TDA Observation Project
Final Report: Phase 2

School names have been removed from this report to protect their confidentiality.

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Introduction

The TDA Remote Observation Report aimed to engage young and newly qualified teachers with other educational practitioners, to provide feedback, reflection and self critique, which would enable NQTs to develop their teaching skills, whilst providing a network of support.

Phase 1 took place in 2010. The findings from phase 1 were documented in the 'Weflect" report.

Phase 2 took place in 2011. Early findings were reported in an 'Interim Report' dated April 2011. This report is the final report for the project. The aim of this report is to:

1.   provide information on the effectiveness of the developed system;
2.   provide information on the use of the system within schools and by NQTs;
3.   test the developed software which provides for two video streams, time stamps and annotations;
4.   demonstrate the cost effectiveness of the system;
5.   identify cost savings.

Phase 1 to Phase 2

Phase 1 research was carried out using two schools: D Middle School, Bedford and Y Secondary School, Dorset. One of these schools had early and illuminating problems and in effect only one school was able to fully test the developed system.[1]

Adaptations were made to the technology based on this phase 1. These adaptations are outlined on page 5 below.

Phase 2 intended to test the effectiveness of the system developed by investigating its use in schools. To enable this a number of schools were selected which represented different geographical regions, contexts and intakes.

Timeline for Phase 2

Please see appendix 1 for the detailed timeline of phase 2 of the project

Reasons for initial delay

School Selection

Finding suitable schools took a longer time than expected but was worthwhile because five satisfactory participant schools were identified. The identification process continued alongside the choice of the hardware and the software development. Adaptations to the software, based on phase 1 findings, took place in parallel to school selection.

A large number of schools were approached to gain their involvement in this phase of the project. Reasons for non-involvement were:

  •   Meeting the desirable project criteria: Selecting schools that had varying locations, context and ages meant that a number of schools willing to take part were removed from the final five because they duplicated an already existing participating school.

  •   Philosophy of the school: A number of school expressed a desire to see every lesson recorded by the NQT. The project aim was to improve practice by enabling self-reflection and critique. By allowing

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[1] The 'Weflect' report fully documents this development

NQTs to control who was invited to view recorded lessons it was hoped they would feel empowered, would take risks and record less successful lessons and more challenging classes. This did not sit well with the philosophy of some schools.

- Agreement of the NQTs: Although a number of School Management Teams (SMTs) were willing to take part in the research a number of NQTs in schools were not. The reasons expressed were simply that NQTs felt judgements were being made regarding their competence which could be used in determining their future employability. This is concerning and has implications for any project with NQTs.

- Timetabling: Those NQTs who continually moved around the school to teach lessons and were not based in one classroom were eliminated as the hardware used for the project was not portable on a lesson-to-lesson basis

- Willingness (and authority) of the network management to implement changes to the system: Although SMTs and NQTs were often willing to take part in the research, in practice the arbiter of what actually happened was the network manager(s). Where the school network was externally contracted issues were considerable and schools appeared to have little control over machines on the network. Hence the project hardware could not be effectively used. Where the network was internally managed it was easier to gain a face to face interview and persuade the network manager the technology was configured in such a way as to minimise disruption and menace to the network . This provided to be an important element, even within the five schools selected, and is dealt with on, page 23

Access to school staff

School staff are busy people. Appointments were made with schools to talk with all key members involved, including SMTs. Inevitably meetings with those responsible for NQT programmes were difficult to make and sometime cancelled despite flexibility of the project team. Having to engage Head Teachers, SMTs, mentors to NQTs and NQTs themselves in the aims and objectives of the project in five schools all took time, but was essential.

System testing

The hardware required testing in a live environment, connected to an external network.   Although this could be simulated the hardware could not be fully tested until directly connected to a school network. As each network is radically different the hardware needed to be reconfigured for each school system. Although the systems were installed within the expected period of time, there was a time lag before the systems became active depending on the length of time it took network managers to connect the project computer to the internet.

