course assessment despite many of their students failing to keep up with the course content. Yet, these concerns have had little coverage in the education or business literature to date – hence the motivation for this work.

The objective of this study is to explore the relationships between student absenteeism, paid work, and academic performance. Further, using statistical modelling, this study seeks to quantify the impact that reduced class attendance has

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<sup>#</sup>This research was approved by the Griffith University Human Research Ethics Committee: Protocol Number AFE/13/09/HREC

on academic performance. It adds to the currently small body of research regarding paid work and student learning outcomes. It also brings gender differences into the mix as well as differences between international student experiences and behaviours and those of domestic students – topics also little researched to date.

In the next section, previous related literature is reviewed and summarized. Then the research methodology and data used are discussed. Empirical results found in the study are then presented and analyzed. Lastly, the conclusions, implications and limitations of the study are discussed along with avenues for further research.

## 2. Background and Literature Review

### 2.1 Flexible Learning Practices

'Flexible learning' with its switch of emphasis from teacher-centred to student-centred learning has been embraced at university level and indeed, most universities include flexible learning policies as prominent in their mission statements. Research regarding the impact and effectiveness of technology-based and web-based delivery of education abounds (e.g. Laurillard 1993). The consensus is that new technologies can be used to enhance student independence and control over access to course content and other resources and can significantly reduce the required amount of formal face-to-face teaching. However, not so much has been written about the impact of these new learning environments on students learning the often less-popular quantitative courses in business degrees, like mathematics and statistics. There is some evidence that little face-to-face teaching may not provide a quality learning environment for these students and especially for those students with little prior mathematics experience (Cybinski and Selvanathan 2005).

### 2.2 Patterns of Participation in Work and Tertiary Study

Neither have we seen much constructive research on what has been termed "the new millennium student" – one who is working to study and studying to work (Anderson 2006), and the effects on academic performance of adding a substantial workplace commitment to full-time study. The fact that commerce students are now paying upwards of \$8000 a year (in Australia) towards the cost of their tuition, has meant that many students are engaged in more hours of paid employment every week in order to fund their degrees than was the case a decade ago (McInnis *et al* 2000). By 2002, 72.5% of Australian university students had paid employment during semester, working an average of 15 hours per week (McInnis and Hartley 2002) and by 2006, from a regional university study by Anderson (2006), that figure had increased to 18 hours per week for a full-time student.

Many are also mature-aged students, with only 27.2% aged under 20 (Australian Vice-Chancellors' Committee (AVCC) 2001, p.39). More importantly a national survey of Australian student finances in 2006 showed that the number of students who claimed their paid work affected their studies had more than doubled from 16 to 40 per cent since 2000 (AVCC 2007). In the United States the National Centre for Educational Statistics (NCES) reported that among those undergraduates who initially enrolled full time, the more hours they worked, the more likely they were to reduce their participation to less than full-time enrolment or to stop attending altogether (NCES 1994). But in a later study of undergraduates who work, the

## Cybinski

NCES (1996) reported that effects on outcomes were linked to a threshold number of hours worked per week - those working for more than 15 hours had significantly higher chances of dropping out of study than those who worked for less than 15 hours per week.

In Australia, longitudinal surveys by Vickers *et al* (2003) found that 44 per cent of male tertiary students do not work compared with only 36 per cent of females. So more young women than young men sampled worked while they studied at tertiary level but males were more likely than females to work longer hours and a higher proportion of males than females work on a full-time basis while they are studying. The same study also found differences in the hours that non-English speaking (NES) and English speaking (ES) full-time students worked part-time, with 50% of the NES group working, compared to 66% of the ES group. The statistics for students who work more than 10 hours a week were 28% (NES) and 41% (ES). Research has shown that paid work has both positive and negative impacts on student learning (e.g. McInnis *et al* 2000) but nevertheless, this 'double commitment' means that students are often no longer in a position to fully participate in the educational opportunities provided at their learning institution to support their studies.

So although educators are now teaching to a larger enrolment, they are not seeing most of their students in classes for the two reasons cited above. The push for flexible learning has meant that educators are packaging their courses onto the web for students to access at will and thus enticing many students, who already have many competing demands on their time, to miss lectures and tutorials. Perhaps greater accessibility to educational resources has given students a false sense of security in their studies so that they feel that physical engagement in their courses is no longer necessary.

