Talking Teaching

Edited by Birgit Loch* and Sid Morris**

The opinions expressed here are those of the author and not necessarily of the Editors of this column or the Editors of the Gazette or the Australian Mathematical Society.

Birgit and I have agreed to edit a column in the Gazette addressing teaching and learning issues that university mathematics lecturers face today, particularly as regards the use of technology. Our focus is primarily the technologies used to facilitate student learning as well as mathematical software packages. While we plan to write some of the articles, we welcome contributions from others. This column will complement Classroom Notes.

We believe that the Talking Teaching column is timely, if not overdue, because great change is occurring in university teaching and learning but there has been too little focus on the special needs of mathematics. For example, some believe that the 50-minute lecture or video recording is outdated and can be replaced by 10- to 15-minute video snippets. While this may be suitable in some subjects, it has some limitations in the teaching of mathematics. We shall take up this topic in a subsequent column.

The fact is that today most university students do not attend most lectures. An extreme case recently went viral. It was a complaint by Associate Professor Adrian Raftery of Deakin University’s Business School. It was even widely reported in newspapers including https://tinyurl.com/nostudents on news.com.au on 12 July 2017. The heading was “University professor posts in exasperation after students failed to show up to class”. He posted an image of his classroom which was supposed to introduce the first class of the second semester — but sadly, there was no one in it. Literally, no one had shown up. He went on to say “After being pumped up to give a great class, I am deflated that they couldn’t bother their arse to show up”. He notes that the class was not available online and would not be recorded. That communication sparked a lot of response with other lecturers saying his experience is not at all novel and suggested that “maybe universities need to change to recognise how the young’uns want to be taught these days”.

So what makes a lecture worth attending? I have often heard it said by mathematics lecturers that the key thing you need in order to interest students is to give an application for the mathematics you are teaching them. However it is my view that this is neither necessary nor sufficient.

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Fifty years ago Professor Clive Davis lectured me on the Prime Number Theorem, which was proved independently in 1896 by Jacques Hadamard and Charles Jean de la Vallée-Poussin, and which says that the number of prime numbers not exceeding $x$ is asymptotic to $\frac{x}{\log x}$. I was both surprised and impressed by this result and its beauty. I did not need real-world applications to enjoy this result. You might respond that I was not the typical student. There is no typical mathematics student! There are different categories of students and I will introduce these shortly, but first I want to describe my restaurant experience which gives some insight.

I once visited a Moroccan restaurant. The menu, not because of the language, was full of dishes I had never heard of. So I asked the waiter to select on my behalf. After I had finished my meal, the restaurateur came up to me. He did not ask whether I enjoyed the meal. Rather he asked: Did the food speak to you? In my opinion, this was exactly the right question. (By the way, it did speak to me.) And this is the question we should ask our students. Did the mathematics we were teaching you, speak to you? If not, we have failed. The Prime Number Theorem spoke to me! It is also true that when I recently read Ian Stewart’s book In Pursuit of the Unknown: 17 Equations That Changed the World, which won the 2017 Euler Book Prize, https://tinyurl.com/17-equations, it too spoke to me.

Whether the mathematics speaks to the student or not of course depends on the interests and the mathematical ability of the student. Students are more likely to be receptive to the material if it is not beyond their mathematical ability and appears to have some relevance to their future career. And an important feature is precisely how that material is presented to the student or discovered by the student. In an attempt to address this, I have put the students in separate categories. How you facilitate a student’s learning in mathematics should depend on which group they belong to. A very coarse classification might be:

(i) those who have strong ability in mathematics and want to have a career as a professional mathematician;

(ii) those who plan to be high school teachers and have mathematics as one of their specialities;

(iii) those who plan to major in mathematics in their Bachelor degree;

(iv) those who have good mathematical talent and are doing a professional qualification which requires mathematics, such as engineering;

(v) those who have little mathematics talent but are required to do one or more mathematics subjects in a course such as nursing or agriculture or biological science.

Another very important classification is whether they are first or later year students. One also needs to be mindful of the fact that for many students English is not their first language and even students with a good IELTS score may struggle with the English, even in a mathematics course.
How you approach your task as a lecturer should differ greatly, depending on which group you are dealing with. And what technology you use, and how you use it, should also depend on your audience. So this will be a topic of analysis in future articles.

I take it as a given that, irrespective of how good a lecturer you may be and how relevant the topic is, the majority of students will generally not attend lectures. The solution to this in the past was to prescribe a good textbook and to provide good lecture notes. But today, with students not wishing to spend what little money they have on purchasing books, this is not an answer.

