Open Teaching
A Case Study on Publishing Lecture Videos Publicly

Richard Buckland
School of Computer Science and Engineering
The University of New South Wales
Sydney 2052 Australia
Email: richardb@unsw.edu.au

Abstract

This paper reports on a project to video record lectures for undergraduate computing courses and publish them openly online. It outlines the objectives of the project, the techniques experimented with to record the lectures, the major challenges encountered, and how they were addressed. The paper then highlights a number of the interesting and sometimes unexpected benefits which have followed from publishing the lecture recordings, as well as some disadvantages and warnings. It is my hope that others may be able to benefit from our experiences and feel empowered to record and openly publish their own teaching practice.

Keywords: OpenLearning open data online lecture video recording eLearning YouTube

1 Introduction

“The internet is fantastic. I am receiving a university-level education whilst I sit here in my underwear in my mom’s basement, eating nachos and drinking coke. Life is good.”

YouTube user caesiume commenting on video ‘Lecture 1: Introduction to Data Structures and Algorithms’ (caesiume 2010)

This paper reports on the experiences of a project to video record undergraduate lectures and publish them openly online. In 2008, with the encouragement and enthusiastic support of former students, I started capturing lectures of our first and second year computing courses on video. I delivered the lectures and the former students operated the cameras and live mixing equipment. My original intention was merely to make the recordings available to a handful of off-campus students and the undergraduate teaching academics within our school (CSE, the School of Computer Science and Engineering). However in the spirit of openness in education and after much agonising I also made the recordings publicly and freely available to all via YouTube and iTunes. In the subsequent two years these recorded lectures have been viewed over a million times by hundreds of thousands of learners of widely varying age, nationality, socio economic background, and prior knowledge and experience.

Since that time there has been a constant demand via email, YouTube comments, and physical mail for further such recordings and for supplementary material to support the current recordings. There has also been a similar volume of messages of thanks and gratitude from learners and fellow teachers worldwide for sharing the lectures. I have been delighted to find that what was originally envisioned as a small project has blossomed into one of the most significant educational activities I have undertaken.

This paper outlines on the techniques we experimented with to record the lectures, the major problems we encountered, and how we have addressed them. The paper then highlights a number of the interesting and sometimes unexpected benefits which have followed from publishing the lecture recordings, as well as some disadvantages and warnings. It is my hope that others may be able to benefit from our experiences and feel empowered to record and openly publish their own teaching practice.

2 Background

The initial impetus to video record first year CS1 computing lectures in 2008 arose from two problems CSE was facing at that time. Firstly we wished to offer selected secondary school students the chance to take a first year university computing course whilst still at secondary school but recognised they would find it hard to miss school and travel to campus several times each week to attend lectures. Secondly we wished to share teaching practice amongst the pool of teachers for our core first and second year courses to both demonstrate how a new and ambitious syllabus could be implemented, and to ensure that course coverage remained relatively stable from semester to semester.

2.1 For viewing by students

Video recording lectures was a key part of our secondary school outreach program. Secondary school students in the programme were to watch the lecture videos in their own time in advance and then attend university once each week for a face-to-face tutorial and lab. In 2008 we ran a trial with three secondary school students, we expanded this to sixteen in 2009, and forty in 2010.

Critical requirements: To be able to have the secondary school students participate in the course in synchrony with our undergraduate students the lecture recordings needed to be available to the participants within a few days of the actual lecture. Ideally the next day for the Thursday lectures — since the
exercises for week \(n+1\) week depended on the lecture material from week \(n\). And many students liked to prepare on the weekend. Furthermore it was imperative that the end-to-end process be reliable and robust - if the lecture recording process ever failed for any reason there was no easy way for the students to recover, that lecture would be missed.

**Desirable requirements:** We wanted the remote secondary school students to feel that they were part of the course community, and that the undergraduate students talking to the peers.

Our objective for the lecture recordings was that the viewer would feel that they were sitting in the class. To this end we used a Cinéma Vérité approach to the filming. This precluded using a simple screen-capture plus static camera arrangement such as the proprietary Lectopia system which was then being used to audio record some lectures at UNSW.

Instead we used a human camera operator recorded each lecture from the back row of seats. The operator was instructed to point the camera wherever they felt that they would be looking if they were a student in the class and to zoom on things that they would want to see more closely. We didn’t use experienced camera operators, instead we used enthusiastic ex-students of the course. We hoped that this would mean they would have some insight into the mind of the student viewers.

