

Identifying and dealing with students at risk ^{*}

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SUMMARY: *The engagement and retention of engineering students are issues that have been of concern for educators for at least 50 years, and with an increasing number of students engaged in work outside the university, the pressures are increasing. In the current study, the effectiveness of a program titled "Students @ Risk" has been assessed. The program revolves around a weekly summative quiz where performance and attendance are noted. In an attempt to prevent problems before they set in, students who have not attended at least half of the quizzes in the first four weeks of semester are contacted by the lecturer and urged to make the most of the opportunities that the quizzes afford. The numbers contacted normally account for up to 10% of the class, although it is often less than 5%. Experience has shown that the students who are contacted respond well to the approach. Approximately 40% respond to the email, and in most cases these students then make significant improvements in attendance with rates going from a low 35% to 45% for the rest of the semester. The students are also likely to go on to pass the course. The feedback from the whole class is very positive with regards to the quizzes, with 64% of respondents to one course evaluation listing the quiz as one of the best aspects of the course. There has also been encouraging feedback from individuals in the class who have been contacted as part of the program.*

1 INTRODUCTION

Engineering schools spend considerable time and effort in an attempt to attract students. In many cases this involves more than simply advertising the existence of a particular program of study or stimulating some interest in a particular course. Due to entrance requirements, not only is it necessary to deal with competing student interests, but students must also be undertaking the appropriate prerequisite courses in the final two years of their high school studies; something that may require them to make a conscious decision to select appropriate subjects around the time they are in Year 9.

And after all this work to attract them, just under 10% (eg. University of Adelaide, 2008) leave their studies, with many doing so during or at the end of their first year. Some may simply be changing courses, others may find that university is not for them. However, within this group there are others who have, for whatever reason, failed to engage with the course or have failed to engage with the concept

of university learning, and it is these who are the focus of the current work.

Of course, there has been much work done on student retention already, with studies going back to the 1950s (eg. Malloy et al, 1955; Athanasiou, 1971). In those days attrition rates appear to have been much higher (Athanasiou was following a group of 862, of whom 195 had left by the second semester of their second year, giving a two-year attrition rate of 23%) and the focus seemed to be on determining entrance tests that would identify those who were likely to stay the course, although there was mention of the need to change the course to appeal to the student with broader interests than the narrow range assumed for the traditional engineering male at the time.

In a study of first-year students at university, McInnis et al (2000) found many students are actively engaged in the workforce and, according to Bell (2006), many see their lives revolving around work rather than study. Those that work outside the university engage in fewer contact hours and are more likely to be isolated in their study. A key finding from the study was that students had some difficulty in making the transition to a system of learning where much more personal responsibility was required. Procrastination and time management have also been

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found to be key issues. Research has shown that the better students get onto the task sooner and work at it more efficiently, while the poorer students leave it to much later and then spend excessive amounts of time trying to get what is required prepared in time (Bernold, 2007).

Another key factor in student retention has been shown to be student confidence, both in their basic background knowledge and in their ability to succeed in engineering. This confidence is in turn determined, to an extent, by personality and other issues rather than straight competence (Besterfield-Sacre et al, 1998; Bernold et al, 2007). For example, females in engineering have been found to be less confident, and even those with the same marks as males are more likely to be part of the program attrition (Besterfield-Sacre et al, 1998). This lack of confidence is important since it points towards the need for strategies that are likely to be successful in building student confidence and retention. Some universities have gone so far as to set up special first-year transition programs to address this issue (Fink et al, 2005) and some started offering special help on a voluntary basis with the unfortunate result that those who needed it most did not take part (Bernold, 2007). Many universities have appointed senior academics as first-year experience coordinators in an attempt to reduce attrition rates.

But it is not just first-year students who are at risk of disengaging from courses and the university. Later-year students, and particularly those who develop a pattern of missing lectures and tutorials, are also at risk. There is ample evidence to demonstrate that attendance is a key factor in course success (eg. Marburger, 2001; 2006) and programs aimed at engaging students and maintaining attendance should be useful in this regard. Of course, there are myriad reasons why students skip lectures and tutorials, however, Marburger (2006) put it down quite succinctly in terms of standard economic principles, attributing it to "utility-maximising". The question then is: what does it take to alter the student utility function so that attendance is improved?

