And the winning email question is... -how I got students to ask the questions they needed to ask

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Presenter's biographical details

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Abstract

For some years I had been trying to use email as a method of feedback from students. This strategy was a success in that it created a system of mandatory weekly email reports from my final year project students. The key element here was that I got the students to not only write on their weekly progress, but also their goals for the following week. This continues to be an excellent tool for keeping final year project students focussed and accountable. One notable failure was my idea of asking students during lectures to email me questions about anything that was unclear during the class (The response was really low!). The problem was (i) shyness (most students like to ask questions anonymously) and (ii) after the lecture is over, the questions are no longer fresh in the mind of the student. This all changed in 1998 when I attended courses organised by the ACUE and HERDSA and learned of and adapted a technique used by Prof. Frederick Mosteller (Professor of Statistics at Harvard). He would ask his students at the end of each lecture to write the "muddiest point" in the lecture on a scrap of paper. He would then answer the 2-3 most common questions in the following lecture. In combining my original email idea with Mosteller's technique I created a surprisingly powerful evaluation strategy that has seen student satisfaction increase markedly in my 2nd, 3rd and 4th year Electronic Engineering Subjects.

Web address

http://online.adelaide.edu.au/LearnIT.nsf/URLs/winning_email_question

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Introduction

SET scores are usually out of 7. One interesting idea is to convert your score into a percentage and compare it against 45%, 65%, 75% and 85%, which are the thresholds we judge students by. When I do this myself, for the 'overall lecturer rating' I've always hovered around 70%, ie. I was always a 'credit' lecturer and never quite made a distinction. This jumped quite dramatically to >90%, in 1998, when I developed a method of class feedback, with the help of email. This culminated in the 1998 Stephen Cole the Elder Prize [1]. The background and process involved in this feedback method is the subject of this paper, and a

quick summary can be found in ref. [2]. Note that this year my 'quality of researcher' rating for my Large ARC was 90%, averaged over 5 anonymous reviewers - I mention this to dispel the myth that an excellent lecturer is always a poor researcher. Naturally, this kind of performance involves some sacrifices: in my case my office is messiest in my Dept., I can't remember my multiplication tables and I don't have time to learn the ins and outs of photocopiers & machines with more than 3 buttons.

Another indicator as to the success of the email feedback method is that of attendance.

Typically the attendance indicator on the SETs was around 55%, and this increased to

87% when feedback was introduced. It should be mentioned that this was an Electronics, subject offered as an unpopular 'service course' to students outside the discipline Ð this makes the results even more remarkable.

Year	Average	Standard Dev.	Max.	Min
1994	50	16	79 3	
1995	55	12	81	16
1996	66	14	90	19
1997	65	11	87	47
1998	66	14	89	17

Table 1: Exam results over a 5-year period. Feedback was introduced in 1998. The data shows that variation is so great, that from exam results, a quantitative learning outcome cannot be reliably assessed. Note the exam was 'open book'.

Another possible success indicator is to check for a quantitative learning outcome in the exam results. Table 1 shows that, although the results did in improve in 1998 over the previous year, the variation between all years is so large that no statistically meaningful conclusion can be made. This does not mean that the feedback technique did not produce increased learning Ð it simply means that exam results are not a good indicator in this instance. Note that these were open book exams Ð an interesting open question would be to test in future if closed book exams would make a more reliable indicator. However, SET scores do indicate markedly increased student satisfaction. The key point that produced this increase in satisfaction is feedback.

Background

Before we go into the details of the process, let's say something about the background to the development. Firstly, bear in mind this is an Engineering course. If we liken the theoretical sciences to the arts 'mind' subjects) then engineering can be likened to the performing arts 'mind & action' subjects). So in the same way a music student must have an instrument, an engineering student must thereby have a laboratory. A laboratory is where 'mind' and 'action" connect for the engineering student. This connection is so important, that final year Electrical Engineering students are given a lab project that take a year to complete.

These final year projects are usually carried out in groups of 2 or 3. Keeping the groups focussed and accountable, is a formidable task. However, for some years I have been adopting an email feedback technique with great success. The process is to (1) demand a weekly progress email from each individual student - only one paragraph (2) stipulate the weekly progress and problems must be listed (3) specify goals for the following week. I

cannot stress the importance of item (3) in keeping the student focussed, accountable and involved in step by step project planning. An indicator of the success of this method is that in 1999 I took 16 students to the Gold Coast for an electronics conference and 9 were undergraduates. The 9 undergraduates represented 4 project groups Ð and they were able to present and publish 4 papers [3-6]. It is an unprecedented success to have 4 undergraduate papers published in a refereed proceedings in one go!