We did not feel that elaborate post production was of key importance, or even that the video quality was critical, so long as it was sufficient that the students were able to see and understand what was going on. In summary we strove to give the recordings a sense of authenticity rather than a sense of professional production.

### 2.2 For viewing by teachers

The second factor motivating our venture into lecture recording was to enable the teachers of our core first and second year courses to share their teaching practice, and to stabilise the content of these courses. In 2006 CSE’s core syllabus was reviewed and substantially restructured. Before the review and restructure first and second year courses had learning objectives predominantly in the lower half of Bloom’s taxonomy (Bloom 1956) *(remembering, understanding, applying in the terminology of Anderson (2001)).* The content objectives of each course were almost exclusively low level discipline knowledge and skills. In contrast the new syllabus added a sequence of higher level learning objectives and explicitly included the development of graduate attributes in each course. For example, after the restructure developing effective group-work, leadership, innovation, skepticism, rigour, time management, life long learning skills, and a framework of ethics and professionalism are now objectives of each course rather than simply being addressed at the end of the degree program in a standalone fashion - for example by a single final year course dedicated to group-work and time management.

However in the period immediately following the restructure a number of the pool of teachers who taught these core courses expressed uncertainty as to how this integrated approach could be achieved in their course, and even skepticism that it were possible to do so at all in more than a token way. I felt that in addition to talking about ways the new syllabus could be implemented it could be useful and compelling to directly show concrete examples of ways of achieving these objectives — and to that end over the past two years I have run, video recorded, and published a reference version of each of these core first and second year courses.

A related challenge which the school wanted to address was the issue of syllabus drift. Each of our large core courses is taught by at least two teachers, one in first semester and one in second semester. Furthermore over time teachers move off courses and new teachers take their place. We have observed that individual teachers have their own understanding and interpretation of the syllabus and that the material covered in a course, and the depth to which it is covered, can change substantially from year to year, even from semester to semester. This can cause problems in subsequent courses which rely on the material which was supposed to be covered. For a personal example: in my Computer Security and Cryptography course in 2008 I had students who had never heard of the RSA cryptosystem, students who had already been taught it once, students who had been taught it twice, and even some outraged students who, because of the particular sequence of semesters in which they had taken the prerequisite courses, had already seen it three times!

The school has instituted a series of measures to limit the problem of syllabus drift. Having a public and published reference version of each course is an important part of our approach.

### 3 Publishing Online: Lofty Goals

The previous section described my initial motivation for video recording lectures. In this section I discuss the decision to then publish those recordings online, free for all to access and view. In the Outcomes section to follow I will posit that this decision to publish openly, mirroring the emerging movement for open data generally (see for example (Uhlir & Schroder 2008), (OECD 2004), and the data.gov and data.gov.uk sites) was the most important decision of the project. As MIT President Charles M. Vest, whose inspirational OpenCourseWare (OCW) project pioneered open teaching, proclaimed “*openly sharing lectures expresses our belief in the way education can be advanced - by constantly widening access to information and by inspiring others to participate.*” (Vest 2001)

The initial goals for undertaking the recording were modest and pragmatic: issues at my own institution. In contrast my hopes for publishing the material online were more lofty — to disseminate discipline content and practices to categories of learners traditionally unable to access universities for learning, and to encourage improvements in the professional practice of teaching.

#### 3.1 Openness and Autonomy

Openly publishing lectures has the potential for widespread improvement in the practice of teaching by introducing a novel form of openness into the teaching process.

What happens in the classroom has traditionally been a private matter between teacher and students. Referring to Britzman (1986)’s observations on the culture of teachers Rogers & Babinski (2002) posit:

‘It is this “culture of teachers” which promotes privacy and autonomy, which establishes barriers to genuine dialog among teachers,’ and ‘there are invisible walls constructed by the “culture of teachers” that perpetuate a lack of community’

Afterwards, in some cases, some aspects of the process may be made open through scholarly reporting and writing on teaching practice, some aspects may
be informally discussed with fellow teachers, and another view of what transpired may be made open via student feedback and ratings. However these are all interpretative events—it is not possible for interested parties to gather primary data on what happened in a particular teaching situation unless they happened to be physically present at the time. In our experience teaching practice is generally unobserved.

Yet openness and genuine collegiality between teachers, open discussion and critical reflection on teaching practices has well established and significant impact on the development of teachers and on the quality of their teaching (see for example Patricia et al. (2010) and Daya (1993)). Indeed open practice and a concomitant culture of review and reflection is the hallmark of a healthy profession.

