Combining a Tablet personal computer and screencasting for chemistry teaching

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Abstract
This article describes innovative use of a Tablet PC and screencasting in delivering chemistry lectures. Introducing such technological innovations as an aid to chemistry lecturing is shown to be of immense benefit to both lecturer and student alike. The Tablet PC provides a clear method of presenting technical information in a dynamic fashion catering to both lecturer and student needs. It also permits archiving of lectures 'as delivered' to be achieved. Screencasting allows easy recording of the entire lecture and archiving for future viewing by the students. Student reaction to such innovations is universally extremely positive and the widespread adoption of these practices is to be encouraged.

Introduction
There is currently great interest in a number of universities in using technology to enhance student learning. In the UK this is increasingly driven by the importance attached to the National Student Survey (NSS) results and the need for many institutions to maximise output from teaching activities while managing to remain 'world-leading' in research as well. The change to an industrial-style competitive research ethos in universities together with the enhanced status placed on 'grantsmanship' skills leads inevitably to a sidelining of teaching skills development by many lecturers. In addition, since the introduction of student fees in England, university students rightly expect a better and more modern learning experience. As students can expect to contribute ever more to the cost of their university education in years to come, such expectations will inevitably increase, and a modern university will need to adapt their teaching roles and practices to reflect the most up to date technological advances.

As many technological tools become available sound pedagogical reasons for adapting such approaches must be present rather than adopting new technology simply for its own sake.

Various approaches at integrating technology to result in changes in pedagogical practices are available. As many technological tools become available sound pedagogical reasons for adapting such approaches must be present rather than adopting new technology simply for its own sake. The key measure of any such change must be judged as providing an enhanced student learning experience. Technology which aids comprehension of new material by the student is to be welcomed and in the chemistry area modern molecular modelling software which can often enhance visualisation of molecular and electronic structure is a good example of this.

In most university courses the traditional lecture format is still the favoured means of relaying information to a large body of students. This practice originated in medieval times when textbooks were not readily available to students[1] and why the practice has persisted throughout the years has sometimes been questioned. However, despite its critics it is still highly valued by the student body as evidenced in my own institution where a decrease in a school's lecturing hours drew student protest demonstrations to the vice-chancellor's office. Electronic projection, or e-projection, usually in the form of Power Point slides, while the instructor discusses the material on the slides, is increasingly being used to deliver lectures. Here is a case where the evidence of technology-enhanced learning is lacking and indeed there is evidence of a backlash against its widespread adoption[2]. It leads to lazy teachers, lazy students and not much learning. Most classes using this technology turn into simple slide-shows and are ineffective. In some cases people revert back to blackboard and chalk or overhead transparencies while some attempt to introduce some interactivity into PowerPoint presentation using for example classroom personal response systems.

The use of a Tablet PC provides another option for instruction which benefits from the interactivity and dynamism of the blackboard and chalk or overhead methods but also allows incorporation of pre-prepared diagrams or figures plus animations. In addition as the presentation is presented electronically it allows for archiving of the lecture as it was delivered and in addition as described here allows screencasts of the entire lecture presentation to be saved and archived for later viewing.

This paper presents a report on the use of a Tablet PC in teaching physical chemistry courses at The University of Manchester plus the recording and archiving of screencasts of these lectures for later student use.

Methodology

Tablet PC

The Tablet PC contains a pen that can be used to write or draw on the laptop screen using digital ink. Digital ink is available in a variety of colours and it can be easily modified or erased. The ease of modification/erasure should not be underestimated as will be appreciated by any lecturer who has used overhead transparencies to deliver lecture material. While initially it can be difficult to write clearly on a computer screen, it is similar to writing on an overhead projector and with practice the author has found that he can write more clearly on the Tablet than on the blackboard or the overhead projector. In addition a variety of writing styles and colours are available simply by clicking on an icon. With e-projection the text appears on the display as written and again has the added advantage that the script is not hindered from view by the lecturers hand or body which is a drawback of presenting on the blackboard or overhead projector. All of these factors lead to clearer uninterrupted delivery with minimal interference of student concentration on the material being presented. A scrolling mechanism on most presentation software allows easy recall/recap of previously presented material plus the ability to cut and paste text or diagrams for presentation in any part of the lecture provides a seamless way of relating different parts of a lecture.

For the physical chemistry course that I teach the main reason for adopting the Tablet PC was to allow me to return to a more interactive form of teaching where mathematical derivations and structure drawing can be done more dynamically with student guidance and input as opposed to the lecture being driven by a pre-determined script as is often the case in PowerPoint lectures. Many students have commented on the much greater ease of understanding mathematical equations and derivations when the actual topic is delivered dynamically in real time. In addition complex chemical structures can be constructed progressively in a similar fashion. Guided by student comprehension the lecturer has the opportunity to change a particular strategy of instruction at any time introducing enhanced flexibility of delivery. All of these factors can lead to enhanced student learning and indeed enhanced teaching satisfaction for the lecturer. In addition to the above, complex molecules such as protein structures can be easily incorporated into the presentation using cut and paste facilities provided by the software and dynamic annotation used to explain structural or functional aspects. In addition animations can be introduced in a similar seamless fashion. A page of lecture notes demonstrating some of these capabilities is given in Figure 1.

