Higher Education Academy

TRANSFORMING TEACHING
INSPIRING LEARNING

Innovative pedagogies series: Videos for learning and teaching

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Contents

Laura's story

This is the story of Laura, who inspired me to rethink my teaching. I mostly teach application of mathematical concepts to fairly large (~200+) cohorts of Bioscience students. My lectures used to be on Monday and Wednesday mornings at 9:00am, a time that for many students is rather 'inconvenient'. About ten years ago I noticed that Laura, a mature student, has been persistently late to all of my 9:00am lectures. At first it did not bother me a lot, but then I got increasingly annoyed with her. Although the student did not make a grand entrance, I thought it was disrespectful and showed that she was not willing to engage in a meaningful way. At one point I got so frustrated and annoyed that I decided to confront the student. However, she must have felt that I was not too happy by her behaviour and asked to speak to me after the lecture. She told me that she had recently split up with her husband and she was now the sole carer for three young children, one of whom was disabled. She had to take the children to various schools across Kent and therefore was not able to be on time for my lectures. This revelation completely changed my perspective - instead of being angry with her I felt enormous respect for this student. She asked me, if there was anything I could do to help her, because she really wanted to do well in her degree.

My teaching is very much based on a developing approach - in my lectures I usually write down concepts and equations on a board. This approach gives the student the opportunity to follow the lecture content step-by-step. Of course, these notes are only transient, but in the case of this student it would have been beneficial to make them permanent. I told her that I would see, if I could come up with a solution to her problem.

Electronic flipchart as lecture notes

The expression 'chalk and talk' has been used synonymously for boring and old-fashioned teaching style, but this approach can have advantages over more 'modern' teaching styles, notably the use of slides and asynchronous online delivery of lectures (for review see Seth 2010). However, a major disadvantage of this teaching style is the transient nature of the notes scribbled on the board: once the notes and explanations have been wiped off, they are gone, persisting only in the more or less complete notes of the students. As a result students focus their attention predominantly on trying to keep up with copying the notes from the board while at the same time listening to the lecturer, which can easily lead to cognitive load (Mayer 2003). It is not a surprise that many students find it challenging to engage with the topic while anxiously trying to get a complete set of notes and at the same time listening to the lecturer. In my view, students should focus on the development of the topic rather than copying the board contents. It was important to me to improve the learning experience and to provide accessible, flexible and diverse learning opportunities that improve student engagement with their studies.

A potential solution

My aim was to develop online support material, which enables students like Laura to learn anywhere/anytime. A similar technology is available in the form of interactive whiteboards, however, these pieces of equipment are rather expensive, cannot be readily moved around and require extensive training (Slay 2008). I therefore wanted to develop a more cost effective and easy-to-use teaching tool that can be used almost anywhere.

To help Laura at first I thought I could perhaps take camera shots of the boards, but since I did not own a camera at that time, it was not a viable option. I then read about someone using a graphic tablet to create a virtual whiteboard and was immediately fascinated by this concept. I found a relatively cheap graphic tablet in the local computer shop and started experimenting. To get started I used a graphical input device

(GraphPad - Genius G-Pen 450 graphic tablet) (Figure. 1A) connected to a laptop computer and data projector (Figure. 1B).

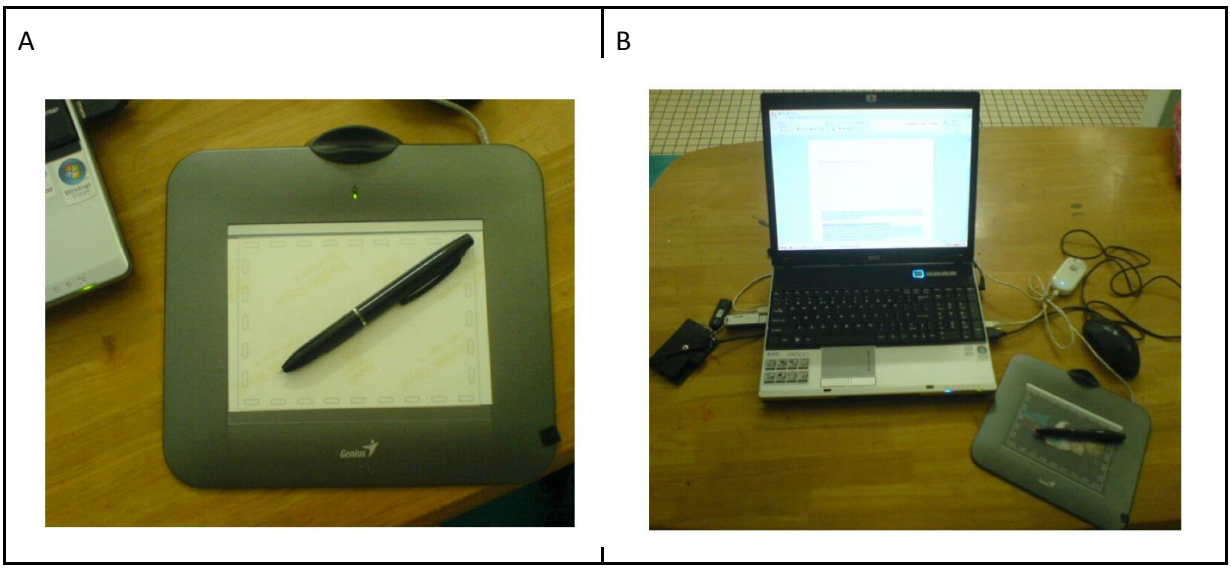

FIGURE 1: GRAPHICAL INPUT DEVICE. A) GRAPHPAD - GENIUS G-PEN 450 GRAPHIC TABLET, B) CONNECTED TO A LAPTOP COMPUTER

How does it work?

I used this approach to capture lecture notes during the lectures in one of the first year undergraduate Bioscience modules to explain fundamental enzymology, e.g. Michaelis-Menten equation, plotting enzyme data, two substrate-reactions and allosteric behaviour of enzymes. For the 'electronic board' to display and capture the notes I used NotateIt Personal edition, a feature-rich whiteboard software for Windows (see Appendix 1). The notes could be saved as image-files and then annotated in PowerPoint.

All the resources I used were readily available and rather cheap, compared to electronic whiteboards: the total costs for the graphical input device and software were in the order of £60. Capturing lecture notes and annotating the resulting images was straightforward and less time-consuming than I expected: for a one-hour lecture I required approximately one hour for the conversion and annotation of the notes, before they could be uploaded onto the virtual learning environment (VLE).

The students' response to this teaching approach was very enthusiastic – overall the students found the capture of the board notes, the annotations and the provision on the VLE very useful.