When I started my career I really didn’t know how to teach maths. I didn’t have the training for it. So, in the beginning I had to find out how to teach it. I needed some help. If you’re only a beginner, it’s difficult to get some help. Also, my colleagues were very busy. They didn’t have the time to help me. So I had to solve my problems on my own. (Clement & Vandenberghe 2000)

There are a number of established ways of teachers addressing this issue and sharing their practice. Two of the most widespread are peer review and team teaching. These are both rich methods with being investigated by an active research community and provide the potential for a range of benefits when they are used sensitively in an environment of trust under a developmental rather than judgemental ethos (see for example (Gosling 2005), (Gosling & O’Connor 2009) and (Anderson et al 2009)). Here we simply note that these approaches provide environments where it is acceptable for teachers to observe the teaching of their peers. Openly publishing lectures online provides another such environment, with the potential to share some of the same benefits, and likely subject to similar mitigating factors.

My own teaching practice has been improved significantly over the years by observing other teachers teaching. For the first five or six years of my career as a university lecturer I made a habit of attending and observing the lectures of other teachers at local universities about whom I had heard students speak highly. This had a noticeable effect on the effectiveness of my own teaching (indeed I subsequently received a number of teaching awards). However the observation process was time consuming and awkward to arrange. The current practice of university teaching is a largely private and closed arrangement. Our students know how we teach, but in the large our peers and colleagues do not.

On the other hand it is easy to “visit” the classrooms of those who publish their lectures online. By publishing we open the doors of the classroom and let in the light.

3.2 Open Learning

Our second “lofty goal” was open learning — to disseminate our teaching so that it is available to anyone who might wish to learn from it. For example this might include students at our own university, students at other universities, students not yet in university, those unable to attend university for socio economic reasons, or reasons of health or time constraints, and those already in a career looking for ongoing professional development or contemplating a career change.

For me this was what education is about - humanity striving to improve itself, thirsting for knowledge and to know more. Putting university teaching online is reminiscent of the transformative power of the Children’s Television Workshop back in the 1960s and 1970s, where open freely given knowledge and teaching gave new opportunities to inner city children with limited educational options (Lesser 1974).

4 Approach

This section sets out in detail the process we use to record and publish the lectures. The specific details of the makes and models of the equipment we used is set out in the Appendix. Our hope is that this will be a useful resource for others interested in dipping their toes into the water.

In general my experience has been that most of the things that I worried about beforehand turned out to be remarkably easy to solve in a satisfactory manner. These included:

1. What hardware to use?
2. What level of quality to aim at?
3. How to publish on the internet?
4. Intellectual property?
5. Will it be too expensive?
6. Will it even work, at all?
7. Fear of looking like an idiot in front of the whole world, irrevocably...

On the other hand the main challenges which arose, and which have still not been solved perfectly, were things I had not anticipated:

1. Correspondence can consume vast amounts of time (and likely contributed to my developing RSI in late 2008)
2. How can we have the recording work every time, without fail?
3. How can we set up the gear and pack away the gear in time?
4. Hateful comments on YouTube can tear your heart

4.1 Selection of Lecture Theatre

A critical requirement for the recording process was that it not diminish the experience for the students sitting in the room. At the end of the day they were most important aspect of the lecture and I didn’t want them to feel like a studio audience, I didn’t want the students in the lecture theatre to feel that the recording was the main thing and they were secondary. We decided to locate all the cameras and recording gear at the back of the room, so the camera and camera operator did not visually intrude during the lecture.

There were only a few lecture theatres which were both large enough for our class (about 250 students) and in which the back row was not too distant from the front of the lecture theatre to record clearly in ambient light. Essentially we needed large, shallow but wide theatres. Furthermore the camera crew had to get themselves and their gear in and out in the brief (10 minute) gap between successive lectures. Luckily we were able to find and get permission to use a wide theatre with a separate back entrance which we could mark off with portable signage and reserve for the camera crew without obstructing safe exit in case of fire or other emergency. The distance from the camera position to the blackboard was about 15 meters.
4.2 Keep it simple

We did a number of dress rehearsals before the start of semester and soon discovered that the biggest challenge was set-up and pack-up complexity and speed. Our hard limit was the length of the interval between the previous lecture finishing and the lecture to be recorded starting. This meant we had to be reliably set up and be ready to roll in ten minutes. This became the limiting factor in our recording design. Basically there was no point in having some fantastic but complex piece of equipment if it took so long to set it up that we missed capturing the start of the lecture.