For writing, the Windows Journal software was used which came packaged with the Tablet PC and the notes for the complete lecture as given can be saved and archived on Blackboard for students to consult at a later stage if required. In addition, as described in the next section, a screencast of the entire presentation can be made with the accompanying audio and made available for student retrieval.

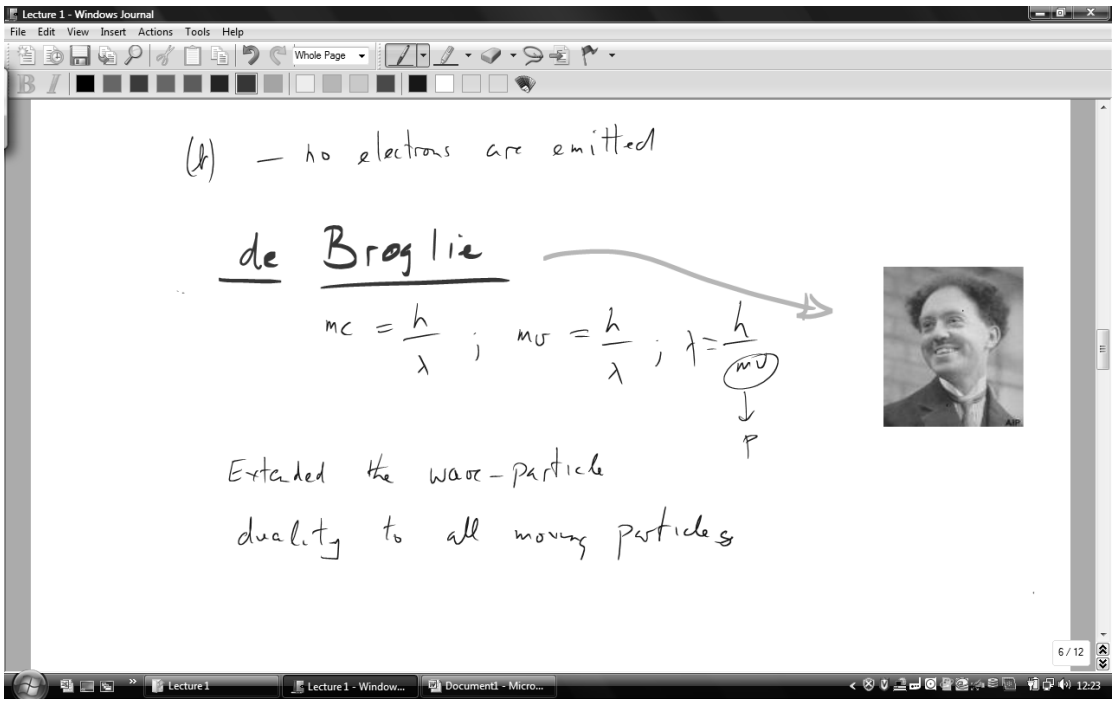

Figure 1: A page of lecture notes from Windows Journal showing the writing, colouring and annotation capabilities of a Tablet PC.

Screencasts
Screencasts are a digital video recording of your computer screen activity and usually include synchronised audio commentary. Essentially they are equivalent to letting somebody look over your shoulder to view your on-screen activity while you provide a running commentary. You can limit the recording to a specific program e.g. a PowerPoint presentation or you can define the part of the screen that you wish to be recorded. You can also record a web camera image of yourself to accompany your presentation. There are a number of software products on the market which allow you to record screencasts. The most popular, and the one used in this work was Camtasia Studio. Screencasts should be distinguished from podcasts[3,4] which generally refer to audio only files which can be downloaded in a variety of formats. In a chemistry lecturing, where illustration and visualisation plays such a significant part, podcasting has limited potential whereas screencasts are ideally suited to the subject.

What is attractive to most students about the screencasts is the ability to be able to pause and replay at a particularly difficult topic. In addition after extra study many students find listening to the whole or part of the lecture again can be extremely beneficial.

In the last academic year it was decided to record screencasts of lectures the author presents on two modules; a first year Quantum Chemistry course presented to 202 students and a third year Molecular Simulation module presented to 51 students. Both used a Tablet PC for presentation of the material as described above. Effective use of the Camtasia software has a gentle learning curve although some basic knowledge of video formats and editing is useful. In general full screen recording was used so that all activity on the screen during the lecture was recorded. For audio recording a Hama microphone which clips on to the lecturer's shirt or lapel was used with a long wire connection to the laptop. Although wireless versions of microphones can be obtained, these are generally quite expensive and unless the lecturer style is to wander excessively while delivering the lecture, the version used here is excellent.