2 STUDENT @ RISK PROGRAM

As a way of promoting attendance and engagement, particularly among the poorer performing students, the Student @ Risk program (S@R) was started in 2006 by the author. The courses to which it was applied had always had a lecture and tutorial format, but a key change was made: the tutorials were changed from a casual (almost come if you like) session, where questions that the students were supposed to have done were demonstrated by the tutor (formative assessment), into one where a series of questions were worked on by the students and submitted for marks (summative assessment). Each quiz was worth 1% and there was one nearly every week of the semester, giving 11 or 12 in total. The contribution of

the quizzes to the final mark was capped at 10% so students could afford to miss a couple of sessions, for whatever reason, or do badly in a couple of quizzes, and still get full marks. This made the quizzes easier to administer, and deflected some commonly-raised student and equity concerns.

The reasoning behind the approach was to try and embed new knowledge using a "learn by doing" approach and to ensure that the foundations were set for the next stage of the study, but the benefits were far more than simply this. The quizzes also engaged the students in the course, evidenced by increased attendance figures, and assisted in building confidence through the tailoring of questions of appropriate difficulty. The quizzes were also part of a continuous assessment that fitted in with university requirements that promoted a diversity of assessment techniques and limited the size of any particular component in the final mark. The quizzes also provided gentle, yet firm, motivation for the students since their performance in them contributed to their final grade. As one third-year student noted in the end of semester course evaluation: "Quizzes are good to keep me on track."

In the sessions, which were often undertaken in a lecture venue, students are asked to spread out as much as possible, and a pre-prepared question and answer sheet was distributed. Students had 25 minutes to work on it under open book conditions, but with no help from the lecturer, other than to clarify what was being asked in a particular question. There was no collaboration between students allowed. At the end of the time, the sheets were collected and then the lecturer would go through the solutions on the board. Occasionally the students would be asked to swap answer sheets and to do the marking. This was partly to relieve the lecturer of the marking load, but there were sound pedagogical reasons for this too: one way that students gain an understanding of their own grasp of the subject material and of their rank in the class is to see the work of others (Kruger & Dunning, 1999). No-one seemed to mind doing this and, despite the temptation to boost marks, the average marks were similar to those generated by the lecturer.

Not all quizzes were run under what might have been seen as threatening or strict exam conditions. There have been situations where, for example, on a particularly nice spring day, students were allowed to sit outside and work on the questions before returning after the 25 minutes to submit and go through the answers. At other times collaboration was allowed, although it was interesting to note that most chose not to take advantage of this opportunity. Every now and again, after a particularly hard quiz, students were allowed to mark (and correct) their own submission and to ensure that all who attended received the full 5/5 score. It is worth stressing at this stage, that the process was not

one of compulsory attendance, nor one of gaining marks simply for attending. A student who had not managed to make a meaningful contribution to any of the questions would score 0/5 for the quiz but, and this is important, would still have had the benefit of thinking about the questions for 25 minutes, and then had the solutions presented and discussed for 25 minutes. On a number of occasions students were reassured about their standing by being told that if they had not been able to do any of the problems this did not necessarily mean there was a problem; there would, however, be a problem if by the end of the session they were still not able to do those same questions should they have to.

The key to the system is student engagement. Once the lecturer had marked or reviewed the submissions, further feedback was provided to the whole class (via class email), highlighting the positive points to come from the quiz (perhaps a concept that most had been able to get), some general problems were outlined

(perhaps a common error) and overall statistics were given, including the number attending and the average score. These were written partly as feedback, but also to encourage those who were not attending. If a student thinks that in not going he or she is one of many, then these statistics soon dispel that notion.

Results have shown that the performance in the quizzes is correlated to performance in the exam. For example, the relationship between the quiz mark and the final mark for a third-year water engineering class is shown in figure 1. Here 34% of the variation in the final mark is explained by the quiz mark, but this is not the primary driver behind the scheme.

The focus of the S@R program are not the students who are not performing well, but the students who are not performing at all. Figure 2 shows the weekly attendance figures for the quizzes for the same third-year water engineering course. While average attendance is high (87%), there is a consistent and persistent resistance shown by some students.

