Monitoring and Analysing Attendance in First Year University Mathematics Tutorials

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As part of an innovative tutorial structure introduced to a first year university mathematics subject, an attendance monitoring system was implemented. The system collected data that was used to investigate the relationship between student attendance and assessment performance which is reported here. The implementation of this system also assisted in the increase of student participation and engagement.

Over the last twenty to forty years mathematics tutorials have had a characteristic structure across the Australian university sector: A large group of students working individually on tutorial problems with one-on-one instruction from a tutor when requested. These tutorials exhibit problems of low attendance and poor student engagement.

At James Cook University (JCU), the tutorials of the mainstream first year mathematics subject MA1000, suffered from these problems with little to no student collaboration and tutor interaction that was usually transmissive. Furthermore, no systematic collection of tutorial attendance data took place in order to assist in the analysis of these issues. Therefore any suggested solution was temporary. Even though it was not monitored, anecdotal data suggested high tutorial attendance during the first third of semester followed by a decline with approximately 30% of students attending tutorials for the remaining two thirds of semester. This gave an overall average of approximately 50% of students attending MA1000 tutorials. It was believed that poor attendance and a lack of participation led to poor results in assessment, a trend that had continued over several years. With the increasing pressure on staff to maintain high pass rates, the student's lack of knowledge was carried through to higher years and other subjects.

More recently, a range of teaching strategies have been introduced into tutorials to address problems with attendance and participation (Webb, 1983). The standard tutorial no longer exists. The members of the Mathematics Action Research Team (MathsART) at JCU recently restructured the MA1000 tutorials. One feature of the new structure is the introduction of an attendance monitoring system. This system was first introduced into a first year Engineering subject at JCU by Schneider (2010). We have adapted this system to have two components: (1) an electronic barcode attendance monitor and (2) a mathematical task used to encourage participation and engagement.

In this paper, we discuss the attendance monitoring system that forms part of the new tutorial structure that we implemented. We report on attendance data collected by this system and investigate the correlation between student attendance and assessment results. This relationship has had much attention in the past with studies focussing on data collection, reasons for non-attendance and the impact on student performance. See Newman-Ford et al. (2008) for a review. We also discuss how the introduction of this system has increased participation and engagement of students when attending tutorials. This marked the first time that data were collected and analysed on this scale by the mathematics discipline at JCU.

Methods

The MA1000 student cohort comprises first year students from the disciplines of Engineering (70 - 75%), Science (20 – 25%), and Education (~5%). Contact hours for each student consists of three 50-minute lectures per week for 13 weeks and one 50-minute tutorial per week for 12 weeks. The data presented in this paper were collected over 10 weeks of tutorials with no data collected in weeks disrupted by public holidays. Tutorial classes consisted of ~25 students. The new tutorial structure was introduced into the first semester offering of MA1000, 2011. Of the 201 students that remained enrolled at the end of semester, 150 (~75%) gave consent to participate in our study. Of these, one student did not complete any assessment or attend any tutorials and has therefore been removed leaving 149 students as the cohort for this study.

The new tutorial structure incorporated into MA1000 had the following general format:

1. An informal, but mathematical warm-up exercise (5 minutes).
2. Tutorial task used to encourage participation and monitor attendance (10 minutes).
3. Task marking and discussions (5 minutes).
4. Problems arising from small group meetings from outside tutorials (15 minutes).
5. Individual one-on-one questions (15 minutes).

Monitoring Attendance

At the start of semester, students were issued with a page of barcode stickers. The barcodes contained the student's identification number and could be read by a USB barcode scanner. During each tutorial, students were given a mathematical task related to the material covered in lectures (step 2 above). This task sheet had space for the barcode sticker and room for the student to answer the task. All task sheets were collected and barcodes were scanned into the student database recording attendance. With an accurate account of student attendance, we analysed the relationship between attendance (or non-attendance) and assessment results.

Increasing Participation

The tutorial tasks were designed to increase participation and engagement in tutorials. Although we cannot collect systematic data on engagement, we can encourage participation through the marking and discussion of the task as part of step 3 in the tutorial structure above. This facilitated an interaction between students, and between the students and tutor. Also, instructing students that blank task sheets will not be collected, and therefore attendance will not be marked encourages at least some participation. With a formal tutorial structure and relevant tasks designed to support lectures and encourage interactions, the students were compelled to participate.

Results

The introduction of the new tutorial structure which incorporates the attendance monitoring system has no-doubt had an impact on the learning experience of the MA1000 students. During the semester, approximately 1200 completed tutorial tasks were collected from all tutorial classes. As an initial measure of participation, we observed that no blank tutorial tasks were submitted. This is in contrast to traditional tutorials that would contain an element of the student cohort that did not participate in any way.

We have tracked student attendance throughout the semester and calculated the total number of tutorials attended by each student. These results are shown in Figures 1 and 2.