This email feedback process is also useful for assisting in marking individual members who have worked in a group. Those who are not functioning well, invariably betray themselves by sending 'skimpy' emails.

Figure 1: Dr. Abbott's group at the 1999 SPIE conference at the Gold Coast. All are wearing matching 'University of Adelaide, Centre for Biomedical Engineering,' T-shirts. From left to right: Greg Harmer, Dr. Derek Abbott, Yullia Shen, Said Al-Sarawi, Scott Hill, Peter Celinski, Jarrad Maple, Andrew Allison, Boon Tay, Leonard Hall, Abdulla Mohamed, Andrew Campbell, Jiansheng Xu, Sam Mickan, Mark Perkins (Kevin Chin, not shown). Nine undergraduate students are shown that comprised 4 project groups. This led to 4 undergraduate papers presented, refereed and published. This is the educational outcome of final year projects that were kept accountable via weekly email reporting.

Figure 2: Andrew Campbell, Greg Harmer and Sam Mickan on the airplane back home to Adelaide from the Gold Coast. This demonstrates they worked hard and played harder.

Email Feedback for Lectures

Given the unprecedented success in using email for project groups, it became natural to ask if lectures could somehow be enhanced by email also. One notable failed attempt was when I announced that students may email me later, if anything was unclear during the lecture. The

problem was a very low response, probably due to:

- Shyness
- Forgetting to email
- After the lecture, the 'moment is lost'.

Then I learned of Mosteller's Muddy Method [7,8]. Mosteller is a retired Professor of Statistics at Harvard. He had the highest SET score in his whole department, but there was nothing especially different about his lecture delivery itself. People wondered why. The answer was that he had a system of getting lecture by lecture feedback from the students. At two minutes before the end of each lecture he would ask the students to write the 'Muddiest Point' in the lecture and he would then collect the pieces of paper. In the following lecture he would then answer the most frequent points.

This inspired me to adapt my email idea. I adopted Mosteller's approach, but with the following differences: (i) I answered every question, (ii) I sent the answers to the whole group via email - we have an email alias set up for each class that goes to every individual, (iii) the answers were then posted on the web and (iv) 2-3 important answers were also given verbally in the following lecture. The sheet of paper I handed out to procure the Muddy Points contained 3 pre-printed questions:

- What is the most meaningful thing you learned during this session?
- Which question(s) remain uppermost in your mind as we end this session?
- The Muddiest Point: What was the 'muddiest' point in this session? (In other words, what was least clear to you?)

Where the first two questions were inspired by Tom Angelo [9]. However, it was the final question, due to Mosteller, that always solicited the best response. In future I shall play with the wording of the first two questions. Two possible alternatives are (i) what was the key point of this lecture, and (ii) what do you want to hear more about?

Details of the Feedback Process

The process was implemented on class sizes ranging from 60 to 180. The number of responses I received at any one time ranged from 10 to 50. It would typically take 2-3 hours to answer all the questions and compose an email, and in some instances it took as many as 5 hours. Fortunately processing a big batch of 50 questions was not intractable, as there would cases where one answer could deal with several of the questions. I would typically sit down to create the email straight after the lecture.

The objectives of the process were too (i) solicit immediate student feedback on unclear issues, (ii) rectify misunderstandings quickly, (iii) allow requisite information to be absorbed before introducing new material Ð ie. avoid compounding 'run away' consternation, and (iv) provide grist for setting exam questions. The key objective that led to the success of the process was that I wanted students to relax, feel cared for and feel as though they could ask me anything.

Rules for Answer Giving

There are some rules I set myself, when answering the student responses that were crucial for the success of the process. (i) Always reply quickly, (ii) reply clearly, sincerely & succinctly, (iii) no 'talking down', even if trivial question, (iv) reword their questions more clearly (v) reply to the quirky/comical questions too, (vi) use humour and simple mental pictures in the replies,

(vii) ask colleagues to peer review web page, to check both the explanations and appropriateness of the humour, (viii) reply to every question, and (ix) for those impossible to answer, explain why in the lecture.

These rules were essential for gaining the trust of the students and to give them a sense of feeling validated. Another important ingredient was my innovation of awarding the 'Most Perceptive Question Prize', at the beginning of each lecture. I define this as the

question that made me think the most. The prize is the lowest denomination that happens to be in my pocket (5 cents to $100!) The students loved the element of risk here for me and it certainly kept their attention. Fortunately, I have not parted with more than $2 in one go Ð but the day will surely come when I only have $100 in my pocket!