4.3 Cameras and Microphones

I wanted to record the output from slides/data projector/blackboard/document camera and also to record the lecturer and to see the backs of the heads of students to give viewers the effect of being in the room rather than the effect of watching a slick Audio-Visual presentation. The decision to adopt a Cinéma Vérité approach had the fortunate consequence of allowing us to use consumer quality recording equipment which was considerably cheaper than professional equipment.

For recording the lecturer we used a high end consumer grade HD digital video camera. It was a common camera so we were easily able to find a spare to swap when the camera went in for its one repair (tip: never plug firewire cables in backwards — you can do it without too much force and it reverses the power supply and blows the camera and the firewire board on the computer. We now use an in-line polarity protecting electronic fuse...). We mounted the camera on a professional tripod with fluid filled head to allow steady recording and smooth panning. For audio the lecturer wears a wireless microphone and transmitting pack, and the receiver is mounted on the camera. The camera we used accepted multiple audio inputs which was very convenient as it permitted us to mix in the microphone audio channel on the camera itself and not have to worry about an extra data stream and extra cables to the computer.

We tried various clever hardware and software approaches to record the images from the backboard and projected from the data projector/document camera etc. Luckily we were able to try out proposed solutions before having to pay much money as these did not live up to our expectations. The two general types of approaches we initially tried were:

1. Resampling the SVGA signal going into the data projector (quality too low, didn’t capture the backboard, needed slow moving facilities staff to implement a hardware solution for each room we used before we could record in it);

2. VoDcasting software to capture the screen from lecturer laptop (quality too low, didn’t capture black board, document camera, or the built-in computer in the lecture theatre, needed a long cable run from front of the theatre to the mixing area at the back)

None of these were reliable and flexible enough for our requirements. So we instead adopted the naïve solution of purchasing a second camera (identical to the first) and simply pointing it at the blackboard/screen. That meant we could capture data projected from any source. Furthermore for reliability it meant we were physically isolated from, and so not dependant on, the existing (unreliable) AV equipment in the lecture theatre. For speed of setup we didn’t even attach this camera to another tripod — since it was fixed in position for the duration of the lecture we simply placed it on a sandbag and pointed it in the right direction. At 15 meters with near maximum optical zoom it produced good quality video.

We attached a high grade microphone to the fixed camera as a backup in case the lecturer’s radio mike failed, and to capture ambient sound in the room such as questions from students.

4.4 Audio Reliability

The camera operator always wore headphones plugged into the camera they were operating so they would know instantly if there was a problem with the sound. We used fresh batteries in the radio mike and receiver each time. This seemed wasteful but after once experiencing losing sound due to flat batteries we never wished to risk that again! Periodically I offered the resultant half-used AA batteries to students who seemed excited to be offered a gift of such riches. Perhaps they’ll recall this and endow the university with similar generosity when they are running Google...

4.5 Mixing and Data Logging

Both the technicians in the University’s own Audio Visual unit, and the two professional video editors I initially consulted for advice used the same editing software and the same family of hardware so we simply mimicked their setup. No doubt a vast range of other configurations would also have been satisfactory for our purposes but we didn’t have the time or tolerance for possible recording problems to permit the luxury of experimentation. Working on the same system as the locally available and friendly experts seemed the most prudent approach to adopt to minimise risk of problems arising which could not be solved rapidly.

We choose to capture on a desktop machine rather than a laptop. It would have been more convenient to capture and mix on a laptop but the laptops we experimented with all had problems processing 3 firewire streams in parallel at high data rates and we wished to have the capability to use 3 cameras if needed (to date we have never needed 3 cameras however). In addition the desktop machine has 2 quad core processors which provided much faster postproduction editing and processing than a laptop.

Mixing and processing audio visual data is astonishingly time consuming. A very minimal edit takes me about five minutes per one minute of footage. This means five hours for a one hour lecture. This was not sustainable in our context as I was already very busy lecturing and running the course and could not find an extra 10-20 hours time to work on video processing each week. Furthermore we needed to release the videos to the off campus students within a day or so. And this fast turnaround would have been critical precisely when the course, and consequently I, was most busy (near assignment due dates etc.) After much consultation and brainstorming we decided the most reliable strategy was to mix the footage live during the lecture (much like a television studio does) and post the already mixed footage immediately at the end of each lecture.