What students thought

> Using the electronic flipchart is much easier to read which is important to me due to bad eyesight. It also allows me to make good proper notes rather than rushing to copy things from PowerPoint presentations. *(Student taking BI301 – Enzymes and Metabolism)*

> I *enjoyed the writing on the electronic flipchart, since it's well-paced, easy to follow. Having a copy of these notes on Moodle is very useful.* *(Student taking BI301 – Enzymes and Metabolism)*

What I thought

The approach of using a graphic tablet and making notes more permanent worked very well, but it was clunky and I had to invest some time in post-processing. So I wondered, whether there was a different and more dynamic way of taking screenshots and perhaps even record my voice. The solution was screencasts - videos of my computer screen with simultaneous voice recording.

Screencasting

It has been well-established that the learning approach of students has considerably changed over the past ten years. Students make more use of the Internet in their learning e.g. YouTube, KhanAcademy etc. (Thompson 2011). Feedback from students indicated to me that many of them are visual learners (Mustafa 2011), i.e. they very much enjoy watching animations and short movies to understand complex biological processes, rather than read up on the topic in textbooks (or attend lectures). To accommodate this learning style I started to use videos in my lectures and also as a resource for students to prepare for classes, quizzes etc. However, sometimes it is difficult to find the right material, pitched at the right level and containing all the information. I therefore decided to create video resources myself.

Finding the right tools

Software for sceencasting

When I started this project, firstly I had to investigate the appropriate software and hardware. At the beginning I used a desktop PC, running Windows XP, a very basic webcam with microphone and the aforementioned graphical input device (GraphPad - Genius G-Pen 450 graphic tablet). As for the most suitable software, I had to solve two interdependent problems - firstly, I needed some software that allowed me to 'write' on the screen and secondly, I needed software to record the screen and my voice at the same time. I tried a number of software packages, mostly free or as trial versions, but found a software package called 'LectureScribe' the most useful. LectureScribe was developed by Brian C. Dean at Clemson University and is available as freeware. The software allows me to use my graphic tablet, with which I 'write' on the monitor while at the same time I record my voice, making explanations[1].

The advantage (and also, to a certain point disadvantage) of this software was that the resulting files were saved in the 'swf'-format. Although the file size is comparatively small, this format had some compatibility issues. Most modern browser can open swf-files, however, on some occasions I encountered problems, e.g. students had to download the file onto their computer first etc. Once the recording was finished, the resulting files were directly uploaded onto the VLE, without any further post-processing steps. I found it very easy to quickly produce such recordings and provide students with the opportunity to watch these clips outside the formal teaching setting.

Discussions with students showed that they were very happy with the provision of LectureScribe-generated video clips on the VLE, however, some students felt that compatibility issues with swf-files stopped them from making best use of this resource. In particular, students with smartphones, iPod and iPad were unable to use the video clips, since Apple does not support swf-files. I therefore investigated the use of conversion software for swf-files, however, I found that this process was rather tedious and the resulting file size was too large for upload onto the VLE. I therefore decided to look for alternative software to generate video clips in a different format, which could be uploaded to the VLE. I came across BB Flashback Express software, from Blueberry Software plc, which has a direct 'upload to YouTube' option (see Appendix 2).

A good alternative to BB Flashback Express is a free piece of software called 'Monosnap', which I use regularly on my Apple Mac computer. It has similar functionalities, but I found it more intuitive and easier to use than the BB Flashback Express version for Mac.

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[1] For a demonstration of this process, please see 'example of LectureScribe' available at: **https://www.youtube.com/watch?v=gdpTEqJn-_g.**

Hardware for screencasting

The aforementioned software solutions worked all very well, but restricted me to my desktop PC in my office, which, due to traffic, can sometimes be fairly noisy. I was therefore looking for alternatives that allowed me to produce screencasts without a desktop or even laptop computer.

When looking for suitable hardware and software I discovered that some very interesting 'apps' had been developed for the Apple iPad. This device gave me the flexibility to record screencasts outside my office, but with the required amount of professionalism. I tried various apps, especially Educreations, ShowMe, Explain Everything, Knowmia Teach Pro, DoodleCast Pro and ScreenChomp for my screencastings. All these apps have distinct features, which make them particularly useful for different purposes (see below). For example, most of these apps allow the inclusion of pictures from the photo library, thus making it possible to annotate imagines. An interesting feature of 'Knowmia Teach Pro' is the option to record a video within the screencast - I therefore could record myself while writing on the iPad, which is useful for video feedback (see below).

Designing a good screencast

Having established the most suitable soft- and hardware for screencasting, the next decisions I had to make was the design of the videos. Should I, for example, include a 'talking head', i.e. a video of myself in the recording? Or was it sufficient to just show a static photograph of myself at the very beginning of the tutorial? Should the recording include captions and subtitles? How should the videos be distributed? What would be the best background for the recordings? Should I include an introduction of myself in the recordings? And should I mention the School of Biosciences, University of Kent in the introduction?

The last two questions were fairly easy to answer: I am very proud of working at the University of Kent and therefore it was only natural to include the logos for the School of Biosciences and the University on the first slide. I also thought that it would be polite to briefly introduce myself at the beginning. I deemed this particularly important for videos, which were watched by people outside the University of Kent. As for the question whether I should include a photograph of myself, I looked at examples from well-known educators, who use similar approaches.

Paul Anderson, from BozemanBiology, said that his students preferred the 'talking head' approach, which is achieved by having a web-cam video recording inside the screencasts (Anderson 2010). His students thought that this gives it a more personal touch. On the other hand, Salman Khan, producer of the KhanAcademy videos, did not include any images or webcam recordings of himself within his video tutorials. He stated that he wanted his audience to focus solely on the explanations. I decided to use a flexible approach - whenever I use a video to give direct feedback to a student (see below) I used the 'talking head' style, since this would also allow the student to receive information through my facial expression and body language. For video tutorials I decided mostly to only include a still photograph of myself, so at least the viewer is not just confronted with a disembodied voice. Where the screencasting is used as a tool for lecture recording, I decided that there is no need for me to either show a picture of myself (the students should know, what I look like) or even to include any logos.

What about subtitles and captions? Being a non-native speaker I thought that it might be useful for the audience, if I included subtitles. However, I was very aware that for me subtitles are often distracting, leading to cognitive load (Sweller 1988). Having come across Richard E. Mayer's 'cognitive theory of multimedia learning' (Mayer 2002) I decided against the inclusion of subtitles. His work also convinced me that it might be useful to have a webcam video inset, but only at the beginning of a tutorial, not during the explanations.