When the winner is identified, (s)he has to 'come on down' to the front and we all applaud. This process starts the lecture off with 'high energy' and a buzz in the air.

Examples of Questions and Answers

The types of questions students tend to ask, once they are relaxed with the process, can be

broadly divided in to the following categories:

House keeping

Q: Why don't we do away with lectures? I learnt more in the tutorial than at any other time.

A: Ah, but if we hadn't had the lectures that we did, would you have understood the tute? Perhaps it's the combination of the two that does the trick.

Q: How are exam and assignment marks divided?

A: Exam 70%. Practicals 15%. Homework 15%.

Q: Will you show us how do the exercises after the holiday?

A: Yes and no. No, I won't show the class. But yes I will help those who come to me with a neatly written attempt, who got stuck -- I will help you to find out what went wrong. You get plenty of other examples with solutions. It is part of education to try something on your own now & again. If you can't cope with it now, how will you cope at exam time?

Q: Will you be here during the exam weeks?

A: All wise lecturers go on business trips during exam weeks. Wise students ask plenty of questions throughout the term, and don't save them up until the day before the exam!!!

Humourous-frivolous

Q: I am a capacitor! Yeah baby!

A: It can't be.....Austin Powers?

Q: Why not substitute a sheep with an equivalent RLC circuit?

A: Sounds a bit of a woolly idea to me :-)

Q: Exit light, enter night, take my hand, we're off to never never land. Duu-nuh-nuh. (Sung in a grungy voice). Now you know some Metallica!

A: I'm very touched that you feel me worthy to educate in the apogee of postmodern, ear-wrecking, post-head banging, grunge. My sheltered life is now infinitely so much more cultured. You have filled that aching void. Thank you. Know any Mozart arias?

Q: When you turn on the light, where does the dark go?

A: I give up. Where?

Q: Have you ever done a comedy routine with Costello?

A: No, but I've eaten the cheese :-)

Q: Why do kamikaze pilots wear helmets?

A: Why do people get buried with their clothes on?

Q: Since Donald Duck doesn't wear pants, why does he wrap a towel around himself when he gets out of the shower?

A: I think you'll go very far in life. That was a very perceptive question.

Humourous-serious

Q: What is my capacitance?

A: Capacitance is between your body and some other conductor. It doesn't make sense to talk about yourself in isolation. Do a rough calculation for yourself standing 1 cm from another person and tell me what you get.

Q: If two people can have capacitance between them, what about fish?

A: Sure anything goes man. But if the water is salty and conductive, capacitance will be shorted out.

Q: If two people can have a capacitance between them, does that mean when Bill moved closer to Monica that he had an involuntary discharge?

A: As you move closer to Monica, capacitance goes up. You only discharge on impact.

Q: If God exists, why does he let us suffer lectures?

A: He believes in 'character building'.

Prescription

Q: Exactly what is going on when the MOSFET transistor is on?

A: When the n-MOSFET is on, holes are repelled from the surface and electrons are attracted to the surface. The "sheet" of electrons at the surface is then a conducting channel that connects source and drain.

Philosophy

Q: By Ohm's law V is proportional to I, so what's the difference between constant voltage and constant current?

A: OK, let's talk about a constant voltage source, for example. We know that it's output resistance R must be zero to get a constant voltage. Now by V=IR, if R is really small and there is a huge fluctuation in I, then the fluctuation in V will be small (as it is I multiplied by a small number R). Thus V is nearly constant, whilst I wildly varies.

Q: How does voltage get from one side of a transformer to the other?

A: Black magic :-) In other words you don't need to know that for this course. However for those of you who are keen: it is a process called electromagnetic induction. Faraday's law says that a change in magnetic flux induces a voltage in a nearby conductor. The higher the rate of change, the higher the voltage. So the first coil in the transformer is producing an oscillating magnetic field (at 50Hz) which induces a voltage in the second coil. This explanation can be refined further, but there comes a point where we have to stop and say we just don't know... eg If I ask you why one billiard ball moves if it is being hit by another one, you will answer 'there was a transfer in kinetic energy between the balls'. Now if I ask you why the kinetic energy decided to hop out of one ball and enter the other like some kind of ghostly spirit, you would say, 'we don't know'. Similarly if I ask you why gravity works, nobody really knows. Electrical Engineering is exactly the same.....we can explain everything in terms of basic laws, but when we try to explain the laws

themselves we find that we really know nothing. We only get to find out when we meet the Boss Upstairs. However, as engineers we tend to be into utilitarianism and we know that we can do useful things based on

those laws and tend not to care about explaining them. If you do care, then you need to consider doing degrees in philosophy, theology, physics and a few other things.