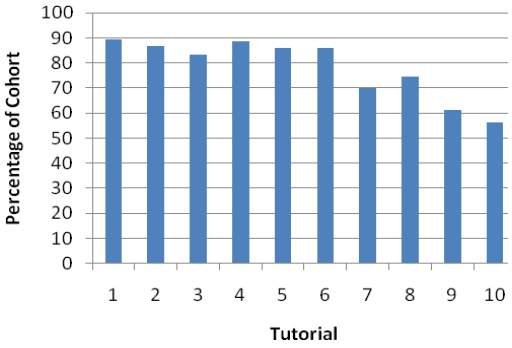

Figure 1. Percentage of cohort that attended each tutorial.

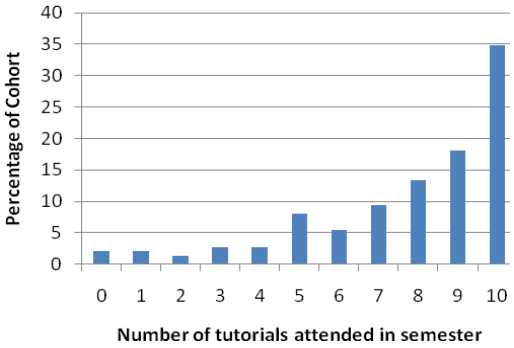

Figure 2. Percentage of cohort versus total number of tutorials attended

Figure 1 displays the percentage of the cohort that attended each tutorial during the semester. The overall average percentage attendance for all tutorials is 78% of the student cohort. This is in contrast to previous years with an anecdotal average of approximately 50%. The overall average for the last two thirds of the semester (tutorials 4 – 10) is 74% compared to 30% reported from previous years. We also note that there is a significant drop in attendance as the semester progresses. Although the decline is less dramatic, this trend is not in contrast to previous years.

Students were grouped with respect to the total number of tutorials attended during the semester. Figure 2 displays the percentage of the class in each of these groups. We note that the largest group contained those students that attended all tutorials with 35% of the cohort. We also note that 76% of the class attended seven or more tutorials.

We also compared the attendance data to assessment results. We investigated the link between final grades and overall assessment percentages with tutorial attendance. These results are shown in Figures 3 and 4. Final grade definitions are: HD – high distinction (85 - 100%), D – distinction (75 – 85%), C – credit (65 – 75%), P – pass and supplementary pass (45 – 65%), N – fail and supplementary fail (0 – 45%), and X – did not complete on-course test or final exam. Figure 3 displays the average number of tutorials that were attended by students that were allocated each final grade for the subject. This figure suggests a relationship between attendance at tutorials and performance.

We have also calculated the average overall assessment mark (as a percentage) for the groups defined for the results in Figure 2. These values are connected by the solid line in Figure 4. The error bars display the 95% confidence interval for the average mark of each group. Again, we observed that the general trend suggests that the students who attended more tutorials, performed better on assessment. We noted that students attending 0 or 1 tutorial performed better than expected. This was explained by the fact that these groups are small (three students in each) and contained two high-achieving students in each group. This is indicated by the large spread in the 95% confidence interval. These students were considered as outliers and were removed from any further calculations. The calculated correlation between tutorial attendance and overall assessment mark was $R^2 = 0.30$, which implies that 30% of the variability of the overall marks obtained can be explained by the

number of tutorials attended. The data has a significance value of $p < 0.0005$ which is highly significant and extremely unlikely to be the consequence of chance.

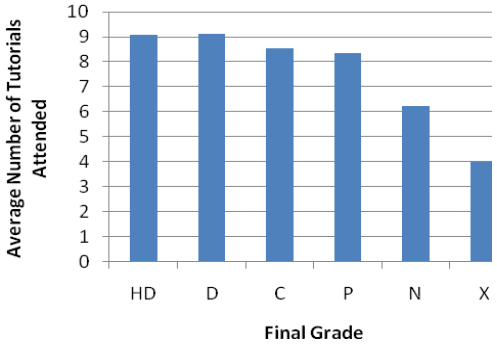

Figure 3. Average number of tutorials attended versus final grades.

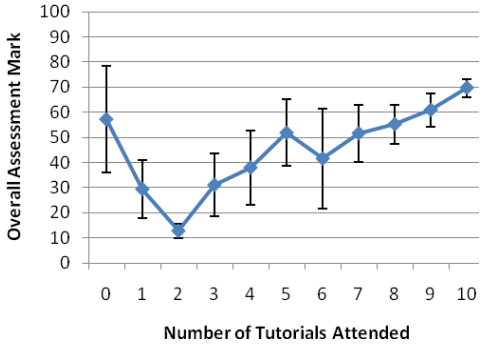

Figure 4. Average overall mark versus number of tutorials attended. Error bars indicate the 95% confidence intervals.

Conclusions and Discussions

With the implementation of an innovative tutorial structure into the mainstream first year university mathematics subject at JCU, an attendance monitoring system yielded a rich data set. This marks the first systematic collection of detailed student data for the mathematics discipline. Analysing the data shows that there is a strong relationship between tutorial attendance and assessment performance. These results imply a strong positive impact of the new tutorial structure on student learning. This system had the additional benefit of increasing student participation and engagement. As the MathsART team are dedicated to the action research methodology, this is only a first step to our ultimate goal of optimising the learning experience of mathematics students at JCU.

Acknowledgement

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