As for the most suitable background, I decided to use a white writing on black background for tutorials and black writing on a white background for lecture capture. The black background was chosen in accordance to the videos from the KhanAcademy, which I found to work very well for me. The white background in the lecture capture was used, since these recordings were taken 'live' during lectures in which I preferred a light background so that the lecture theatre is not too dark. The main point, however, was for me to ensure that

the combination of writing and background was easy to read and free from other distractions, as suggested by Bradshaw (2003).

Another important question was the length of the recording. A huge amount of research has been conducted in the areas of instructional design, investigating the optimum length of screencasts (Sugar 2010, Thompson 2012). I found that for me personally a video of between five and 12 minutes works best - this time allows me to present the topic without rushing, but is still short enough to keep most students engaged.

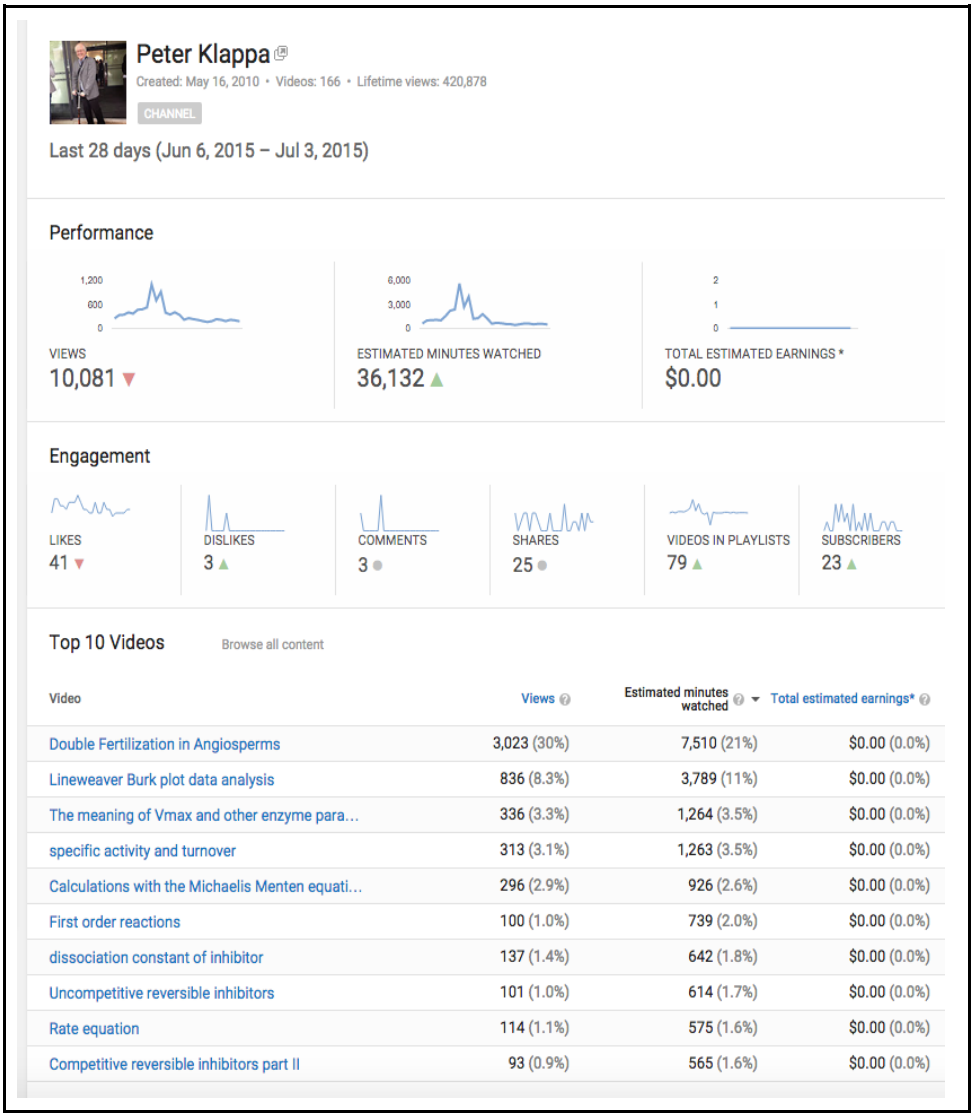
Distribution of videos and screencasts

One considerable drawback of screencasts is the large size of the resulting files. A three-minute video recording with BB Flashback Express, saved as an mp4-file at average resolution, will result in a 20–30 MB file, which, when it is emailed to students will quickly fill up their email inboxes. I also discovered very quickly that the upload limit for the version of Moodle the University of Kent was using at the time was only 64 MB. Although videos and screencasts could be saved as swf-files with reduced files size, some students reported compatibility issues as outlined above. I therefore had to explore alternative methods of distributing the videos and screencasts to students.

During my research for the most suitable screencasting software products I came across an iPad app called 'Educreations'. This app allowed for files to be stored on a dedicated Educreations server, so that only the link to the video needed to be shared with students (see Appendix 3).

Another option to distribute screencasts and videos to students was the use of public video sharing sites, like YouTube and Vimeo. For a collection of my videos on YouTube I have set up my own channel at pk11kent (**https://www.youtube.com/user/pk11kent**). This channel is 'public', i.e. it can be accessed by anybody without any restriction. I make extensive use of this channel for the distribution of tutorials, which are of interest to a wider audience.

A very interesting feature of YouTube is its extensive viewer analytics, which gives me valuable information about how often the tutorials have been viewed (Figure 2) and also about the geographic distribution of the audience. So far my channel has attracted over 900 subscribers worldwide. Collectively my YouTube videos have gained over 400,000 views with the video on Lineweaver-Burk plot data analysis having received over 74,000 hits and numerous positive comments over the past two years. The highest number of viewers are from the US, UK, India, Canada, Australia and Malaysia.