At the end of the lecture the recording can be saved in a number of formats. Flash (flv) format was usually chosen to produce the video screencast as this is generally considered to be the most portable and compact format available. After saving the video file was transferred to Blackboard. In general the video was available to the students within thirty minutes of the end of the lecture.

While most lectures used a Tablet PC as described above some Clicker (Personal Response Sessions) using PowerPoint were given to assess student comprehension. These were also recorded and feedback after polling to each question is facilitated once again by the ease of annotation using Tablet functionality as shown in Figure 2.

Student Feedback
To assess student feedback to the use of screencasts and the Tablet PC, students were polled to rate these innovations on a scale of 1 to 4 where:

1 = useless
2 = ok
3 = good
4 = excellent

On a response rate of 70% most students selected 3 or 4, indicating overwhelming satisfaction by the students.

The students were also asked to provide further constructive comments. A sample of these are given below:

"I think that the screencasts are an excellent idea and would love to see them implemented in all courses. I have often wondered why the use of such technology isn't already implemented routinely, given the significant time for which it has been available."

"Too often, lecturers impose their preferred learning style on classes in a way that almost makes it seem like they don't want you to learn.

If forced annotation (blank spaces) and lack of handouts are at one end of the spectrum, your methods are at the other."

"Tablet PC system works really well."

"It's brilliant, really useful if I need to go over anything and I imagine it will be a real benefit when I'm revising."

"The videos are excellent.
They'd be very helpful if you'd missed a lecture due to illness, but they are really good for clarifying your notes or extending them. I think that all lecturers should do this."

Discussion and Summary
Based on student response in our school and previous other similar initiatives[5,6] it is abundantly clear that these innovations, in particular providing screencasts of lectures, is extremely well received by students. Use of a Tablet PC is generally welcomed and is the preferred medium compared with a static PowerPoint presentation. Some would argue that an overhead projector has similar capabilities however the clarity of the projected image from a Tablet PC presentation is much higher and as mentioned in the introduction the ability to

seamlessly incorporate graphics and animations together with the ability to archive notes and screencasts leads to significant advantages. With regard to screencasting, from a student learning perspective, it is clear that this technology leads to a significant gains. This perhaps should not come as a major surprise as the ability of most people to absorb new rather abstract concepts by attending a single lecture on the area is limited. What is attractive to most students about the screencasts is the ability to be able to pause and replay at a particularly difficult topic. In addition after extra study many students find listening to the whole or part of the lecture again can be extremely beneficial. Some students may have to miss a lecture for very valid reasons and the screencasts allow them to catch up on the material missed. There are also a minority of students who find a large, sometimes noisy lecture theatre distracting and not conducive to concentration. Some students have even mentioned that they concentrate better at different times of the day and hence value the opportunity to be able to listen to a lecture at any particular time. For these students the ability to be able to view the lecture in their own time and space is very welcome. There are many other reasons why students find this technique helpful, so in essence from the student perspective of learning and preparing for examinations there can be little doubt that this technology is extremely beneficial.

The major question mark over use of such technology comes from the perspective where some lecturers and educationalists argue that providing resources such as archived notes and now lecture screencasts encourages students not to attend the actual live lecture. A valid response to this would be that students are adults who can choose whatever method they wish to study and from the educational perspective this is fine so long as they learn the course material and are able to demonstrate this learning in an examination. From consultation with other lecturers, who did not provide screencasts of lectures, it would appear attendance at the live lectures was similar to others for both modules. Hence, at least for these particular modules, this concern was not confirmed. On raising this issue with some students, most feel that the screencasts cannot replace the real lecture experience where lecturer-student and student-student interaction is present. While some students do view the whole lecture again most use their notes together with the screencasts to review the more difficult topics. Despite these comments it is valid to query whether certain less motivated students will use the availability of screencasts to skip lectures and put off serious engagement with the course until nearer the examining period. Continuous assessment and tutorial attendance should be able to identify such cases however.

In summary therefore, introducing technological innovations such as a Tablet PC and screencasting as an aid to chemistry lecturing is of immense benefit to both lecturer and student alike. The Tablet PC provides a clear method of presenting technical information in a dynamic fashion catering to both lecturer and student needs. It also permits archiving of lectures ‘as delivered’ to be achieved. Screecasting allows easy recording of the entire lecture and archiving for future viewing by the students. Student reaction to such innovations is universally extremely positive and the widespread adoption of these practices is to be encouraged.

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Some students have even mentioned that they concentrate better at different times of the day and hence value the opportunity to be able to listen to a lecture at any particular time.