We used live mixing software which could be preset with common mixes of the two cameras (e.g. camera A only, camera B only, camera B with the output from camera A picture-in-picture, and so on) and fade between the presets at a mouse click. In theory the camera operator probably could have also done the mixing at the same time but for reliable setup, packing up, and dealing with contingencies we had usually
had two operators at the back, one mixing and one operating the cameras.

The two cameras were connected to the capture computer via firewire, they were mixed live and the resultant stream was saved to the hard disk in real time. We also kept DV tapes running in each camera in case of catastrophic or in case we wanted to re mix the streams afterwards. There have been a few times we have needed to remix from these backup tapes after the lecture as occasionally the mixing software freezes or drops a camera, and for example one time the power cord was kicked out from the computer. The remixing in these cases has taken a considerable amount of time and although the editing is marginally slicker when planned rather than performed live the benefit is far outweighed by the extra time cost.

4.6 Hosting and Uploading

There are a range of ways to host and distribute Open Educational Media (OER) such as lecture recordings. They are not mutually exclusive - we used several.

The most commonly used approach currently seems to be to host the media files on servers at the host university, usually in an ad hoc fashion school-by-school or even course-by-course. Advantage of this approach is it is easy to arrange and monitor and other course material can be integrated. The main disadvantage is that, except for local students with whom you can directly communicate, it can be hard for others to find the material. This is largely a push model of distribution. The most successful exemplar of this approach is MIT who provide lectures and course material via their dedicated OpenCourseWare portal (MIT-OCW).

To allow others to find the material more easily it can be submitted to well known learning repositories such as Academic Earth, the OpenCourseware Consortium, YouTubeEDU, and iTuneU. We hosted the video files on our school’s local file-server for local students but in order to make the material easily accessible globally we also published the videos on YouTube and on iTuneU. Uploading to YouTube is easy but slow. Some of our recent uploads have taken over 5 hours per lecture.

Two benefits of YouTubeEDU are that Google hosts the files for you at no cost (and with no maintenance effort on your part), and that there is already an active viewer community on YouTube so the videos are easily accessible to an existing and substantial audience. Uploads to YouTube have recently been limited to exceed the previous 2GB limit per video, and educational users are permitted to upload videos of any duration (normal YouTube uploaders are limited to videos of no more than 10 minutes.) In practice about 2GB is sufficient to provide a high quality HD video of a one hour lecture at 720p resolution. YouTube provides a range of analytical tools to allow peers where their viewers are coming from, and also provide audience demographic (age, gender) data when it is known. They also provide clear and detailed data on how your viewers have discovered your videos — which is invaluable in selecting and adjusting keywords and video titles.

An advantage of iTunes is that you host the files yourself and so have full control, a possible disadvantage is that you have to organise and pay for hosting and bandwidth. Academic Earth has the advantage of being able to host course material as well as lecture videos.

Be aware that the YouTube uploading process is quite fragile, accidentally navigating away from the upload page during upload aborts the whole process, as can engaging in other YouTube related activity it seems. YouTube offer a bulk uploader but I have sometimes found this to be unreliable and have got better results uploading the videos manually one at a time. I upload from a dedicated machine and don’t touch the machine again until the upload has complete since accidentally aborting a 5 hour upload after 4 hours is very frustrating. Uploads also fail erratically on completion with terse error messages suggesting that the video file is in the wrong format, trying again with an identical file often works.

Viewers in YouTube can interact with the video, they can add annotations, write comments, rate the video, add it to their own public compilations, and recommend it to their friends. As a teacher I find the feedback data provided by YouTube is useful in improving the effectiveness of the videos, in contrast to the basic hit count data our University provides to those hosting vodcast files on the University’s iTunes server. I also like the (admittedly limited) sense of community amongst the YouTube viewers as opposed to the solitary experience offered to my iTuneU viewers.

4.7 IP

Our lectures and course material are released under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 licence. This means copyright of the lecture itself remains with the lecturer but anyone is permitted to copy, remix and derive further works from the material for non commercial purposes provided they provide attribution and impose the same conditions on the copies and derived works.

5 Outcomes

This section first reports on the outcomes of the project with respect to our two initial objectives for recording the lectures. It then reports on the outcomes of openly publishing, whose significance I feel far eclipses the original aims of the project.