Phase 2: Changes

Technology Adaptations

Findings from phase 1 research underpinned the adaption of the design of the TDA Remote Observation technology platform. Design changes took place between January and continued into April 2011. They were mainly those suggested by the practitioners involved in phase 1, primarily:

- the facility to record from two cameras simultaneously (ideally from both the front and back of a classroom). This, practitioners suggested, would allow teachers to be able to observer both the actions, and reactions, of students and teaching staff within the classroom space in a more accurate way;

- any new system developed needed to avoid placing undue load on a school network. The technology platform tested during phase 1 research relied upon a cross network recording mechanism: - video was streamed live from the classroom to an external server where it was recorded directly to disk. The network load for such a mechanism was deemed undesirable by SMTs and the network managers, who feared that the school network would slow as bandwidth was used for the project. The concern was that the synchronous upload would inhibit normal use of the school network;

- commodity hardware should be used wherever possible in order to keep costs to a minimum (and thus, should the system be rolled-out, to increase the availability of such a system to those schools who had a limited budget). It was therefore decided that the hardware would not exceed £600 excluding VAT, per participating school, an appropriate limit.

Some changes to the software were suggested by NQTs during the roll out phase and, where practical, these adaptations were made.

Software Adaptations

The software was further developed for use in phase 2 in the following way, again after feedback and dialogue:

- the two video streams were embedded on one page, one video below the other;

- the ability to 'tag' a selection of video and save it for another user to view was added;

- deletion of a video from the page (not the video database) was enabled;

- the ability to invite any user with an email address to view a recording was added.

Schools

As phase 1 had used two schools it was decided to increase the number of schools to five for phase 2. A number of schools were approached to participate in phase 2 of this research. Of those initially approached the following schools were deemed suitable for use, and accepted[2];

1. GP, Wickford;
2. D Middle, Bedford;
3. WF C of E Comprehensive, Lincolnshire
4. SN Academy, Skegness;
5. CH College, Grays

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[2] Suitability involved ensuring that the school represented the rural/city divide, differing ethnic groups, mixed organisational type, age range taught and geographical locations

School 2 also took part in phase 1 of the project, although the NQT involved in phase 1 had full qualified teacher status so new NQTs were approached.

All the schools had a number of newly qualified teachers (NQTs) for the academic year 2010 - 2011; Head Teachers were approached initially and discussed the project with their SMTs. SMTs in the chosen schools were enthusiastic with regard to the aims of the project and at least one of the NQTs approached within each schools was willing to be involved in the project.[3]

Profile of NQTs

For phase 2 the number of NQT involved in the project was expanded from one in phase 1 to eight NQTs in phase 2. These NQTs no longer came from one age range but covered age ranges from year 1 to Key Stages 2, 3 and 4. Only the foundation stage was not represented in the group. Four NQTs were male and four female.

Where two NQTs took part from one school, in two cases the NQTs shared a classroom, and hence taught the same subject whereas in one case the hardware was moved from one classroom to another during the project. This tested the flexibility of the kit in terms not only of differing classroom set-ups but also with differing teaching styles.

The subjects taught by NQTs covered English, Mathematics, Science and Art. It was expected that the classroom activity would vary depending on the subject taught, for example Science might include work on a bench following teaching from the front whereas Art might well involve a mostly revolving teaching.

Only one of the NQTs, the year 1 teacher, taught the same group all week. All other NQTs had differing classes and so could choose who, and who not, to record.

It was anticipated that these differing profiles would allow any differences in use of the software to become apparent as the project developed.

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[3] Full details of the schools are contained in the 'Interim Report' but are included in Appendix 1 of this report for easy reference.

Hardware

Technology solution overview

The newly developed TDA Classroom Observation Project system is comprised of three main components:

- A client recording kit: hardware which was located within the classroom

- A Personal Computer (PC) which provided a web-based interface to authenticate the individual accessing the page as a valid user which then allowed them to create new recordings.

- A community web site running on top of a Central Server to which recordings were uploaded asynchronously, and through which recordings were viewed, edited and deleted, shared, and commented upon.

Hardware components

Central Sharing Server

The Central Server was provided by Linode[4] (a virtual server provider), and based in London, England.

Having made recordings on the PC placed in the classroom, the recordings were later uploaded to a Central Server at times set by the school network manager.

It was not anticipated that for the purpose of the research that this machine would need a high amount of memory nor disk capacity but rather would require bursts of high CPU activity, and high bandwidth capabilities) and as such a mid-level machine was chosen for the project.

This proved to be good judgement and sufficient.

Client recording "kit"

The school-based "kit" comprised of several pieces of equipment:

- A wireless router/access point, used to connect to the school network. All other pieces of equipment would attach to the wireless access point, though themselves remaining within the internal network of the access point.