Peter Klappa

Created: May 16, 2010 • Videos: 166 • Lifetime views: 420,878

CHANNEL

Last 28 days (Jun 6, 2015 – Jul 3, 2015)

Performance

VIEWS	ESTIMATED MINUTES WATCHED	TOTAL ESTIMATED EARNINGS *
10,081 ▼	36,132 ▲	$0.00

Engagement

LIKES	DISLIKES	COMMENTS	SHARES	VIDEOS IN PLAYLISTS	SUBSCRIBERS
41 ▼	3 ▲	3 ●	25 ●	79 ▲	23 ▲

Top 10 Videos — Browse all content

Video	Views	Estimated minutes watched	Total estimated earnings*
Double Fertilization in Angiosperms	3,023 (30%)	7,510 (21%)	$0.00 (0.0%)
Lineweaver Burk plot data analysis	836 (8.3%)	3,789 (11%)	$0.00 (0.0%)
The meaning of Vmax and other enzyme para…	336 (3.3%)	1,264 (3.5%)	$0.00 (0.0%)
specific activity and turnover	313 (3.1%)	1,263 (3.5%)	$0.00 (0.0%)
Calculations with the Michaelis Menten equati…	296 (2.9%)	926 (2.6%)	$0.00 (0.0%)
First order reactions	100 (1.0%)	739 (2.0%)	$0.00 (0.0%)
dissociation constant of inhibitor	137 (1.4%)	642 (1.8%)	$0.00 (0.0%)
Uncompetitive reversible inhibitors	101 (1.0%)	614 (1.7%)	$0.00 (0.0%)
Rate equation	114 (1.1%)	575 (1.6%)	$0.00 (0.0%)
Competitive reversible inhibitors part II	93 (0.9%)	565 (1.6%)	$0.00 (0.0%)

FIGURE 2. YOUTUBE ANALYTICS FOR VIDEOS WATCHED ON PK11KENT CHANNEL BETWEEN 6 JUNE 2015 AND 3 JULY 2015

Recently I have started to use social media, especially Facebook, as a platform to upload screencasts and video tutorials. This is particularly useful in cases where for example students ask a question that is difficult to explain without visual aids.

Applications of videos in teaching

Having addressed the challenges of finding the most appropriate tools, I was now able to experiment with screencasts and videos to enhance student learning. I was particularly interested to see, how I could include these tools into providing useful feedback, explaining complex concepts and embedding creativity into the learning process.

Video feedback

I noticed that for some assessments, especially numerical problem solving questions, it would be desirable to give the student direct visual feedback. I therefore explored the use of screencasts to simultaneously record voice together with a screen display of the model answers. These recordings allow me to directly address the student, e.g. “Hello John, here is some feedback to your kinetics test” and give clear feedback. I usually go through the entire test paper, emphasise correct answers, e.g. “the first part of the question you answered very well and your illustration looks nice”… and correct wrong answers, e.g. “…in this part of the question you made a mistake in your calculation – instead of multiplying the terms you should have divided them” - highlighting the aspect I am talking about. At the end of the recording I summarise the positive aspects and

give additional advice on how to improve test/exam performance. For example, sometimes it is apparent that the student suffers from exam anxiety. I then suggest that the student consults colleagues from the University's Wellbeing team. I believe it is very important to end the recording on a positive note and hence I try to give additional encouragement and motivation, e.g. ".....if you take these comments on board, I am convinced that you will perform very well in future assessments" (for example see http://www.youtube.com/watch?v=Jqu8JaSzZfs). The video is then saved and emailed as an attachment to the individual student.

While the above method worked very well, using the model answer as a background for the screencast, I wanted to investigate, whether it was technically possible to give video feedback also directly to the work the student submitted. If the submission was in an electronic format, then making a screencast of the work was not difficult at all. I just used the student's work as the background for the screencast. However, in-class tests, in which the students submitted a handwritten piece of work were more challenging, since it meant that the work first had to be scanned in – a rather time consuming process (see Appendix 4).

A video recording was then done as described above, using the BB Flashback Express software, the file was saved as a swf-file and attached to an email sent directly to the student[2].

Relatively recent iPad apps like 'Educreations' etc made it even easier to include student work - all I need to do is take a picture of the script with the iPad camera, save this to the photo library and then include it into the screencasting app. The recorded files are then uploaded to the Educreations server and students were emailed the link to it.

The method of using the student's work as a background for the screencast is more time-consuming than using the model answer. On average I can produce about five to six video feedbacks per hour - it is therefore only suitable for a relatively small number of assignments. In my opinion this form of feedback is probably the most extensive and comprehensive one, which has many advantages over the conventional written comments.

Firstly, it allows the student to directly see where they went wrong. Secondly, and this is very important to me, it has a very personal approach – the student receives a personalised and individual message and can even see and interpret my facial expression. By addressing the student by name and virtually sitting down with the student and going through their assessment I create rapport with the student. While generic feedback with videos of the model answers also shows the student where they went wrong, it is this hugely individual approach that makes the student feel valued and important. Finally, the feedback can be saved and replayed whenever the student wishes, unlike a direct face-to-face feedback session. I strongly believe that video feedback is highly beneficial to students, since it gives them a very comprehensive and personalised form of feedback. Video-feedback, especially with students' work as the background of the screencast takes longer than written feedback, but provides a far more detailed approach. Informal feedback from students showed clearly that my efforts have been very much appreciated. I am convinced that this kind of feedback can be used in almost any discipline, where feedback is given to students.

What students thought

Comments from students, who received video feedback were:

> Amazing in teaching, feedback and explaining! Knows how to get that info through and gives you PERSONAL INDIVIDUAL feedback, not many do that so it's highly appreciated. *(Student comment from the 'How enzymes work' module evaluation form).*

[2] An example of using the student's work as background can be found at http://www.youtube.com/watch?v=6vwpFlhU-SM.

> We have test and he worked hard to make a correction video for each students in our class.
> *(Comment from a module evaluation form in the Plant physiology module).*

What I thought

I found that the use of video feedback, be it individualised or in the form of generic feedback through model answers, worked very well for me. It certainly gave me the opportunity to give students meaningful feedback by addressing specific areas for improvement. When using the general feedback approach I even could prepare the model answers in advance and make them available as soon as all the students have submitted. This way, students immediately receive feedback.

Video tutorials

For many students it is getting more and more difficult to attend lectures on a regular basis, due to changes in their economic situations and a change in the demographics of the student population. All programmes in the School of Biosciences are full-time programmes and students face the challenge to balance life and study. Many mature students have family commitments, like Laura, and hence cannot attend all the lectures. Furthermore, due to changes in the National Curriculum and, again, the demographics of the student population, many students find it increasingly difficult to cope with more advanced mathematical concepts in Biology. To overcome these problems and to provide students with the opportunity to learn outside the lectures I use video clips of topics the students find difficult in the form of short tutorials or to provide them with model answers to problem questions.

I now frequently use this approach in a blended teaching scenario in which I provide students with worksheets, which aim to support the material discussed in the lectures. These worksheets are problem-based, e.g. rearrange an equation, calculate the concentration of a solution, calculate a buffer solution etc. They also contain the correct answer, but do not show the working-outs. Students are encouraged to attempt these worksheet questions BEFORE they watch the corresponding video clips with detailed model answers. Both worksheets and video clips are usually uploaded at the same time onto the VLE, so that students have access to questions and answers at the same time. So far I have created over 150 of these clips, mainly focussing on answers to practice questions relating to worksheets. My main tool for the creation of these model answers is Vittle and Educreations, when recording on the iPad or PowerPoint slides, annotated with the pen tool and recorded with BB Flashback Express or Monosnap, when using PC or Mac.