5.1 Secondary School Outreach Programme

The secondary school outreach program has eventually proved a substantial success although the 2008 pilot involving three students had a number of problems. That year one student dropped out, and another two had problems accessing the videos online due to the bandwidth limits of their home internet connection. Furthermore we had problems uploading the videos to YouTube in a timely manner - largely as a result of the problems outlined in the previous section.

In 2009 the program ran again with the already recorded 2008 lectures, this time with 16 students. By this time all of the lectures were already on YouTube but a few students also reported problems with their download quotas. All the files were available for free download over the university wireless network which mitigated this problem to some extent. In 2010 we provided all students with the video files on DVDs so no downloading was required.

The response of the students taking the course has been overwhelming. Although we provide formal transcript qualification at the end of the course suitable for credit at any university three of the four students who have completed secondary school to date have come to study computing at the university suggesting that they found the experience rewarding. Many of the other students from the course, currently in their final year of secondary schooling, have stated a firm desire to proceed to university and continue to study computing. The level of enthusiasm, excitement, and community amongst the graduates of
the course is quite remarkable. At the 2009 UNSW open day a number of the secondary students turned up at the university of their own initiative and organised their own stall where they demonstrated the project they were currently working on. We observed two of the students speaking excitedly to visiting students about the fun of studying computing at university. Students from the 2009 course have subsequently volunteered to tutor and mentor the 2010 students. This shows considerable dedication from them and the same time they are studying for their own HSC. Interestingly approximately half of the returning tutor/mentors are female, which contrasts with our typical first year intake of around 20% female students. If this trend persists it will warrant investigation.

On average the academic performance of the 2009 students who watched video lectures and face to face tutorials and labs exceeded the performance of the students who physically attended lectures and had face to face tutorials. Obviously the sample size is small and the group was positively selected so the two groups are not directly comparable but it does not appear that the students who did not have face to face lectures were at any significant educational disadvantage. Indeed the video students themselves reported high levels of satisfaction with the way the course was organised, the average response to the summary question “Overall, I was satisfied with the quality of this course” was 4.8/5.0 (15 responses) for those who watched lecture videos, compared with 4.4/5.0 (184 responses) for the university students who did physically attend lectures. These results are comparable to those experienced in CMU’s Open Learning Initiative (Lovett et al 2008).

The high positive response from the video-watching students may well have been a consequence of the resultant shift in focus from lectures to the group based tutorial-lab sessions. These students watched lectures at home privately as preparation for the tut-lab session, which was then seen as the focus of the course each week. Being a tutorial-lab it was highly interactive and personalised perhaps making the overall experience seem much more social and personally relevant. We are currently gathering data from the 2010 course participants to further investigate this hypothesis.

5.2 Sharing teaching practice, and Syllabus Stability

We are still working on the project of using the recordings to share ways of teaching higher level content such as group work, skepticism etc. Some teachers outside of the group were targeting with the lectures, have unexpectedly approached us and said they have watched some and in some cases all of the lectures and have found them useful in their own teaching practice. From informal conversations it seems many of the teachers in the school have watched at least one of the lectures but it is extremely unlikely that many have had the time or inclination to watch the full 50 hours for any course. We are currently working on a teacher summary for each course which gives links to small fragments of video demonstrating each of the more novel aspects of the current syllabus. This is a work in progress and is publicly available for any interested teachers (see https://wiki.cse.unsw.edu.au/openlearning).

One interesting aspect of having lectures captured as open and persistent objects is that this makes them available as first class objects for academic discourse and analysis. For example in a paper I am currently writing on the effective teaching of skepticism I am able to cite specific moments in various lectures to illustrate points — and then readers are able to see the teaching at these moments for themselves rather than just reading my second hand reports of my own interpretation of what I recall doing. Further they can roll forward or backwards to any other part of the lecture, or indeed view preceding or subsequent lectures, and investigate to their own satisfaction issues of context and acts of summary and selection I perhaps unknowingly perform when reporting the work. This is consistent with the emerging open data movement discussed in Section 3.0 above, and parallels the modern practice in scientific scholarship of making raw data publicly available in addition to the conclusions drawn from the data. This approach offers many novel and exciting possibilities and suggests that dramatic changes may lie ahead in conducting and disseminating the scholarship of teaching and learning.

