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Is anybody there? Bootstrapping attendance with engagement

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The report card for the introductory programming unit at our university has historically been unremarkable in terms of attendance rates, student success rates and student retention in both the unit and the degree course. After a course restructure recently involving a fresh approach to introducing programming, we reported a high retention in the unit, with consistently high attendance and a very low failure rate. Following those encouraging results, we collected student attendance data for several semesters and compared attendance rates to student results. We have found that interesting workshop material which directly relates to course-relevant assessment items and therefore drives the learning, in an engaging collaborative learning environment has improved attendance to an extraordinary extent, with student failure rates plummeting to the lowest in recorded history at our university.

Keywords: introductory programming, IT course, student engagement, attendance

Introduction

Krause et al (2005) in their report commissioned by the Department of Education Science and Training into the first year experience in Australian Universities, found that time on campus and class attendance were important indicators of engagement by students.

Schneider (2010) addressed the issue of attrition in his introductory engineering unit by monitoring attendance. He was able to identify students with poor attendance patterns and communicated with them to determine if there were any issues which had lead to non-attendance. After abandoning a manual record-keeping system because of the impracticalities of processing 175 students each time, he introduced an electronic attendance record system using a simple bar code scanner. Schneider recorded attendances by having students complete written in-class assessments in lectures. The attendance data helped identify students potentially 'at risk' and the assessment sheets provided the opportunity to analyse any relationship between attendance and final grade. Schneider found that students who achieved High Distinctions attended nine out of ten lectures where he took the roll. The question is of course, would those students have obtained the same success without regular attendance, and were they attending simply because that is the nature of high achieving students? On the flip-side, students who failed the subject had attended between one and eight of the ten lectures, which indicates that regular attendance does not necessarily guarantee success.

This paper attempts to further analyse the effects of student engagement on attendance and final outcome.

Engagement

In a project commissioned by the Department of Education, Science and Training (DEST), Krause et al (2005) found that "...an important indicator of engagement is time devoted to academic endeavours, including class attendance and time spent on campus". How is 'engagement' measured? Can we assume that students who attend lectures and remain awake are engaged? More students are armed with media enabled devices, and there are obvious distractions available to them if the lectures do not grab their attention. So can we measure engagement by monitoring attendance and completion of assigned work in a workshop?

The Australian Council for Education Research (ACER) defines engagement as "...students' involvement with activities and conditions likely to generate high-quality learning". In 2009, participation in the Australasian Survey of Student Engagement (AUSSE) involved 75% of Australian and New Zealand universities with over 30,000 responses (ACER, 2009). Several of the ingredients for student engagement identified from analysis of this survey infer an interactive learning environment which can more easily and efficiently be supported in the physical sphere. These include, but are not necessarily limited to: active learning; student-staff interactions and a supportive learning environment. Hence, to some degree, a dependency may exist for engagement on student attendance at lectures and/or workshops and tutorials. ACER suggest that we can improve student engagement by supporting learning through "enhanced and integrated relationships with peers, academics, student services and the broad intellectual and social domains of university life" (ACER, 2009).

Higher education researchers recently looked at the transition of students into universities as an important factor in retention and progression (Kift, 2008). Nelson, Kift et al (2008) describe the key issues with commencing students was that they wanted to learn but their expectations were often not adequately met. Meeting some of those expectations by establishing authentic processes, collaborative learning for problem solving and co-operative learning techniques resulted in increased student engagement for the University of Adelaide (Falkner & Palmer, 2009). Hansen and Eddy (2007) found that as long as they could challenge students with projects that applied what was learned in class, they engaged well.

Improved Engagement in Programming

QUT recently restructured its Bachelor of Information Technology (BIT) course to improve student engagement and increase retention without jeopardising the quality of its graduates (Corney, Teague, & Thomas, 2010). The latest incarnation of its introductory programming unit INB104 ("Building IT Systems") was designed to encourage engagement by students by stimulating their motivational focus: either an interest in programming; focus on games, web development or information systems. INB104 gives a shallow introduction to three of the basic information technologies: programming, information systems and web development and is seen as an interactive, interesting and inspirational introduction to how IT applications and systems work.

Active Learning through Pair Programming

The INB104 teaching and learning approach is aimed at maximising student involvement. Workshops are run as busy and noisy experimental computer labs. There is little time here for quiet contemplation as students follow the Agile pair programming protocol (Beck, 2005). Other than in extenuating circumstances, no students work alone. Students select the person with whom they will spend the remainder of the semester working. Workshops each week conclude with a selection of student pairs demonstrating their solutions with the remainder of the class critiquing them.