Tutorials that are not linked to worksheets, but which might be of interest to a wider audience, are usually uploaded onto my YouTube channel. The main tools to create these tutorials are PowerPoint slides, annotated with the pen tool and recorded with BB Flashback Express or Monosnap, when using PC or Mac, or 'Explain Everything' and 'Knowmia Teach Pro' when using the iPad .

What learners thought

The response from students is very enthusiastic and positive. Students find this additional support very helpful:

> ...In addition, he has made hundreds of minutes' worth of video tutorials on various topics, which have been extremely helpful and are greatly appreciated. (*Student taking BI308 – Skills for Bioscientists*)

Dr Campbell Gourley, lecturer in the School of Biosciences at the University of Kent, said,

> I just hosted the tutorial session on the kinetics mini-project and found your YouTube videos very helpful for this purpose. Just thought you might like to know that I found them to be a valuable teaching aid.

YouTube user makhzania commented,

> Thank you very much for the explanation, I have found it extremely helpful in my Biochemistry lab work. You explain things clearly and in simple terms which many lecturers can't seem to manage.

Things to think about

When I upload screencast tutorials to YouTube I am very aware that these videos are now in the public domain and hence I aim to generate these clips in a professional way. I also realised that by having an introduction screen, showing the logos of the School of Biosciences and the University of Kent, that this has a strong promotional aspect. Furthermore, I am aware about potential copyright issues with such videos. Unfortunately, the IPR situation with YouTube is not entirely clear and hence I decided to protect my videos with a Creative Commons Licence (CC BY-NC-SA), which allows third parties to use and modify these clips as long as they give credit, are used only for non-commercial purposes and any modified versions are also distributed under the same licence[3].

What I thought

Using a blended teaching approach, with formal lectures and video clips, enables me to focus on certain aspects of a topic, while other topics could be presented just in the form of a video or a tutorial. Furthermore, I used these videos to reinforce the learning in the lectures and workshops. In a further development I now frequently adopt a 'flipped classroom' approach - the students are given the video tutorials for a certain topic in advance of a lecture (Tucker 2012). In the lecture itself, which in fact is more akin to a workshop or seminar, I then can focus on problem-solving questions related to the topic. Of course, this approach relies on the students having watched the video tutorials before the session (see below).

My videos mainly deal with numerical concepts through a developing teaching style, but there is no reason why this cannot be expanded to more generalised concepts. It is, therefore, anticipated that it can be easily adopted in other disciplines, which also use a developing teaching style, e.g. Mathematics, Chemistry, Pharmacy etc. Furthermore this approach would be highly beneficial in any discipline that teaches 'concepts' – Social Sciences, Humanities etc., wherever the lecturer so far used a board to illustrate ideas.

Computer-generated video animations

So far, all my videos and screencasts have been fairly basic, without any sophisticated elements in them. Although this might be appealing to my students, and a certain public audience, I felt that certain topics could be presented in a more engaging and artistic manner. As a lecturer in Biosciences, I always wanted to transmit my fascination for life, its beauty and richness, to my students, but never had the means to present accurate science in a way that does full justice to the greatest artists of all – nature. Many textbook publishers have already taken this into account by providing students and teachers with online resources in the form of videos. However, looking at many of these resources it is clear that the focus has not been on captivating the audience. Many animations have been designed without a deeper understanding of what the audience will find interesting and would like to engage with. Many of the currently existing animations available from public sites, e.g. YouTube, are either lacking in scientific accuracy or are not very engaging and stimulating. Very clearly, not only does the content count, but also the presentation is of similar importance.

In a collaborative project between Phil Gomm, University of Creative Arts (UCA), his students and me, set up in 2009, we decided to bridge the gap between capturing the elegance of life and scientific knowledge by making computer-generated animations (CGA) of biological processes. These animations are designed to combine scientific accuracy with the aesthetics and beauty of nature. The audience should immerse itself in

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[3] For an example of such a video clip, please see **http://www.youtube.com/watch?v=1h2PYCwXSAs**.

the magic of life; while at the same time see accurate details of what is happening in nature on a microscopic level.

For this collaboration I teach UCA first year undergraduate students enrolled in the module 'Computer-generated animations' basic concepts in Biology. The students are then asked to translate a biological topic into a short animation. I supervise the scientific accuracy of the animations and am responsible for the dissemination of completed projects. This collaboration sets an exemplary approach for communicating complex scientific topics in a way that engages a very wide audience. One of the jointly produced videos – Lifecycle of a Mushroom by Tom Beg[4] - attracted nearly 21,000 views within four weeks after being published on Vimeo, and has now been posted on sites around the world.

All these animations are between four and ten minutes long and cover topics of biological relevance. A crucial aspect of the animations is the pitch and pace. It is essential that a wide audience is able to understand the scientific concepts in these animations. As mentioned above, however, we also use different styles of presentation to make the animations more contemporary. For example a previously produced animation on the sexual reproduction of a fungus uses a science-fiction like style to present the scientific information[5]. I strongly believe that this approach gives a potentially rather dull subject a very interesting and engaging aspect, not found in other resources on the same topic. Another animation on the sexual reproduction of angiosperms uses a more conventional presentation approach[6]; however, here the focus is on a very detailed and feature-rich visual insight into the process. The software, like Maya and AfterEffect, used by the students has a high level of sophistication and requires intensive training, I therefore will not discuss this in more detail.

Lecture capture

I am aware that the landscape of HE has changed considerably over the past ten years due to the development of new teaching approaches, e.g. the concept of a 'flipped classroom' and 'BYOD – bring your own devices'. This development has been facilitated by the introduction of technologies with which students are very familiar. Most students now own devices, smart phones, tablets, laptops etc., with which they can easily connect to the Internet and thus can engage in learning wherever they are. In my view, one of the biggest achievements in learning and teaching in the last decade is the ease with which students can develop into active learners anytime, anywhere (Hlodan 2010). By making use of a variety of technologies learning (and teaching) is no longer restricted to a physical space or indeed one instructor/teacher.

At the same time, many students find it increasingly difficult to attend all lectures, due to outside commitments, like Laura. Putting these two developments together and encouraged by the overwhelmingly positive comments on my electronic flipcharts and video tutorials, I decided to trial dynamic recordings of lectures. The University of Kent has recently started to introduce lecture recordings, using a system called KentPlayer, which is based on Panopto (see Appendix 5).