5.3 Unanticipated Impact

As reported above the lecture videos have been watched over one million times. They have been highly rated by viewers on YouTube all being rated either 5 or 4.5 stars. One of the lecture videos was selected by YouTube as a Featured Video on the YouTube front page world wide. The response from students and teachers worldwide has been somewhat overwhelming and by late 2008 responding to emails and written letters about the lectures was taking hours each week. Many of these interactions were from university students currently studying computing at other institutions but signifiant impact of the lectures was on those for whom university was not an option. I received messages from viewers were from third world countries without local university options, from viewers who were not permitted to attend university, from those who could not afford university, from younger students bored at school but not yet of university age.

THANKYOU for posting [your lectures]. I am dyslexic with the reading comprehension of a 7yo and the language ability of a 35yo, have pretty much fallen behind at uni within the first 3 weeks of every course (at [another university] not UNSW). Putting the lectures online is a really good help as it gives people the chance to learn at their own pace instead of under pressure of the course. It is definitely a worthwhile project, and a great supplement.

YouTube user Battlwench comment on UNSW-e-learning YouTube channel (Battlwench 2009).

Existing mechanisms for course feedback and assessing the effectiveness of my face to face teaching do not translate in any obvious way to assessing the learning arising from the largely anonymous group of remote learners watching the material online. I am currently engaged in research project to investigate possible ways to address this challenge. Nonetheless the flood of qualitative feedback I have received since starting to publish the lecture recordings makes it clear that the project has had an educational impact dwarfing all my previous work. This has been both humbling and inspirational and is incredibly motivational as a teacher.

The online lectures currently average 1,500 viewers per day watching 3,000 videos. It is hard to divide these viewer numbers into students and fellow teachers. An interesting indication is that Google reports 70% of our viewers are over the age of 34. I have received considerable correspondence and YouTube comments from other teachers who have enjoyed watching a different perspective on teaching. As an
indication the most recent teaching comment from a viewer today is quoted below.

I look forward in turn to observing the teaching practice of other teachers who engage in open teaching. Current practitioners of open teaching in computer science include Mehran Sahami, Eric Grimson and John Guttag. I believe that teachers openly sharing our practice in this way will improve the teaching profession and the quality of what we do.

Wow!! Our high school here in Texas has gone to a 1:1 laptop to student setup. We are in our 3rd year of computers this year. I thought I had exhausted the possibilities! Now I see that I’ve only begun... I can’t wait to try the wiki experience this year with my students. Thank you..!! — (SkyRookie1 2010)

### 6 Issues

After the mechanical details of recording and publishing lectures are resolved there remain important questions about how to make the process effective for learning. We set out briefly issues which need to be carefully considered.

- **Consent:** Students present in the lectures must not only consent to the recording but the act of recording and perhaps their concerns about being recorded must not interfere with their own learning. Our approach is that the students in the class are our primary concern, the recording is a nice bonus if it works. We consult with students in the first lecture, we strive not to record faces of students, we identify areas they can sit to avoid being recorded, and we ask that if anyone is unhappy with their comments in a lecture being recorded that they advise us as soon as possible after the lecture and we will erase this before posting the footage. Despite providing these avenues for students to exclude themselves from the recording to date no student has raised any concerns. This needs further investigation but perhaps they are simply not as concerned with privacy as say my generation is.

- **Engagement:** watching videos is passive by nature, and one hour lectures are much longer than the 10 minute norm most viewers have become accustomed to on YouTube. To stop viewers falling asleep we use a combination of active camera work, cuts between cameras, and the way the lecture is structured in an effort to keep the students engaged. As mentioned above we strive to make experience for viewers feel like they are present in the class rather than simply watching a passive recording of it. Luckily also the discipline of computing is very interesting in and of itself!

- **Criticism:** Comments on the internet can be made quickly and with little thought. Debate can be robust. Furthermore such comments are made publicly and are available for all to see. I follow a policy of only deleting comments which include offensive language or which are disrespectful to specific students in the audience, and leave other critical comments untouched. Some of the comments and feedback I have received on my teaching has been quite confronting. It seems likely that some teachers may not wish to be exposed to blunt and public criticism of their teaching. Furthermore it is possible that some teachers will not wish to share their teaching even if public commenting is not permitted, engaging in what Clement & Vandenberghe (2000) refer to as strategic autonomy in order to avoid the criticism of colleagues. This may well prove the most significant barrier to widespread adoption of open teaching.