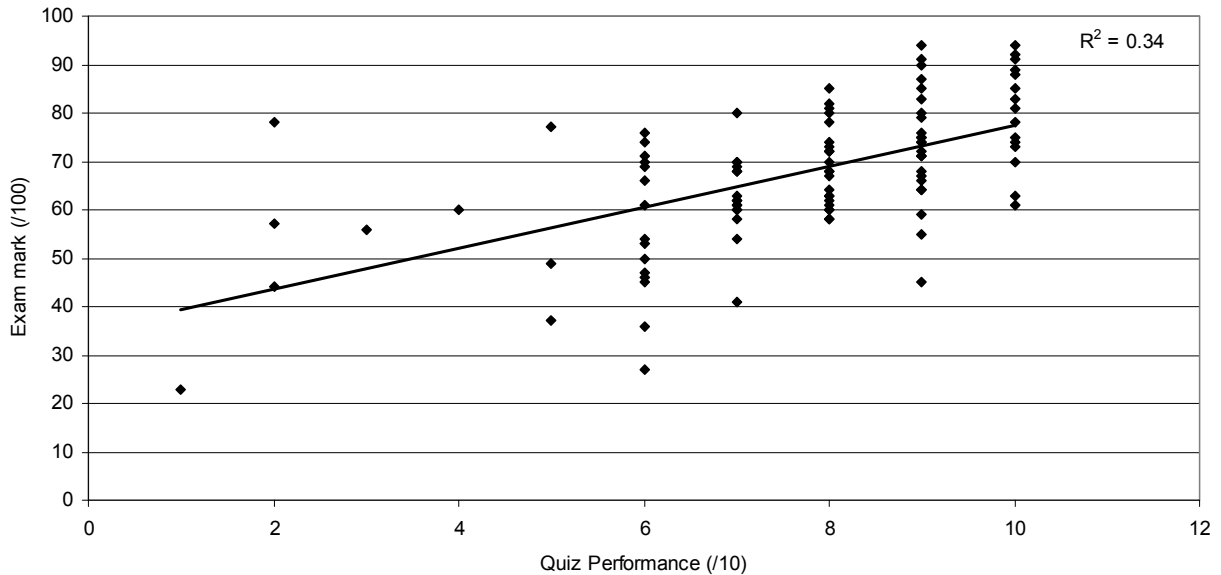


Figure 1: Exam mark versus quiz performance.

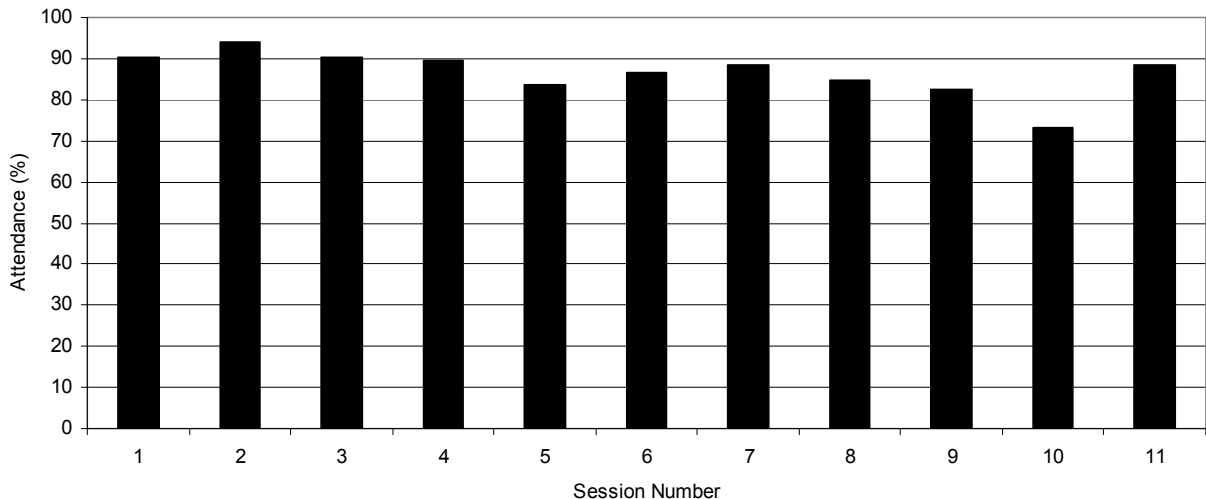


Figure 2: Attendance results for Water Engineering IIIA – 2008.

After four weeks and four quizzes, the S@R program is brought into action. Students who have not attended more than 50% of the sessions at the end of the first four weeks of a course are contacted (in a very gentle way). For the program to be effective it requires frequent and regular exercises to measure engagement. In this regard it is suitable for subjects that have lots of small increments. Engagement is the key, rather than performance, and students who are attending and doing badly are not contacted. This is not because there is no concern for these students, rather if they are attending, and therefore aware of their performance, then they have all the information they need to address the problem (if they see it as a problem). As mentioned earlier, the program is not just measuring attendance and the summative quiz is more than a "students on seats" program. The program assumes that a personal approach by the teacher will have a positive impact on the student and their attitude to the course. A typical email to a student contacted as part of the program is shown in figure 3.