Is videoing lectures the answer? It makes it possible for students to view the lecture when and where they want. If a student did not understand the whole or part of a lecture, they can watch it again. They can usually play it faster or slower as well if that assists. Of course videoed lectures allow for no interaction during the lecture. In truth, how much interaction between students and you is there in your lectures?

Many people over the years have come up with wild and wonderful solutions. Some even seem to be exciting. But the problem is usually scalability. While you may get a teaching grant to test out a clever method, that is of little importance if what is proposed cannot be used without a teaching grant. Having been primarily responsible for a university budget of hundreds of millions of dollars, let me assure you that Vice-Chancellors are not looking for teaching technologies which cost more than a lecturer in front of the class. So I will ignore all uses of technology that are not scalable, and if preparing a lecture using a particular technology is extremely time-consuming for the lecturer or requires significant technical support, then it is not likely to be a practical solution.

To consider what might work, let us look back briefly at how teaching technology has changed. How did we reach what is often referred to as ‘Death by Powerpoint’? Let me begin with Raphael’s fresco ‘School of Athens’, painted in the early 16th century. According to the Web Gallery of Art, https://tinyurl.com/ycbtpyzv, “The scene takes place in classical times, as both the architecture and the garments indicate. Figures representing each subject that must be mastered in order to hold a true philosophic debate — astronomy, geometry, arithmetic, and solid geometry — are depicted in concrete form. The arbiters of this rule, the main figures, Plato and Aristotle, are shown in the centre, engaged in such a dialogue.” In the right corner we see the teacher is using a slate about the size of an ipad. When I was in primary school we still used slates. Teachers wrote on a blackboard using chalk. When I attended classes at the University of Queensland, my lecturers still wrote on a blackboard using chalk. We, as students dutifully copied what was written on the blackboard onto paper. To be precise the lecturer wrote on the board and said what he or she wrote and we wrote that on paper. The speed of presentation was speed limited, like NBN. It was not limited so much by our need to understand what was written as by the speed the lecturer could write. At this point in time, photocopiers were not widely available, so attending lectures and writing what was written on the blackboard was necessary. This reminds me of the 1999 movie “Not
One Less set in the People's Republic on China. The summary from imdb says: “In a remote mountain village, the teacher must leave for a month, and the mayor can find only a 13-year old girl, Wei Minzhi, to substitute. The teacher leaves one stick of chalk for each day and promises her an extra 10 yuan if there’s not one less student when he returns.” The teacher’s job is to write on the blackboard and each student’s job is to copy it.

The next step in the evolution was whiteboards, but this made very little difference to the teaching procedure except it was a bit easier to use colour. Then came overhead projectors with a roll of plastic. The lecturer would write on the plastic roll during the class and the students copied what appeared. Still the speed of presentation was limited by the speed of the lecturer’s writing.

Then came a dramatic change, though we did not realize it at the time. Single plastic overhead sheets became available. This made it possible to write or even type your whole lecture in advance. So during a class, the lecturer simply placed an already prepared sheet on the projector. Suddenly the speed was not limited by the speed of the lecturer’s writing. Some lecturers used a couple of overhead projectors. And next came projecting the lecture from a computer, with the material presented by PowerPoint or pdf. In principle this was no different than use of single sheets on an overhead projector except it could be presented even faster. A big positive of computer projection was that no longer did students have to decipher the lecturer’s handwriting, which was not always easy. Initially lecturers simply read out aloud what was on the PowerPoint. Many still do! Better lecturers supplement and enrich what appears on the screen with a good commentary and by writing on a whiteboard or the slides during the class. Of course we can also add a new dimension to the presentation with good graphics, videos and animation.
But there is no doubt that PowerPoint presentations tend to be very boring. Students have voted with their feet. The solution to this may be to move to blended learning, which we shall take up in future articles.

Let me conclude by recording that teaching mathematics without lectures is nothing new. When I started my first tenured position, a lectureship at the University of New South Wales in 1971, some subjects were taught using the Keller method which involved no lectures. And when I joined La Trobe University five years later, a second-year course was taught with only practice classes. Indeed my online book was written with a view to students learning without classes. But most agree that while lectures may, to some extent, be dispensable, tutorials in mathematics are not.

We definitely need to open our minds to alternatives which radically change how mathematics is taught and learnt.

Sid Morris has taught mainstream and service mathematics and computing courses to classes of up to 500 students at 12 universities on 4 continents at all undergraduate levels. His online text, accompanied by videos, is used in over 100 countries, and is translated into 8 languages. The facebook group of readers of his book has 5,000 members. He has published internationally 5 other undergraduate and advanced books and served as chair and member of university-wide teaching and learning committees.