Although I have not used KentPlayer extensively, I did not find the system very intuitive to set up and I also encountered frequent problems with the saving of the captured lectures. To overcome the limitations of the university-installed software, I investigated alternative approaches and discovered that Apple provides several apps to record lectures. For my purposes the most useful apps were Educreations and Vittle, two excellent tools for the iPad, which enabled me to screen-capture and audio-record at the same time. To use

[4] See **https://vimeo.com/31324153**

[5] see **http://www.youtube.com/watch?v=k-pBcbC2R5g**

[6] see **http://www.youtube.com/watch?v=bUjVHUf4d1I**

these tools, I connect my iPad to the laptop input of the data projector with an iPad-to-VGA adaptor. This allows projection of my iPad screen onto the data projection screen – students can easily follow my writing on the screen. Using the aforementioned Educreations app I am able to record up to 30 minutes of my lectures. Vittle is even easier to use than Educreations; and allows for a longer recording time. It also has the advantage of a direct upload option to YouTube without having to pay an annual subscription as in the case of Educreations. The recordings can be watched on any computer, smart phone or tablet and are available indefinitely. The recording at **http://goo.gl/CYyu4** gives a practical example of a lecture in a first year Bioscience module on enzyme regulation.

This recording also highlights a problem that I encountered when using the iPad as a tool for lecture recordings - since the iPad is hardwired to the laptop-input of the data projector, my mobility in the lecture theatre is severely restricted. In order to achieve a good audio recording with the internal microphone I needed to be close to the recording device, which is tethered to the laptop-input. To overcome this restriction I attach an Apple TV device to the laptop-input of the data projector, using an HDMI-to-VGA adaptor. The Apple TV device can be set up in such a way that it is connected to the iPad through a local WiFi signal. With the 'mirror-function' on the iPad I am now able to stream wirelessly the iPad screen to the Apple TV, which then projects onto the data-projector screen. Since the iPad is no longer hardwired I can carry it with me and write notes on it while I walk around in the lecture theatre. This set-up gives me full mobility in the lecture theatre, yet allows me to 'write' on a board and develop concepts and equations.

What students thought

> ...The teaching of this module has been really good, with recordings of lectures that enabled me to revise topics covered in the lecture with added practice and examples to help with revision. *(Student taking BI301 – Enzymes and Metabolism).*
>
> ...His lectures have been thoroughly engaging, and his method of teaching (using an IPad to write things down and to record the lectures) has been extremely helpful. *(Student taking BI308 – Skills for Bioscientists).*
>
> He had a different approach to teaching by using his iPad and having an on screen white board which also allowed him to record the whole lecture. This really helped to engage me in the lectures as normally I have lectures which involve PowerPoint slides which are full of text. *(Student taking BI301 – Enzymes and Metabolism).*

Things to think about

When I mention to colleagues that I record all my lectures, I often get asked, whether this has an impact on students attending the lectures. After all - why should a student go to a lecture, when they know that they will be able to access a recording of the material? Although I have not carried out a thorough analysis of this issue, I observed that at least for my lectures, apparently recording did not stop students from attending. I believe that extrinsic factors, like the time and day of the lecture or whether the students have several hours of non-lecture time after the event might have a bigger effect on lecture attendance than the recording of lectures itself. This observation is in line with the results from Larkin, who analysed the impact of lecture recordings on student attendance (Larkin 2010).

How do I know whether students actually watch the tutorials?

One of the things that interested me was, whether students actually engaged with the screencasts and especially with the tutorials I had created. YouTube provides excellent analytics, e.g. measuring the number of views, location of viewers, how long on average the video was watched etc. (Figure 2). This information was very useful on a larger scale, but did not answer the question, whether individual students engaged with the

tutorials. I therefore investigated the possibilities for making the tutorials interactive, i.e. the students had to perform certain activities, which could be easily measured and analysed.

After trying out different online services I came across a service called Zaption. The service says it:

> Transforms video-based learning with interactive content and tools that engage learners, deepen understanding, and track progress. Teachers, trainers and instructional designers use Zaption to quickly add images, text, and questions to existing online videos. With Zaption's Analytics, instructors get immediate feedback on how viewers interact with content and understand key concepts. *(Zaption 2013)*

With this service I can take any of my video tutorials on YouTube (or in fact any video on YouTube) and include multiple choice or free form questions at certain points (Zaption 2015). I can set different feedback options and design elements for these questions, and can even choose whether students can skip questions (only available in the subscription version of Zaption). The modified video is then saved on the Zaption server and the students are provided with the link and instructions how to log onto the service.

The service records all student interactions (Figure 3), which is then accessible to me in the form of detailed learner analytics. For example, I can see which of the students watched the video for how long, how they answered certain questions, whether there are any threshold concepts, which I need to explain again in a lecture or whether there are particular students who find the presented topics too easy or too challenging.

FIGURE 3: LEARNER ANALYTICS OVERVIEW OF THE TUTORIAL 'SPECIFIC ACTIVITY AND TURNOVER NUMBER' IN ZAPTION.

How to create videos for teaching - my experience

Numerous guidelines for making efficient screencasts have been published (Mayer 2002, Garner 2008, Oud 2009), however, here is an overview of what worked for me.

Hardware and operating system

The hardware and operating system (IOS, Windows, Android or Mac OS) available to you very much dictate the software you can use. I noticed that at the time of writing this document the Android platform was not well-supported - there are not many apps available that allow simultaneous writing and voice recording. Note - Explain Everything has very recently been released for Android (19 June 2015), but there are still some issues with the stability. I found the Apple IOS ecosystem in general more versatile than the other operating systems, with numerous apps available. The choice of hardware and software is therefore hugely up to the individual, but if you are completely new to lecture video creation for your teaching, I would suggest to invest in the latest iPad from Apple. A very useful tool in this case is a good stylus, unless you are used to use your fingers to write on the screen. I found the styli with rubber tips less suitable - they tend to be less precise when writing and getting increasingly 'smeary', thus reducing the smooth flow of writing. My advice would be to use a stylus with a micro-knit tip.

Although the microphone on the iPad and most webcams is of decent quality, it might be useful to invest in a good USB-microphone, which can be easily attached to an iPad with a USB-connector. I found the Blue SnowBall microphone from Blue Microphones very good value for money.