Despair

Q: How am I going to pass this subject?

A: Spend 9 hours per week working on it (for a high distinction) or half that if you just want to pass. Also do every prac and homework and tutorial.... don't miss any. And don't miss any lectures. Email me whenever you feel something confused you (after you've had a go first at thinking about it).

Q: I don't know why some days I'm focussed and other days I have no attention span.

A: I think this happens to all of us from time to time. You are not alone. A good way to focus is to sit at the front of the lecture theatre. Also defining to yourself why you want to be a mechanical engineer would help. We understand lots of details about the universe, physics etc..... but one of the biggest things we neglect is trying to understand ourselves and each other. I've learned to find out that what makes me tick is 'detective work.' I love solving mysteries. So I could be quite focussed and happy if I had a job doing historical research, police detective work or the detective work of a physicist studying the universe. I happened to drift into Elec Eng when I was your age, but I found that I stuck with it because Elec Eng has quite a lot of interesting detective work. 'Detective work' might not be your thing, but other possibilities are 'creating something', 'words', 'art', 'performing', 'helping other people', 'making paradigm shifts, ... try and find out that core thing that really keeps your interest.

Q: Why, oh why must this course end? We will be forlorn without your divine guidance.

A: It is tragic isn't it. How will I cope without such a brilliant class to lecture? As for being god-like, I would not pretend to attain that level....but demi-god status will do :-)

Personal

Q: Where do you find the time to read all our questions, answer them and send them out? (Even irrelevant ones like this).

A: Well it's 11:50pm at night as I write this. I hope you are up working too. 9 hours per subject per week.....remember?

Q: Why do you always look neat & tidy, while other lecturers always look old & stale?

A: It takes all types to make a world

Q: I like your taste in clothing. Where can I get a tie like yours?

A: The duty free shop in the airport in Washington DC.

Q: Can you bring me back a bottle of duty free whisky on your way back from overseas?

A: Well.....no.

Q: We all want to see you off at the airport.

A: That's very kind of you all. I'm very touched. Excuse me while I wipe away that tear. But unfortunately, you all have another lecture on when I have to be at the airport. Maybe next time?

Q: Where's the thongs and stubbies?

A: The reason I don't wear thongs to work, is that it doesn't go with the suit :-) Also dress is an important thing. If you walked into a bank and the manager were in cut off jeans and thongs, would you think you had the wrong place? As for stubbies, well if you want me to slurr my lectures.....

Q: Are you single?

A: Have you considered enrolling for sociology or anthropology?

Indignation

Q: We are 3rd years and we know how to integrate like real men -- all in one go.

A: Yeah, sorry if the really easy integrations insulted your masculinity. The reason for splitting up the problem into lots of easy integrations is that it is easier to track what is happening to compare it with physical reality. It's good you found it easy -- because I'm sure you'll sail through the exam. In an exam you are at liberty to solve the problem in any manner that works, if you want to use a more macho method.

Triumph

Q: Why don't I listen in lectures more often? -- I understood everything today!!

A: Wow. Y'know, when a major breakthru' happens like this, if only once in a whole lecturer's life, it makes his whole career worthwhile. You have bought tears of joy to the eye and have made my day.

Q: I've found inner peace with my soul, and the earth, the universe and myself are as one.

A: I'm very pleased for you. I never realised my lectures had this affect on people.

Correction

Q: On slide 5-16, there is a typo. The top line should read 1/2(b3 + b2/2 + b1/4 + b0/8)Vref.

A: You are right. Muchas gracias. Merci beaucoup. Efaristopoli. Mille grazie. Muito obrigado. Tak (that's Swedish in case you weren't sure). Danke. Koszonom (Hungarian). Toda-rabah (Hebrew). Kiitos (Finnish). Spasibo (Russian). How else can I thank you?

Q: Just to let you know. You can't write R=infinity, you should write R->infinity.

A: Mea culpa. OK. Point taken!

General Questions

Q: What does pedantic mean?

A: Pedantic means writing (10^8)-1 instead of 10^8, for example. Only a pedantic person would care about the -1. A pedant is someone who is overconcerned with minute details and rules. The trouble with people like that is they always miss the "big picture" and tend to be really irritating. They should all be locked up and fed bread & water. Pedants make great physicists & mathematicians, that's why we're proud to be engineers. Approximation is our motto.