Like for instance, if you have difficulties with one of the children, the real and problem children, then it’s delicate to discuss that with your colleague. You don’t feel inclined to tell about it, because the other would doubt your competence. Especially if you’re a novice teacher. Then they look at you with Argus eyes, don’t they — teacher comment (Clement & Vandenberghe 2000)

### 7 Conclusion

Publishing videos of my lectures online has proved to involve only a modest amount of work and virtually no cost, despite the university having no useful recording infrastructure in place. This was made possible due to supportive colleagues and university management, enthusiastic student volunteers, and the adoption of a Cinéma Vérité approach and live mixing.

From my point of view the main costs have been the time taken to respond to correspondence from remote learners and the continual guilt I feel for not being able to do this adequately.

The rewards have been unexpected and immense, both emotionally and in the impact I have been able to have with my teaching on students worldwide and on other teachers. I are excited by the potential for video recording to transform the practice of teaching from something that happens largely privately and behind closed doors into an open and communal process.

### 8 Future Work

Further work is needed to develop useful ways of assessing and improving the effectiveness of teaching and course design when learners are largely anonymous; have widely differing and unknown levels of prior knowledge, skills, and learning objectives; and need not follow the course in a linear fashion.

### 9 Acknowledgements

I acknowledge and thank my students from COMP1917 (2008 semester 1), COMP1927 (2009 semester 2), and COMP2911 (2010 semester 1) for being so supportive of our time together being recorded, and for not letting the presence of the cameras dim their enthusiastic and active engagement during lectures. Our courses are based around a strong sense of community. If the classes look fun and interesting, it’s because they were, and this arose from the community we formed while each course unfolded - with students contributing at least as much to the mood of the class as I did as lecturer. It was our class, not my class, and it was with great generosity and open heartedness that the students were willing to allow outsiders to share in their experiences. Furthermore I thank my students for their unquestioned trust, which I found quite moving, that I would treat them respectfully in the editing and release of the recordings of our times together.

That this paper was written is due in large part from the encouragement and support I have received.
from my many wonderful colleagues with a passion for education. Most directly in the case of this paper Helen Dalton, Jan McLean and Judy Kay who asked great questions, and Matthew Clarke who provided helpful writing advice. Matthew also very kindly read and commented on an earlier version of the paper and this version has been improved by a number of his comments. Likewise the paper has benefited substantially from the critiques and insights contributed by each of the three anonymous reviewers. I thank you all most warmly for the care you put into making very helpful suggestions.

I would like to acknowledge all those who by their encouragement and efforts made the lecture recording possible. At the time we started there were very few widely known exemplars of public videos of university courses outside of MIT-OCW (iTunesU and India’s nptelhrd channel had only just started, in the case of iTunesU most content was audio only) and certainly none locally, and it would have been very easy for someone somewhere to have said “no, it’s too hard” or “it won’t work.” Elithamby Ambikairajah, the pioneer of lecture recording at UNSW, gave me much useful information about the impact of recording on students in the classroom and watching his recordings provided reassuring evidence that current camera resolutions were sufficient and that it could be done. Patrick Stoddart first suggested the idea of making the recordings public, Mary O’Malley, Tom Cavadovski, Mark Foster, Michael Rampe and Daniel Woo provided wise and practical advice on the mechanics of video recording, Paul Compton and Ashesh Mahidadia first thought of the idea of live mixing. David Collien and Theo Julienne were constant advocates for resuming outreach to show bored secondary school students the joy of computing in the same way they themselves had been inspired by the CSE computing club in the 1990s.

The biggest contributions of any individuals to the project was the heroic and entirely voluntary (they repeatedly refused payment) efforts by Rupert Shuttleworth and Thurston Dang, former students of the course, who operated the cameras and live-mixed the lectures throughout the project. They set up and packed up the gear, sorted out hardware and software problems, and just generally made everything happen. Their efforts meant I never had to worry about recording when I needed to be worrying about the lecture. Furthermore they are intelligent and effective educators. I deeply valued our times travelling the course together, conducting a post-mortem on the lecture that had just happened, and bouncing ideas around for what was still to come. Being open in my teaching practice and the consequent benefits from Thurston and Rupert being able to observe what had happened in lectures and discuss it in a rich manner was a compelling endorsement of open teaching.

Appendix: Equipment List

Camera: 2 x Sony A1 HDV
Tripod: Miller + DS-5 head
Wireless Microphone: Sony UTX B1 / URX B1
Computer: Apple Mac Pro 2x2.4GHz Quad-Core
Live Mixing: WireCastHD by Telestream, Inc.
Postproduction: Adobe FinalCut Pro

References