### 2.3 Class Attendance and Academic Performance

The role of application in relation to academic performance research has long been presumed significant, and conscientiousness has been called 'a powerful predictor of academic performance' (Busato *et al* 1999; Furnham and Mitchell 2002, p.62). Consequently it is important for tertiary educators to consider the implications of an increasing trend for students to physically disengage from academic life on campus. But measuring these concepts can be difficult, so attendance data is often used as a proxy measure for student engagement.

Research has shown that student attendance positively and consistently correlates to standardised achievement tests in the USA and the UK (Park and Kerr 1990; Romer 1993; Devadoss and Foltz 1996; Marburger 2001; Woodfield *et al* 2006; Chen and Lin 2008; Westerman *et al* 2011; among others) and in Australia (Massingham and Herrington 2006).

If class attendance is, indeed, important for academic success then it would be useful to analyse the major reasons why students might be discouraged from attending classes either by choice or by necessity. Therefore this study is unique in that it investigates the effect of paid employment on the level of student attendance and whether there are different patterns of paid employment for foreign and domestic students and for males and females.

## 2.4 Numeracy and Academic Performance

The importance of mathematical skills to student performance in many quantitative disciplines is widely recognised. Johnson and Kuennen (2006) found that a math-quiz score was significantly related to performance in an introductory statistics course (as was student GPA and gender) and that this result was robust across course formats and instructors. Other studies have used the maths component of a tertiary entrance score like the Scholastic Aptitude Test (SAT) or American College Test (ACT) (e.g. Ely & Hittle 1990). It is important to control for prior maths experience/knowledge in order to validly test the research question: whether class attendance provides any value-added to overall course performance.

## 3. Data and Methodology

### 3.1 The Data

A short questionnaire including a basic numeracy pretest was administered to all students attending the first lecture of the Quantitative Methods for Business, Finance and Economics course (hereafter termed 'QM') offered in 2007 within the Griffith Business School at Griffith University in Brisbane. This is a core course for majors in Banking and Finance and in Economics and an elective for many Accounting majors. The participant sample, termed the 'respondent' group, included all of the 158 students who sat the pretest and who also provided their correct student i.d. on the questionnaire/pretest that allowed a matching of this data with their assessment results and tutorial attendance information. The respondent group comprised 60% of the 262 students who completed the course.

At the time data were collected for this study, lectures were delivered in the traditional way via a large lecture theatre without any form of lecture capture capability. Only the lecture notes were available on the web, prior to the lecture. So there was a small window of opportunity to investigate students' engagement with the course as measured by on-campus class attendance before lecture capture was introduced to confound the effect that attendance has on performance.

### 3.2 Hypothesis Development

The main hypothesis (stated in the alternative form) that reflects the research objective given in the Introduction is:

$H_A$ : Reduced class attendance has a negative effect on academic performance.

This paper seeks to test this hypothesis and quantify the effect that class attendance has on academic performance by using multivariate statistical modelling. Specific details of the variables included and their measurement are listed below.

#### ***Academic Performance/Achievement Overall Score***

In practice, teaching and learning effectiveness remains predominantly determined by student performance in the recall and application of learnt concepts and skills. In this study student performance is measured by the overall total score out of 100 achieved on three closed-book exams: a mid-semester exam (20), a computing exam (20) and a final exam (60).

## **Attendance**

The QM course is normally taught in one block, that is, on one day of the week and, in 2007, with 8 tutorial groups each week that all met within a few hours either before or after the two-hour lecture, scheduled in the early evening. It is difficult to take attendances at the lecture but students enrol in one tutorial of typically 25-30 students where tutors can more easily record individual attendances every week. There were 10 tutorial weeks so students received an attendance score out of 10. Whether attendance is recorded for lectures or tutorials/classes may, arguably, be of little importance for the general issue of performance, as Stanca (2006) noted that both have a similar effect on performance.

