# Using a tablet PC and audio podcasts in the teaching of undergraduate mathematics modules

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**Adapted from a case study in *Giving a Lecture*, Exley and Dennick (2009)**

**For some further discussion of some of these issues, see Dr Feinstein's blog at**

**http://explainingmaths.wordpress.com/**

## Original motivation for using a tablet PC and audio podcasts

I began using a tablet PC to present my undergraduate module on Mathematical Analysis in autumn 2006-7. Originally, my main aim was that I would have a complete record of the notes that I had written in class, and that I could make these written notes available to the students immediately after each class. In addition to this, data projection screens are often relatively large and this can make it easier for those students further back in the room to read the written notes.

In Spring 2007-8 I continued to use the tablet PC in order to teach my undergraduate modules on Measure and Integration and Functional Analysis. One of my third-year students asked for permission to make audio recordings of my lectures, and I felt that this could be a valuable additional resource for the class. I obtained some high quality digital recording equipment in order to make these recordings myself, and I made the resulting mp3 files available from the module web page.

As my facility with the technology grew, and I obtained more and more feedback from the students, I became aware of many more advantages, and also some disadvantages, of this system of presenting classes. These will be detailed below, along with the various different teaching methodologies that I have tried using this technology.

## Benefits for dyslexic students

Some students with dyslexia have found the use of the tablet PC and the resulting provision of material on the web particularly beneficial. For some interviews relating to this, see the web page **http://www.nottingham.ac.uk/dyslexia/video/browse/person/361/**

## Technical details

The tablet PC that I currently use for my lectures is a **Toshiba Portégé** running Windows XP, **Adobe Acrobat Professional** and **Windows Journal**. I have found that it is often worth passing my pdf files through Acrobat first before converting them to Journal note format, as this can give improved results. For the audio podcasts, I currently use an **Olympus DS-50** digital voice recorder. Unfortunately, this only records in wma format, so I use a freeware converter (**Free Mp3 Wma Converter** from **http://www.koyotesoft.com/indexEn.html )** to convert the resulting files into mp3 format. I prefer not to edit the mp3 files, as this can be very time-consuming. However, when such editing is essential, I have found the freeware **mp3DirectCut** from **http://www.mpesch3.de** very easy to use.

## Learning to use the hardware and software

Overall, use of a tablet PC is fairly intuitive, with the stylus acting as a (mostly) superior mouse. Windows Journal has an excellent tutorial, and I felt that I had a fair grasp of the capabilities of this package within an

hour. To develop genuine fluency requires more than this, of course, and I discovered a few pitfalls in my first few lectures.

Learning to use digital voice recorders is very quick indeed: probably five to ten minutes for those I have used.

Converting documents or sound recordings from one format to another and then placing materials on the web is another matter. Unless you are fairly expert at this (and maybe even then), it is probably best to have some technical support available.

## Teaching methodology

For my standard lectures, I prepare pdf slides including the basic outline of the material to be covered, but with gaps where I can add written annotations covering the details. I then import these slides into Windows Journal so that they can be annotated in class. I issue the students with single-sided copies of the slides (suitably scaled). This allows plenty of room for students to make their own notes during lectures. As well as the gaps, I can also insert additional pages at any time if I need more room to write.

I also give examples classes, where the students work together on problems from a question sheet. The prepared pdf slides have just one problem on each page, leaving plenty of room for hints and other annotations. I give the students a few minutes to work together on each problem, before taking feedback and then giving my own solution, in full or as a sketch.

For general question and answer sessions, I do not have prepared slides and simply use a blank Windows Journal document, adding extra pages as required.

Audio recordings are fairly straightforward. However, it is generally sensible to pause the recording when the students are discussing problems among themselves.

Along with all the other module materials on the module web pages, I make the annotated slides available in pdf format and the audio recordings available in mp3 format. It is important to make sure that it is easy for the students to match the audio to the slides. This is mostly a matter of including the relevant information on the web pages, but sometimes I may include some additional written and/or verbal comments to help the listener find their place.

By the end of the module, this generates a substantial collection of teaching resources. What should you do the next time you give the module? For my current Level 3 and Level 4 modules I am trying something new. I made available to the students all of last year's audio podcasts and annotated slides from lectures. I then issued the students with a schedule of what material we would cover in every class, and asked the students to listen to the audio podcasts and read the annotated slides in their own time. The classes are now a mixture of examples classes on specific problem sheets and less structured question and answer sessions on the relevant material (with the prepared problem sheets available as a backup to work on if necessary). Of course, this is generating a new set of written slides and audio podcasts. However, I do not expect to re-use these new materials next year.

## Advantages and disadvantages

Feedback from the students confirms that there are many advantages to the students in using technology in these ways.

- Students immediately have access to a full record of everything that was written and said in each class. In particular, if they think that they may have miscopied something in the lecture, they can

check this immediately, and avoid losing time trying to understand something that does not make sense.

- Students may well miss lectures for good cause such as illness or important job interviews. These students appreciate the opportunity to have access to the lecture materials at a time convenient to themselves.

- Students who are not native English speakers appreciate having the audio podcasts, as this gives them a chance to listen again to portions of the lecture where they feel that they may have missed one or more useful verbal comments.

- Especially in rooms with large data projection screens, the students find that the writing is large and clear, and often clearer than more traditional means of presenting lectures. Dyslexic students have been particularly enthusiastic about this style of teaching.

In addition, when using last year's audio podcasts and annotated slides, students have found the following particularly helpful.