3 STUDENT RESPONSE AND FEEDBACK

It would be nice to report that hundreds of students have been turned around by the program, but it is even nicer to report that the numbers involved are quite low. Most students do attend summative sessions and the positive feedback from them will be

set out later. However, for the few that need a little encouragement, the S@R program has been effective. A summary of the results are listed in table 1.

It is evident from table 1 that the numbers caught up in the program are generally small, around 10% at most, and often none at all (a most pleasing result), leading to an overall average of 6.4%. Experience shows that many students take the message from the lecturer in a very positive way and their attendance at the quizzes shows marked improvement. The pass rate for the students contacted as part of the S@R program (70.5%) is satisfactory, but there is no way of estimating what it would have been if the students had not been contacted. However, the improved attendance at the quiz sessions can only assist the students in preparing for final examinations in the courses involved.

The small numbers involved make statistical analysis of the results difficult, however, by summing the results from three of the largest groups (EP&D, 2007, Water IIIA, 2007 and Water IIIA, 2008) it was found that the attendance at quizzes for the S@R group increased from 35% in the first four weeks to 45% over the rest of the semester. The change was statistically significant at the 10% level.

Not all students respond to the email sent out (typical response rates are around 40%), but there have been very positive replies from some students who did take the time to write. The response from

Dear Water IIIA student,

I note from the Wednesday quizzes that you have been missing on a number of occasions. Now, while attendance is not compulsory and despite the fact that the quizzes are only worth a small number of marks in total, I do believe that attendance is beneficial for your study and progress in the course. I do not expect any response and I will not be following this email up with any action. It may be that you are incorrectly enrolled or there are other reasons for your absence. It is just a friendly reminder to say that I am concerned that you may not be making the most of your opportunities in this course.

David Walker

Figure 3: Typical Student @ Risk email that is sent after Week 4.

Table 1: Summary of Student @ Risk program and overall performance.

Course	Class Size	S@R	Av. quizzes by S@R	Av. quizzes by others	S@R passes
Coastal Eng. (2006)	41	0	n/a	6.6 / 7	n/a
EMA III (2006)	38	4	6.5 / 11	10.2 / 11	4
Water IIIA (2006)	47	1	1 / 11	10.1 / 11	0
EP&D (2007)	373	39	5 / 12	9 / 12	30
Water IIIA (2007)	70	7	3.9 / 11	9.4 / 11	4
Coastal Eng. (2008)	93	0	n/a	in progress	n/a
EP&D (2008)	193	6	n/a	n/a	2
Water IIIA (2008)	101	4	3.8 / 11	9.8 / 11	3
TOTAL	956	6.4%	38.5%	80.8%	70.5%

one particular first-year student in 2006 on being contacted was:

Thank you very much for reminding me the situation and I am very appreciate to discussing what you would like to advise me. [uncorrected, unedited email]

While the English is not good, the general idea is quite clear. Occasionally messages come in and there is sufficient outpouring of emotions to make the sender wonder if they have in fact invaded someone's very private space. For example, in 2008 the following was received from a third-year student:

Thanks a lot for your email. I regret missing all those quizzes. I was actually not in Adelaide during the first two quizzes. I am an international student and had gone back for the holidays. I was supposed to come back quite early, but I missed my flight ... I know this is my own fault and I am not making excuses for not turning up for quizzes. Since I came, I've been trying to catch up work from all of my subjects....But I will try my best to study for the next quiz after this, and face it nevertheless. Again I would like to thank you for your concern. I did not miss the quizzes because I thought that this subject was not interesting or anything like that. I think it's quite fun actually and I wish I had not fallen into this situation. I know I should work harder and your email encourages me to do so. [uncorrected, unedited email]

The opening sentences seem to indicate that the teacher had asked more than he had meant to: students are entitled to some sort of privacy for their personal lives, but the middle and end are quite informative. Notice that the student plans to prepare for the next quiz and "face it nevertheless". In other words, he or she will attend whether they are ready or not. From a teacher's point of view, this is excellent. Missing a quiz where the answers will be given is a very poor way to learn something and it is evident that the format of the quizzes is friendly enough to have the student attend, prepared or not. The last sentence is exactly what the program is all about. The student attended their first quiz in the following week and went on to pass the course. The third and final example is, again, quite positive in its outlook. The student went on to pass with a final mark of 58.