## **Pretest Score**

The maths pretest was used to measure the maths skills of the students before they began the course. It provides (1) student mathematical knowledge on a given day without any preparation or study and (2) student knowledge of extremely basic material, without the use of a calculator. The basic numeracy pretest consisted of 10 questions to be answered in 20 minutes at the first lecture. These were marked to give a total score out of 22. The maths quiz was originally developed by the author, based on many years' experience teaching remedial maths classes. The score achieved was converted to a percentage and used as a necessary control variable in the statistical model that follows.

## **Gender**

There is very little information in the literature relating to whether male and female undergraduate students have differential rates of attendance and whether any such differences are related to their academic performance outcomes. Results from a major study in the U.K. by Woodfield *et al* (2006) of 700 undergraduates at Sussex University and the factors affecting their degree outcomes found differential attendance rates between male and female students.

## **ESL – Language and Student Cultural Background**

Around the time of this study more than 9780 international students made up 26.4 per cent of the students on five Griffith campuses, representing 123 countries of origin. Students were asked for a binary response that identified them as students with English as a second language (ESL) or not (non-ESL). Since the Griffith Business School has the largest number of international students of all the faculties/schools, it is reasonable to assume that most of the ESL students are international students. Under this assumption the respondent sample consisted of 63% international students and 37% domestic students.

## **Paid Employment**

Students were asked to record the average number of hours they worked in paid employment in a typical semester week.

## **3.3 Statistical Analyses**

Firstly, descriptive statistics and bivariate analyses will be used to explore the relationships between the variables of interest described above before carrying out a multiple regression analysis to quantify the effects they may have on performance. Two-way interaction models and a main effects model will be estimated for academic

# Cybinski

performance using the GLM Univariate procedure within the SPSS statistical package.

## 4. Analysis and Results

### **Attendance**

Attendance dropped off in the first few weeks of the semester until about half were attending each week. The median and the mean attendance were both 5 out of a possible 10 tutorials or 50% of the available sessions. Comparisons with other research here and abroad show varying results. Note that neither lecture nor tutorial attendance was compulsory for the course nor was any assessment weighting given for participation – a possible cause of bias in some studies that may have been overlooked or not reported. Massingham and Herrington (2006) reported an 80% average attendance at tutorials but noted that students were required to attend 75% of tutorials or risk failing the subject. Other research gave the following figures: - Rodgers and Rodgers (2003): 62% at lectures, 73% at tutorials; Rodgers (2001): 68% at lectures, 80% at tutorials; and Romer (1993) reports that ‘attendance counts ...indicate usually about one-third of students are not in class’ [p.167].

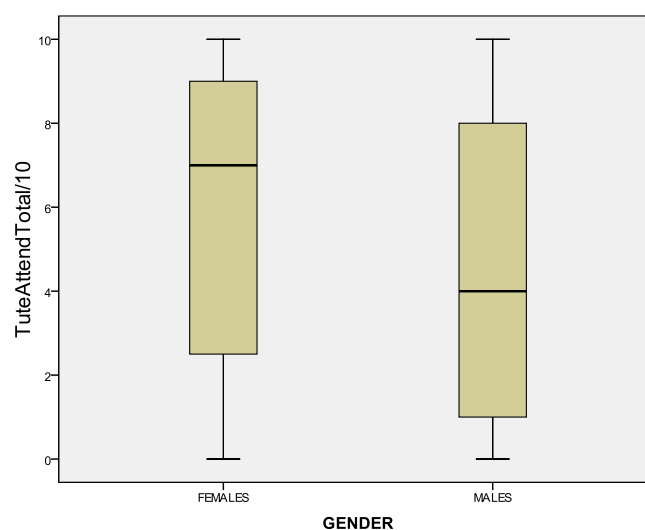
### **Attendance and Academic Performance**

The relationship between attendance and academic performance was a significant one ( $p=0.001$ ). Those students who engaged most with the course achieved significantly higher scores and the relationship is decidedly linear on a scatter plot. But are these students the same ones that have higher numeracy skills (maths ability), as evidenced by their pretest scores, or is attendance indeed a reason for performing better academically? Multiple regression modelling will be employed to test the relationship further.

### **Gender and Attendance**

See Figure 1 displaying the separate boxplots for male and female attendance figures.