New applications, especially for the IOS system, are constantly developing and it is difficult to give any firm advice. The following table gives a brief overview of the apps that I current use:

App	System	Source	Use	Comment
Vittle	IOS	Apple app store	Lecture capture, brief explanations	Excellent and easy-to-use app for recording writing and voice, allows import of photos from the camera roll, direct upload to YouTube
Knowmia Teach Pro	IOS	Apple app store	Video tutorials	Excellent and easy-to-use app for recording writing and voice, allows import of photos from the camera roll, direct upload to YouTube, has individual 'scenes', which make recording of tutorials easier.
Educreations	IOS	Apple app store	Lecture capture and explanations, student feedback	Similar to Vittle. Length of recording is 30 minutes. In the paid version direct upload facilities to YouTube. Videos can be uploaded to the Educreations server and a unique link can be given to the student. Very useful for individual video feedback.
Explain Everything	IOS, Android	Apple app store, Google Play store	Video tutorials	Similar to Knowmia Teach Pro, but no 'scenes' feature available.
PowerPoint	Windows, Mac OS	Microsoft, Apple	Explanations, student feedback	Strictly speaking not an app, but can be used for writing. Needs a recording software like BB Flashback or Camstudio. The use of a graphic input tablet is highly recommended.
BB Flashback	Windows, Mac	BlueBerry	Explanations,	Strictly speaking not an app, but can be

Express	OS	software	student feedback	used for recording screens. Needs a software that allows writing on screens.
Monosnap	Windows, Mac OS	Monosnap	Explanations, student feedback	Strictly speaking not an app, but can be used for recording screens. Needs a software that allows writing on screens.

I am fully aware that there is a plethora of other software available for screencasting on Windows and Mac OS (e.g. Snagit from TechSmith, Camstudio, Camtasia, etc.), so I strongly suggest trying out the different options. For me the most important aspect of any software is how easy and intuitive it is to use and whether it has the features that I want.

How to get started with recordings

It is obvious that the recording is conducted with a certain purpose in mind. For example, if I produce a recording, which is publically available, I will prepare a brief script, which functions as an aide memoire. For a brief explanatory video I usually do not use scripts, since they sometimes give my presentations a slightly stilted tone. According to the aforementioned 'cognitive theory of multimedia learning' by Richard E. Mayer it is useful to bear in mind ways to reduce cognitive load (Mayer 2014). In my experience the most useful approach is just simply to use writing, together with voice recording, similar to KhanAcademy. Only occasionally I will use the addition of imported pictures or a video insert.

When I asked colleagues whether they would like to record videos for their students, the biggest issue seemed to be the fear of not coming across as professional. Colleagues told me that they were worried about making too many pauses, they did not like the sound of their own voice or that they include to many 'ahs' and 'ehms'. Although I had the same concerns at the beginning myself, I found that after a few recordings this is no longer a big problem for me. My advice therefore would be to just simply get started and not to worry about this too much. Students will like the fact that their lecturer is speaking to them and they are usually not faced by any mistakes or pauses.

When using pictures in your videos it is very important to comply with copyright law. It is therefore useful to rely predominantly on Open Educational Resources (OER), which are free to use, share and modify, if correctly referenced. These resources can easily be found through filters in search engines.

The ideal length of a video again depends very much on the purpose of the recording. Lecture captures will obviously be far longer than brief explanatory videos or student feedback videos. I found that for tutorials a good length is between five and 15 minutes, which is in line with the findings of Guo (2014), who found that often students disengage from watching a tutorial after nine minutes.

After the video has been produced

Once the video has been produced it is always useful to watch it in its entirety. I sometimes found that the recording had stopped, or that there was background noise or other problems. I usually try to avoid any post-processing steps, i.e. trimming the video etc.

Another consideration is the way the recording is disseminated. If I use video feedback for an individual student, I am very aware of any data protection. I therefore will either email the student the video or will use privacy settings so that only the student can view their feedback. This is easily achieved when uploading a video to the Educreations server, as mentioned before. On the other hand, when I want to publish a tutorial, which might be relevant to all of my students, then my preferred way of dissemination is to upload the video to our VLE. For maximum exposure and dissemination to a large audience of learners I will usually upload the recording to YouTube. I am a strong advocate of OER and hence I give permission to the wider community to use, share and modify my recordings through a Creative Commons Licence.

Laura's story - the end

I am very grateful to Laura for pushing me out of my comfort zone and giving me the motivation to explore new ways of teaching. She taught me an invaluable lesson - "Think outside the box and try out new things!"

Laura completed her first year enzymology module with a score of 72%. She completed her degree with an overall high 2.1 and embarked on a MSc in Biotechnology. In 2014 she successfully defended her PhD thesis. She now is a Postdoctoral Fellow in a renowned Russell Group university.

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Appendices - Technical information

Appendix 1 - NotateIt Personal edition for electronic flipcharts

A major advantage of NotateIt Personal edition is that notes can be saved in conventional picture-formats, e.g. jpeg, gif or tiff-files. Each note-page is saved as an individual image. Furthermore different backgrounds can be used, e.g. the software comes with a preinstalled graph paper as a background, which is very useful when visualising data.

The individual image-files were saved and then imported into Microsoft Office PowerPoint for further annotations with simple 'callouts' (Figure 4), with or without animation, e.g. fly-in or emphasis. 'Callouts', often used in comics, are textboxes that point towards the relevant part of the slide. Microsoft Office PowerPoint offers a wide variety of 'callouts' for such an annotation of slides.

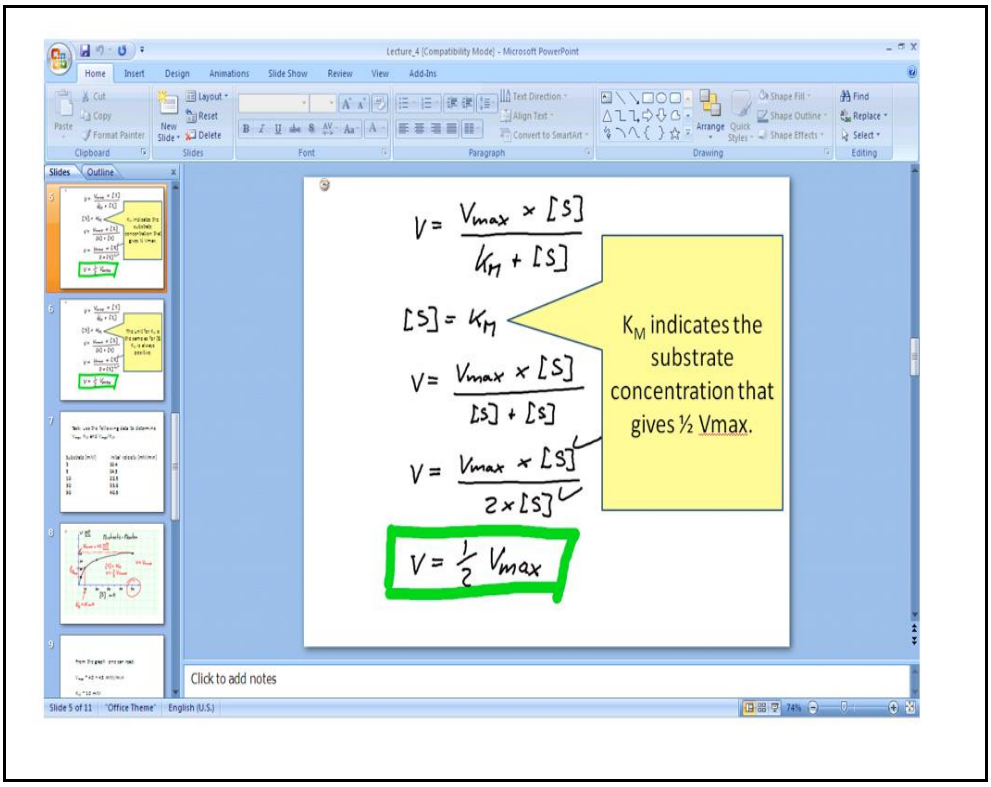

FIGURE 4: POWERPOINT SLIDE WITH 'CALLOUT' ANNOTATION OF LECTURE NOTES, CAPTURED WITH NOTATEIT.