Tutors enforce the regular swapping of roles of driver and navigator at regular intervals. The "driver" has control of the keyboard and mouse e.g. drafting an algorithm; implementing the code; debugging and executing the code. The "observer" is responsible for thinking strategically, asking questions, watching for errors, suggesting alternatives, and providing technical input. Students are encouraged to be vocal and not let a minute go by when they are not communicating in some manner. Expectations are that students continue to collaborate with their partner outside workshops in order to complete the exercises and work on assessment projects together. Learning in this collaborative environment becomes a social process where students learn by working with others. Attendance at workshops is, therefore, strongly encouraged.

Assessment Driven Learning

The concept that "assessment drives learning" has been presented by education practitioners in fields similar to information technology, such as mathematics (Jurges, Schneider, Senkbeil, & Carstensen, 2009). If the assessment tasks are well designed, they can lead the student to learn the material contained in the curriculum. INB104 workshop activities are linked to the material introduced at the lecture with a strong connection to similar tasks set as assessment items. This continuity and reinforcement of concepts is vital for providing relevance to the weekly schedule and engagement with the material. Students choose a number of projects to complete for each of two stages of their portfolio submission, with each project weighted according to complexity. For the first stage of submission, students choose from projects which test their proficiency with basic programming concepts of sequence, selection and repetition. Final stage projects cover programming, databases and web pages and present more challenging programming concepts, and offer the opportunity for integration of two or more of the technologies. All projects required use of the basic programming building blocks, extensive use and design of functions, research into built-in functions, external libraries and data structures, evidence of algorithm development and supporting documentation reflecting students' experiences during development of the portfolio.

The portfolios were pair submissions, with the unenforced requirement that each student contribute equally by adhering to the pair programming protocol. We could not be certain of course that students were sharing the workload fairly, nor taking equal responsibility in the roles of driver and navigator while working outside the supervised workshops. Nor could we eliminate the possibility of plagiarism. However, to somewhat counter plagiarism as well as unfair distribution of work and possible parasitic behaviour by students, we apportioned part of the assignment marks to an oral examination of their submissions. If one or both of the pair could not answer questions about the design and implementation of their projects, they both received low marks for the collaboration component. The oral examination also alerted us to the more obvious cases of plagiarism where neither student could explain their solutions.

Attendance Data

Previously, the trend of attendance by first year programming students at QUT followed a downward trajectory over the course of a semester. For example in 2008, over 80% of students initially attended workshops, and by the end of that semester barely 10% were turning up. A similar pattern has been recorded for previous semesters (Teague & Roe, 2009). Figure 1 shows the change in attendance trends since INB104 has been offered.

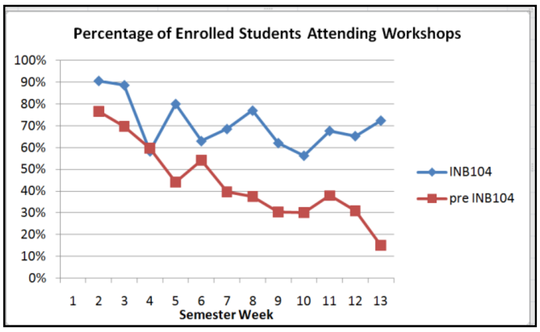

Figure 1: Workshop Attendance Rates

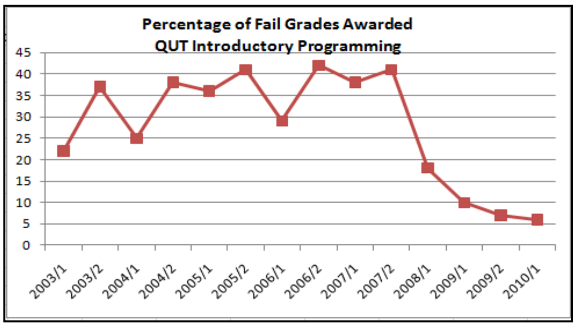

Figure 2: Failure Rates for Introductory Programming

We cannot infer from these figures that a higher number of students were engaged with the learning experience simply because they showed up. However, we feel justified in believing that the change of format and active learning environment, heavily reliant on collaboration, with assessment-related activities which pique the interest of a larger proportion of the students had a very positive influence on engagement. Figure 2 shows the dramatic reduction in the percentage of students who fail the introductory programming unit at QUT in recent offerings. The downward change in trend began in 2008 when a trial of pair programming was introduced into the unit as part of the first author's research (Teague & Roe, 2009).