**Figure 1: Box Plot\* Attendance Distributions for Males and Females**



\*Boxplots give a visual summary of the distributions showing the median, upper and lower quartiles, and the minimum and maximum observed values.

## Cybinski

The mean (median) attendance statistics (TuteAttendTotal/10) were 6 (7) out of a possible 10 tutorials for females and 4.5 (4) for males. This suggests that females are more engaged with the course than males and the difference in the means of 1.5 tutorials is significant ( $p=0.002$ ), especially since the male distribution is highly skewed towards low attendances. This study therefore confirms the differential rates of attendance by males and females found in the large UK study by Woodfield *et al* (2006).

### **Numeracy/Pretest Score and Academic Performance**

Because pretest score was strongly linearly related to overall performance ( $r=0.48$ ,  $p<0.0001$ ) this variable was included as a covariate in the multiple regression analysis as a way of removing the effect of maths ability on performance and hence, isolating the value-added effect of attendance on performance.

### **Gender and Academic Performance**

Table 1 shows the mean overall performance scores (Total/100%) for males and females. Females score better overall by about 10% on average and the difference is significant ( $p<0.0001$ ).

**Table 1: Academic Performance and Gender**

Gender	Mean Total/100%	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Female	<b>71.7</b>	2.03	67.6	75.7
Male	<b>61.8</b>	1.4	59.0	64.6

### **Gender and Numeracy/Pretest Score**

The gender difference for pre-test numeracy scores for males and females was not significant ( $p=0.45$ ), so the significant difference found in the overall performance of males and females is due to something other than numeric ability – perhaps females are engaging more with the course by attending more classes.

### **Paid Employment and Gender**

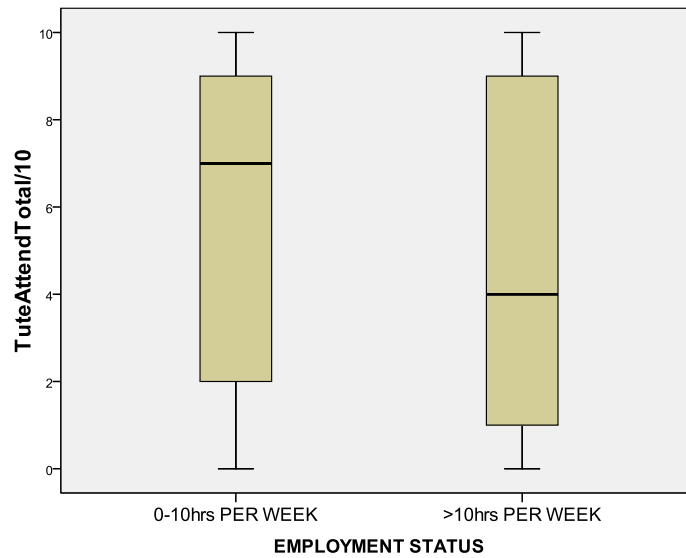
Of the 151 students responding to the employment question 90(60%) were in paid employment and 77 students (50%) worked more than 10 hours per semester week. The mean number of hours worked by the respondents was 13.2 hours per semester week and the median was 14 hours. More females (63.4%) than males (57%) were in paid employment but the male students who worked did so for longer hours on average per semester week (25.1 hours) compared to the female students in paid work (22.4 hours). These findings mirror those of Vickers *et al* (2003).

### **Paid Employment and Performance; Paid Employment and Attendance**

The mean overall performance score for students in paid work was 64.4% compared with 69.3% for those not working. The correlation between number of hours of employment per semester week and overall performance was moderate and negative at  $-0.188$  ( $p=0.01$  for a one-tail test). Similarly the same significant negative correlation was found between the number of hours of employment and attendance. One suspects that the relationship between paid employment and performance is an indirect one via attendance. See Figure 2.