Files were saved as PowerPoint (ppt) files and Adobe Acrobat pdf-files, although in the latter format animations, which were used in the ppt-format could not be saved. By saving the annotated ppt files also as an image slideshow I was able to convert the lecture notes into a format that could be easily uploaded onto mobile devices, for example an iPod Classic (Figure 5), iPod Nano and a Sony Ericsson Ki750 mobile phone. No specific conversion of the files into a different format was required, although loading the files onto iPods required a re-numbering of the individual slides. In order to see the annotations on iPod or mobile phone properly, the font size had to be rather large (i.e. at least Arial 24 boldface). Smaller fonts lead to poor visibility of the annotations. I also found that the screen size of the iPod Nano and the mobile phone were probably not suitable for extended studies. However, reading the notes on the iPod Classic was no problem.

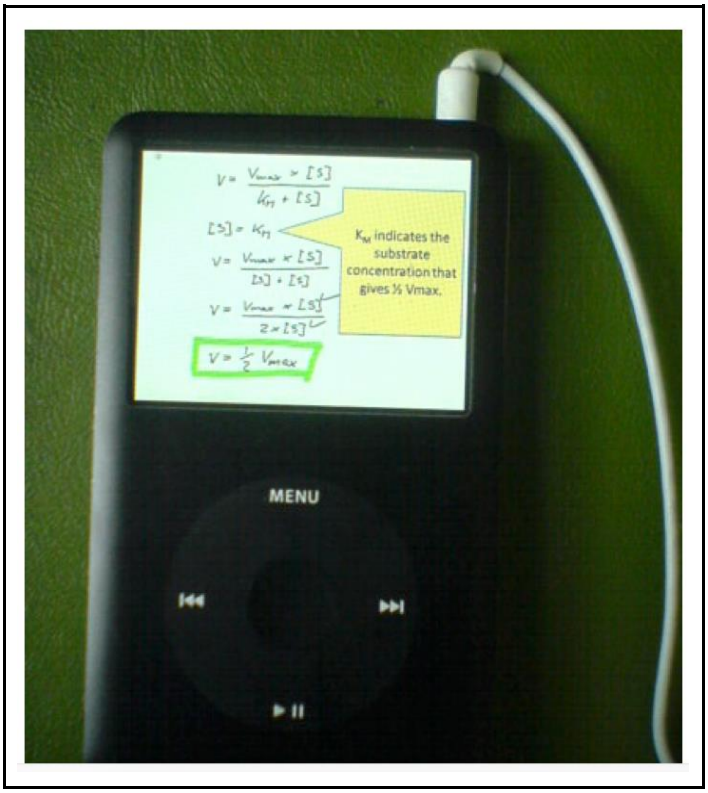

FIGURE 5: LECTURE NOTES WITH 'CALL-OUT' ANNOTATION ON IPOD CLASSIC

Appendix 2 - BB Flashback Express

BB Flashback Express software, from Blueberry Software plc, allowed me to create a video in flv-format, with a screencast of the PC screen, a webcam screencast of myself and voice recording. The advantage of this software is that it has a direct 'upload to YouTube' option, which makes it very easy to make the video publicly available, once a YouTube account has been created. BB Flashback Express is 'only' a screen-recording tool, it does not offer the option of a screen-writing tool and hence I had to find software that allowed me to 'write' on the screen. After various unsuccessful attempts with different programmes, like 'Paint' or 'Draw' I came across a little-known function of the standard Windows Office PowerPoint software. In short, this function allows for the annotation of PowerPoint slides by changing the mouse pointer into a 'virtual' pen. For a new recording I prepared a number of empty slides, then switched to the 'slide presentation' option in PowerPoint, set up the virtual pen and then started recording with BB Flashback Express.

Appendix 3 - Educreations for screencasts

Screencasts with this app are saved locally, but can also be uploaded to the Educreations server. I have set up an account, which allows me to upload up to 5Gb of videos. The enormous benefit of this approach is that once the upload has been completed, I am provided with a link to the recording, which then can be shared with students. Depending on the length of the recording and the speed of the Internet connection, this process usually takes less than five minutes. The recordings can be watched on any computer, smart phone or tablet and are available indefinitely. The use of Educreations and the online storage on the Educreations server requires either a free account, with reduced functionality (i.e. limited storage space) or a yearly renewable subscription account. However, the uploaded screencasts can be made 'private' so that only recipients with the link can watch the video. I found this very useful when I wanted to provide individual students with personal feedback on assessments (see below).

Appendix 4 - scanning student work for individual feedback

To overcome time-consuming scanning of student work, I used the JotNot Scanner Pro application on my iPod Touch 4G to take a snapshot of the student's work. This application, available from the Apple store, together with the in-built camera on the iPod made it fairly easy to scan in the work and immediately transfer

it to my PC through a Dropbox account, where it is saved was a pdf file. I open this file in PDFX-viewer, a free pdf reader and annotation software and made annotations in free-hand style, using the aforementioned graphics tablet.

Appendix 5 - KentPlayer as a tool to record lectures

Many lecture theatres at the University of Kent have been equipped with ActivePanel Touch monitors (2013), which allow a presenter to 'write' on the screen and project the writing on a board, however, not all rooms on campus have these facilities. The University of Kent has also started very recently to introduce lecture-capture software, using a system called KentPlayer. This service uses webcams in teaching rooms to record audio and/or video of the lecturer alongside a recording of the computer screen, including any PowerPoint presentation, and makes the resulting recording available to students on the VLE. KentPlayer uses a system called Panopto (2007) a software package installed on presenter PCs, which captures lecturer video and/or audio (using a High-Definition webcam), PowerPoint slides (if applicable), Computer screen (for computer/web demonstration or other presentation formats) and any other attached USB video device (such as a visualiser/document camera or additional webcam).

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