Q: Is it OK to kill someone if they want to die?

A: That is known as 'mercy killing.' That is a tricky ethical question! It is tempting, if someone is in great pain and wants to end it. On the other hand, what if you didn't and they were to get better and thanked you for not killing them after all? Life can be full of very big dilemmas -- and working through each one is all part of it. We all make wrong decisions along the way. That is why it is important to forgive..... we are all learners finding our way.

Blackmail

Q: If you were a real friend you would give us all the solutions in the exam.

A: If we did that we would be doing you all a disservice, as the value of your degree would crash. It is a similar principle to flooding the market with bananas -- the price of bananas would suddenly drop. Another analogy is this: imagine you could suddenly hit a six every time in the game of cricket without fail, no matter who the bowler was. What would happen? The game of cricket would die. There would be no game. Everyone would lose interest. This is a very important principle in life: no pain, no gain. If there's no dissipation, there's no current flow. A kite flies against the wind. For things to succeed there always has to be some form of barrier or resistance to overcome. Exams are the resistance, if you like. Whenever you find a barrier, in life, it always means there is an opportunity. No barrier, and it has no worth. There are some things in life that that are unconditional, but then the barrier we have to overcome is ourselves.

Panic

A: Where overseas are you going? I just can't help this feeling.....I'm losing you

Q: I'll be in a number of places, but mostly Malaysia & UK. I will still be contactable by email, so you can still feel as if I am here. Keep those questions rolling and I'll answer from wherever I am. Isn't technology wonderful?

A: I cannot really understand anything

Q: Read about it. Chat to friends. Think about it. Then if you are still stuck email questions and I will answer them. If you are still confused, you then need to make a long list of questions and come and see me in my office and I will go through it with you.....other than that I could transplant my brain into your head, but I don't think you'd want to inherit all my personality defects :-)

My Teaching Philosophy

It is quite possible to implement the email feedback process and not get a good response from the students. This can happen for a number of reasons: (1) students get bored of being surveyed, if you lose their trust by not delivering what you have promised they will ignore the process, (2) missing out the humour and the 'most' perceptive prize reduces interest, (3) your replies must show you care, and (4) if you implement the process mechanically without enthusiasm. Enthusiasm is everything.

Further to this my particular teaching attitudes are probably inextricably linked to the way the feedback process works for me. So perhaps we should review what my attitudes are. My teaching philosophy is to deliver lectures in a clear non-obfuscating manner, to illustrate how to think from first principles, to promote self-belief & good study habits, and to pay particular attention to the students visualising simple mental pictures and analogies. I have a number of 'mantras' that I repeat often to the students. I tell them that I cannot teach them anything. I explain that they really teach themselves. All I do is introduce them to a bit of jargon and place a few 'mental hooks' in their minds that act as starting points for their odyssey into self-learning. I put the responsibility in their own hands. I tell them that I'm not a 'teacher' and I'm not a 'lecturer', I'm in fact their coach. They see me for 1 hour a week for coaching. If they were tennis players they would then have to go and hit the ball a lot on their own, for the coaching to do any good.

I explain that 'hitting the ball' means doing homework, tutes and labs. I explain that they should get together with friends and do extra textbook exercises together in small groups.

A survey was done at Harvard that found that high distinction students were spending 9 hours per week, on average, per subject. I explain to them that that is what it takes. If they have 10 subjects, that is 90 hours per week (if they want to get 10 high distinctions). I then illustrate that people who own their own businesses work between 80 to 120 hours per week, to add some perspective.

I tell my students that I don't believe in intelligence. The difference between passing and not passing an exam is one of 'preparedness' and good study habits, not intelligence. I say there is no such thing as a 'fail' - it really just means 'unprepared.' The scoring system should be re-labled 'F' to 'U'.

I always 'put the blame on me'. What I mean by that, for example, is that rather than saying 'hands up if you didn't understand that', I say instead 'hands up if I was not clear'.

Conclusion

In conclusion, I have outlined a process for soliciting questions from students and feeding back by email. Enthusiasm and showing that you care are important factors in success of the process. Success has been measured by student satisfaction in the SET survey. Learning outcomes in terms of exam results were shown to be inconclusive. The open questions for future investigation are: (i) could changing from open book to closed book lead to a better indicator? (ii) could it be that there never will be an increased learning outcome unless it is accompanied by good study habits on the part of the student? Should the future focus be on finding ways to improve feedback or perhaps should we be concentrating on ways to motivate

self-learning and good study habits or both? Can we find innovative ways to increasingly stimulate self-learning and can IT play a role here?

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