# Cybinski

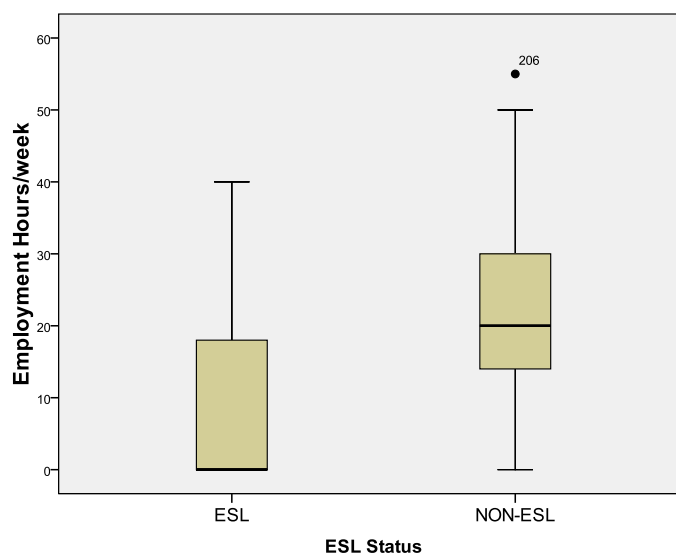
**Figure 2: Box Plot- Attendance Distributions for Different Levels of Employment**



## ***Paid Employment and ESL; Attendance and ESL***

The distribution of hours in paid employment was very different for international and domestic students (See Figure 3). Domestic students (non-ESL) were engaged in paid employment for significantly more hours than international students (ESL) with mean/median values 22/20 compared to 8/0 (ESL) and this was reflected in their significantly lower attendance rates ( $p < 0.005$ ), with means of 4.2 (non-ESL) and 5.9 (ESL) tutorial attendances during the semester. The median differences were even larger with oppositely skewed distributions as illustrated best in the boxplots (See Figure 4).

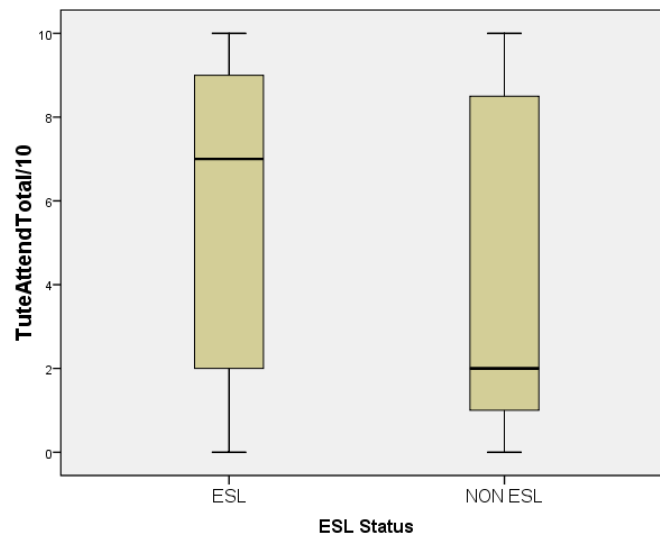
**Figure 3: Box Plot- Hours of Paid Employment per Week for International (ESL) and Domestic (non-ESL) Students**





## Cybinski

**Figure 4: Box Plot- Attendance Distributions for International (ESL) and Domestic (non-ESL) Students**



This study therefore supports the findings from the longitudinal surveys by Vickers *et al* (2003) that English-speaking full-time students in Australia work more and for longer hours than non-English speaking students. Whether this is a cultural issue or because of student visa requirements, given the ESL group are mainly international students or for some other reason, is beyond the scope of this study and warrants further research.

### **Multiple Regression Analysis**

The correlation analyses above have shown that overall performance in the course was significantly related to the numeracy pretest score ( $p < .0001$ ), tutorial attendance ( $p = .001$ ), gender ( $p < 0.0001$ ), and to a lesser extent, to the number of hours in paid employment each semester week and domestic/international student status (ESL) (both  $p < 0.05$ ). Two-way interaction models as well as a main effects model were estimated for academic performance with the first three of the explanatory variables listed i.e. those with the three strongest correlations ( $p < 0.001$ ). Since paid employment and ESL both affect attendance and hence, only *indirectly* affect performance, neither was included in the model to avoid endogenous regressors. A more appropriate model for including these effects would require a two-stage least squares model and more research into the motivators affecting attendance – an avenue for further research.