- While working through the annotated slides, the students can pause or rewind the audio at any time in order to spend extra time on a tricky point of a lecture, or simply to revise some of the relevant background in order to understand the current material.

- Students appreciate the opportunity to study the lecture materials independently and at a time convenient to themselves.

- Studying the material in advance means that much of the contact time can be spent discussing the more interesting issues that arise after studying the notes, as well as further illustrative examples.

However, students have also identified some disadvantages

- The pace of lectures may be reduced. This was especially true when I was first getting to grips with the technology.

- There is a limit to how much material can be displayed on the screen at one time. This is usually less than would remain visible on a set of blackboards/whiteboards, and can occasionally lead to somewhat distracting scrolling up an down in order to refer to earlier material. To some extent this can be addressed by modifying the viewing scale used (easy to do at any point in the class, and particularly helpful when the data projection screen is large) or by using lecture rooms with dual data projector facilities. Probably a better solution, but rather expensive, would be to make use of facilities such as **Thunder** ( **http://www.polyvision.com/products/thunder.asp** ), in order to have several screens visible at the same time.

- The microphone does not always pick up the students' own questions. It is best to routinely repeat these questions for the sake of the recording, as well as for any students present who may not have heard the question.

The following issues are specific to my current use of the lecture materials from last year.

- Some students feel that the module requires a lot of work, with podcasts to listen to, classes to attend and question sheets to answer. Some of the stronger students have expressed this concern. However,

the total amount of time required appears to be the appropriate fraction of the recommended student working week of approximately thirty-five hours.

- A related concern raised by some of the stronger students is that contact hours may be spent on material or questions that they have already understood or worked through for themselves. It is probably not easy to resolve this issue fully. It does help, however, to make at least one class per week into an examples class covering specific questions, which are announced in advance.

- When listening to the podcasts, students can not ask me questions on the spur of the moment. I have suggested that the closest they can get to this is to immediately send me an email with their question. Of course, they can also bring their questions with them to be discussed in class.

In addition to the points raised by the students, I have identified some other features that I find particularly useful

- There is a large selection of colours and digital pen types readily available. This is helpful both for emphasizing portions of the text, and for sketching diagrams.

- It is easy to move the written annotations or diagrams around when more space is needed, or to erase them or change their colours.

- When giving a brief recapitulation of material from a previous lecture, it is useful to have the exact notes available and to be able to simply scroll through them..

- It is useful to know **exactly** what I have written and said in each class.

- Modern digital voice recorders are very small and portable, battery powered devices, while still having high-quality clip-on stereo microphones. This eliminates the problems of trailing cables and immobility associated with mains-powered voice recorders.

- It is easy to select from the accumulated materials to form standalone teaching sessions on selected topics. I am currently making contributions to the U-Now University of Nottingham Open Courseware pages, available from **http://unow.nottingham.ac.uk/**

There are clearly some disadvantages and costs associated with this use of technology: some of these have already been mentioned above. However, the major cost is probably in staff time and nerves.

- As mentioned above, it does not take long to get started with a tablet PC and a digital voice recorder. However, it does take some time to decide on the best settings for the software to fit your purposes.

- You need to allow a few minutes of extra time before the start of each class in order to set up the hardware and software.
- It can be nerve-wracking if there is a problem with the software or hardware in the middle of a teaching session, and this can also affect the pace of the teaching (as mentioned above).Usually it is sufficient to quit Windows Journal and re-open the document, but occasionally I have had to resort to rebooting the tablet PC during the class.

- Exporting and converting the files after the lecture and placing them on the web usually takes me between fifteen minutes and thirty minutes per one-hour class. However, I often take the opportunity to make minor improvements to the annotated slides, and this adds more time.

- We all make mistakes! Occasionally I may say something in a class that is not, on reflection, a hundred per cent accurate. As I usually avoid editing the audio files, these imperfections are then recorded for posterity. My approach is usually to add an annotation to the written slides to point out that I said something slightly wrong at this point in the class, and explaining what I should have said.

Finally, here are some warnings concerning the way some of the students respond to this use of technology.

- Attendance at classes can drop significantly, as students know that they can obtain all the materials whenever they want.
- For the same reason, some students allow themselves to fall behind, perhaps believing that they will be able to catch up later. From the examination results, it looks as if these students do worse than they would have done if the module had been presented in a more traditional manner. Perhaps this could be addressed by introducing assessed coursework and/or mid-term class tests to try to stop students from falling behind.

Overall, I have found this use of technology satisfying and productive. I am very pleased with the set of module materials that I have generated, and the feedback from the students on these materials is overwhelmingly positive. However, this may not be the way to obtain the best examination results from the students, unless the issue of students allowing themselves to fall behind is successfully addressed.

## Web links

- The University of Nottingham's staff resource **Thinking about Dyslexia** is available online at **http://www.nottingham.ac.uk/dyslexia/**
- A selection of my teaching and research presentations is available from the web page **http://www.maths.nottingham.ac.uk/personal/jff/Beamer/**
- My blog, **Explaining mathematics**, is on the web at http**://explainingmaths.wordpress.com/**
- Some of my presentations are also available from the U-Now pages at **http://unow.nottingham.ac.uk/**
- The modules I have taught using this technology are **G12MAN: Mathematical Analysis, G13MIN: Measure and Integration** and **G14FUN: Functional Analysis.** The web pages are, unfortunately, University of Nottingham access only: **http://www.maths.nott.ac.uk/MathsModules/G12MAN/** , **http://www.maths.nottingham.ac.uk/MathsModules/G13MIN/** , and **http://www.maths.nottingham.ac.uk/MathsModules/G14FUN/** .