I really appreciate your concern. I had a rather rocky start to the semester in all subjects. I was considering defering this year but have to decided to press on with a few percent lost for most subjects. I am definitely dedicated to this subject and I dont think I am far behind if at all with the theory covered so far. I very much like your teaching style and enjoy your lectures and look forward to the rest of the semester. [uncorrected, unedited email]

The quizzes also featured in the open-ended responses that students provided as part of the student evaluation of learning and teaching that is

carried out most years. In response to the question "What are the best aspects of the course, and why?", the following were observed:

- Quiz. Good feedback.
- Having a small quiz each week is a good idea. It makes sure we can actually understand and demonstrate what was presented during the week.
- Quiz every week encourages better study practice and frequent revision.

In fact, in that particular survey 25 out of the 39 responses mentioned the quiz as one of the best aspects of the course.

4 DISCUSSION

Student retention, assessment, attendance, performance, and evaluation of courses and teaching staff are best considered through their common links and the effects that each has on the others. For example, while it is becoming more common to have universities addressing student retention in a formal way through the setting up of transition units, or the allocation of academics to the task, there are also moves to ensure that mentoring (Robst et al, 1998), curriculum design, and assessment and feedback (McEntee & Harper, 2007) are being used to assist retention. The S@R program is designed to assist in this regard and runs in accordance with the suggestions of Taylor (2008), who stressed the importance of assessment in engagement and retention, and made a case for the use of summative assessment due to the poor take-up rates with programs of formative assessment.

McInnis et al (2000), in a study of the first-year experience at Australian universities, argued along similar lines: "Some [first-year students] found the shift to personal responsibility for their learning very difficult." Bernold (2007) has highlighted the issue of poor time-management, particularly with commencing students, and the S@R program is designed to assist this by preventing students from putting off their learning activities. There may even be an improvement in student attitude simply from the personal contact that the program brings to some students; an example of the Hawthorne effect (Mayo, 1933), which others have observed following dealings with students (eg. Corts et al, 2000).

Despite the urgings of many who argue that if the course is designed to be relevant and interesting then the students will come, it appears that many require a small inducement to shift the utility function (Marburger, 2006) sufficiently to make attendance at tutorial sessions an attractive proposition. It was found in this study that making the sessions summative, even for as little as 1% each, is sufficient to attract 90% of the students. For the other 10% there needs to be something extra and the S@R program, with its

friendly approach after four weeks of semester, has proven to be effective in dealing with these students. They are not necessarily poor students, and there are certainly valid reasons why a particular student may not have been attending quizzes, however, for those that require some gentle prodding, a simple email has been shown to work well.

Missing tutorials is of course a very poor way to learn. Some students seem to believe that if they have not prepared for a test then there is no use attending. However, a well designed tutorial or quiz can, in addition to highlighting gaps in a student's knowledge, also highlight aspects that the student has picked up and understood, and this can improve student self-esteem considerably. Simply taking the quiz allows an active learning process to begin. For this reason, the students in the courses under discussion are urged to judge their understanding of the material at the end of the quiz session. If they still do not understand, then they have some work to do. If they did not understand during the quiz, but do by the end, then the problem has been addressed and solved, all in the space of 50 minutes. That represents very effective use of their time. The students appreciate this, and this is reflected in the very positive feedback that the sessions generate in the end of semester evaluation of learning and teaching.

Although the current work has been undertaken in a face-to-face mode of teaching, there is no reason why it could not be applied to the increasingly important role of distance education. For those students, the need to feel part of an educational experience may be even more important and the S@R program could be a useful component in the educator's toolbox.

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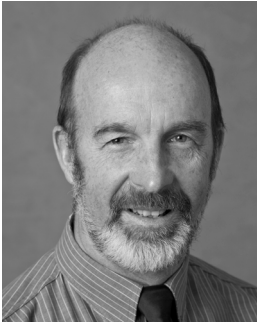
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A/Prof David Walker lectures undergraduate and postgraduate classes in the School of Civil, Environmental and Mining Engineering at the University of Adelaide. The courses include a general introduction to engineering to first-year students, an open channel hydraulics course to third-year students and a coastal engineering elective that is open to fourth-year engineering students, with an extended version of the course being delivered as a postgraduate coursework masters elective. In 2006, he won an Engineering Faculty Learning and Teaching Award and in 2008 an ALTC Citation for Outstanding Contributions to Student Learning. In addition to his engineering research, David has co-authored two engineering text books published by Taylor and Francis. He is founding editor of the Education Research Group of Adelaide (ERGA) journal, *ergo*.