The GLM Univariate procedure within the SPSS statistical package was employed to model the determinants of academic performance with the following final model structure. Only main effects are included since none of the two-way interaction effects were significant ( $p > 0.10$ )

**Performance (%) = 34.9 + 1.07 TuteAttendTotal/10 + 0.38 Numeracy Pre-Test (%) + 10.58 (if Gender =female)**

This model gave a non-significant Lack of Fit F statistic ( $p > 0.9$ ) and all three coefficient parameters in the model as highly significant ( $p < 0.002$ ).

## Cybinski

The interpretation of this model is that student performance is increased, on average, by about 1 % for every extra tutorial attended out of a possible 10 and by nearly 0.4% for every extra 1% scored on a basic numeracy pre-test and females score an extra 10.6 % over males.

### 5. Discussion and Conclusion

This study focuses on the determinants of success in a business mathematics course (mainly for students with majors in accounting, finance and economics) using data from 158 student respondents taking the course in the 1st semester of 2007. The explanatory variables studied and deemed important in the extant literature as determinants of student performance were: physical engagement in the course as measured by attendance; innate numeric ability as measured by a pretest of basic math skills; and gender. All showed a significant relationship with academic performance. Most importantly, the main hypothesis of the study is supported: that reduced class attendance has a negative effect on academic performance, specifically in quantitative courses within a business/commerce degree.

The effects of both English as a second language (or international/domestic status) and the level of paid employment that students were undertaking each semester week were also important considerations for academic performance. But these were most likely impacting *indirectly* on academic performance through their effects on attendance behaviour, since domestic students were more likely to be engaged for longer hours in paid work than international students and hence attended fewer classes. Correlations between these variables were, indeed, significant and in the expected directions.

So the results support the view of other studies that attendance rates *do* matter in terms of course or final degree outcome (Romer 1993; Rau and Durand 2000; Woodfield *et al* 2006; Massingham and Herrington 2006; among others). The results also support the existence of differential attendance rates between male and female students reported by Woodfield *et al* (2006) in the U.K. since we found that females attended more classes and achieve significantly higher marks than their male counterparts despite their equivalent level of numeracy skills coming into the course. The international students (largely identified as having English as a second language) were found to attend more classes and performed better overall than domestic students and the evidence that the international students also spent less time in paid work than the domestic students supports the findings of Vickers *et al* (2003). Similarly, females attended more classes, spent less time in paid work, and performed better than males – as in the Vickers *et al* (2003) study.

Numeracy skills, gauged here from a pretest score, were highly significant in predicting course performance, as in other studies of quantitative course performance. This finding has implications for curriculum development, course content, and especially, course prerequisites. This has particular relevance to the recommendations of the Strategic Review of Mathematical Sciences Report from the University of Melbourne (Rubinstein and Hughes 2006) to encourage high school students to study higher maths and to reward them for doing so with bonus mechanisms when computing tertiary entrance rankings. This finding highlights the need for university departments to offer remedial maths courses or holiday (summer) maths courses for those with little high school maths.

# Cybinski

As usual with studies using respondent data, a limitation of this study is that the respondents may not be fully representative of the whole group. Since approximately 40% of the enrolled students did not attend the first lecture for the pretest numeracy quiz, the selectivity bias in our sample needs to be acknowledged. Are students who miss the first lecture more likely to miss classes on a regular basis and so are systematically different from the respondents with respect to the major predictor, attendance (Chan *et al* 1997)? Such a bias limits the power of the statistical tests and the generalizability of the study's conclusions.

As in all social science research, there is also the issue of completeness of the model tested. Other variables or interactions between variables that were omitted due to an oversight in questionnaire design, measurement difficulties, or because they were beyond the scope of the study may have contributed significantly to the model and further improved its ability to predict or explain academic performance. For instance, further study into the effects of other variables may be warranted and issues that have not been explored fully in the literature include those of timetabling and on-line resource availability.

## Acknowledgements

I would like to thank the participants and reviewers of the Eleventh International Business Research Conference held in Sydney, December 2-4, 2009, with the theme: "Research for Change". I value the enthusiastic response I had to the paper and the constructive comments and feedback I received.

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