The data reported below was collected from semester 2, 2009 and semester 1, 2010 where 190 and 311 students respectively were enrolled. Since the unit redesign, not only have attendance rates increased dramatically and remained high throughout the semester, but failure rates have fallen, and retention has remained high. The assessment items for this unit have been marked by a team of four or five academics including the authors of this paper who were responsible for marking roughly 40% of the students in the class. The range of marks awarded by each academic in the team followed roughly the same distribution. We believe there is no experimenter bias in the data reported.

For semesters 2, 2009 and 1, 2010, 35 of the 501 enrolled students (7%) failed, with 20 of these attending less than half of the workshops for the unit. Conversely, only 42 of the 466 passing students attended less than half of the workshops. This means that a high proportion (almost 60%) of students who failed had poor attendance records, and 9% of students who passed had poor attendance records. Figures 3 and 4 show the ranges of overall marks for the unit based on the number of workshops attended by students for Semester 2, 2009 and Semester 1, 2010 respectively. Unlike Schneider (2010) who found that HD students had attended 90% of the workshops, our data does not suggest such a strong relationship between high attendance and grade, with some of our HD students attending less than half of the workshops, and others with regular attendance achieving a much lower grade. However, there does seem to be a trend to a lower average mark when fewer workshops were attended.

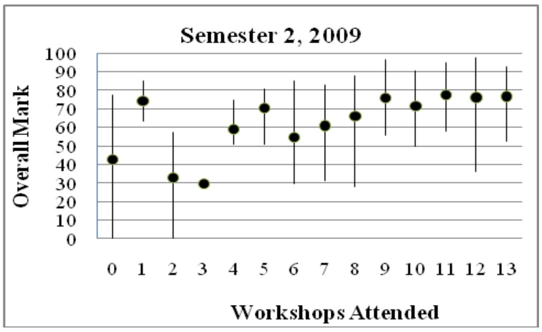

Figure 3: Marks v Attendance Sem 2, 2009

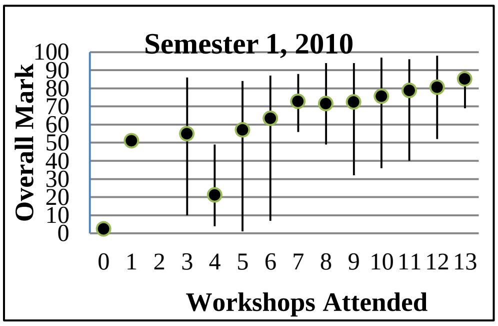

Figure 4: Marks v Attendance Sem 1,

Tarring all poor attendees with the same 'likely to fail' brush is unwarranted. As can be seen from Figure 3, the range of final marks for the students who attended no workshops at all was between 0 and 77. We are dealing with only five students in this instance, with an average mark of just 43. It is useful to know that some students are capable of very successfully completing this unit without attending a single workshop, but this does not diminish the value of using attendance data to target at risk students. The following semester, only two students attended no workshops at all, and both received very low fails. There are also high achieving students with correspondingly high attendance rates. The question here is, would some of these students have performed just as well with poor attendance? Figure 4 shows that some students who attended less than half of the workshops, still achieved final marks above 80%. The range of skills that students have on entrance to this introductory unit is quite varied. It is likely that students who have the necessary skills to pass the unit on entry to university do not feel the need to attend. Further work to prove this hypothesis is warranted in future offerings.

We believe that the overall reduction in failure rates can be attributed to the active learning environment and the assessment scheme implemented in the redesign of the unit rather than improved attendance rates. While the teaching team was changed for this new implementation, the current members of the team were involved to some extent in the design of the previous offering. Conversely, improved attendance can be attributed to the collaborative learning environment where students have a stake in each other’s learning.

Conclusion

Our own anecdotal evidence shows that students who do not pass have failed to submit one or more items of assessment. That is not to say that if a student misses a piece of assessment they will necessarily fail. Many of the low failures come from students who try one or two of the first assessment items and do not carry on. Curiously, these students remain enrolled in the unit, but take no further part. It is not unreasonable to assume poor attendance by these students is a result of disengagement with the material being taught.

The peer-pressure associated with pair programming, which generates a sense of ownership of their learning as well as a stake in their partner's performance, acts as the underlying motivator for attendance. Ensuring that assessment items interest students on a cognitive level and directly relates to the weekly activities means that we have more enthusiastic, engaged students in the workshops. Workshop attendance has improved to an extraordinary extent, with student failure rates plummeting. Students tell us in their feedback and reflections that they love the range of real-world, engaging projects, and come to appreciate the benefits of the active and collaborative learning environment we offer. Our holistic approach to teaching introductory programming seems to have hit on a winning formula. Our work on achieving and maintaining an engaged cohort of introductory programming students will continue to focus on assessment driven learning, the measure of which will be attendance, assessment submission and qualitative student feedback.

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