- A single PC. It was the responsibility of the PC to provide an interface through which teaching staff would start and stop recording, and to communicate with and record the output of audio/video (AV) devices, when required. It was the responsibility of this PC manage the uploading of AV files to a Central Server for later review, replay sharing and commenting upon.

- Two wireless IP web cameras, or wired web-camera's (or any combination of these) were supplied.

- One microphone kit

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[4] Linode.com virtual server, 1024MB with 40GB storage and 400GB monthly data transfer.
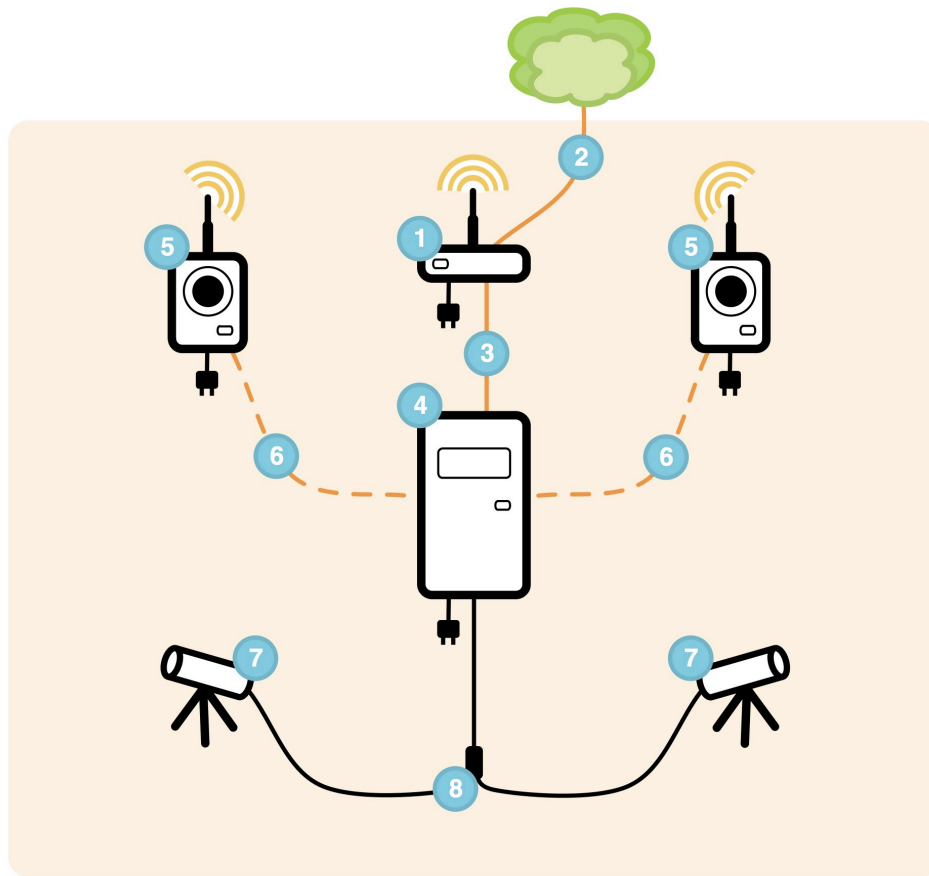
The wireless router (1) was used to connect to the school network (2). In order to establish the connection an IP number was allocated to the router by the network manager at a school. The router used network address translation to forward all TCP calls to port 80 (HTTP) internally via a CAT5e cable ethernet connection (3) to the PC (4).

Cameras (5) transmitted video feeds, via local CAT5e wired (6) and/or wireless network (in the case of IP cameras), or alternatively through direct USB connection (6) with the PC (in the case of connected web-cam). All IP cameras required an external mains power source.

A microphone kit (7) was connected to the PCs 3.5mm audio-in socket. Microphone kits containing multiple microphones make combined signals by using a supplied signal merger (8).

Installing the client kit

Once the five schools had been selected and confirmed dates were made to visit the school to install the kit. The system would allow for the recording of two good-quality video feeds and incoming audio as recommended following phase 1 of the project

The kit was installed between 28 February and 22 March 2011 and a number of pieces of hardware were deployed in each school. This hardware was as follows

PC (Local Recording Server)[5]: Each school was provided with one PC. The PC provided a web interface via which, once the user authenticated themselves as valid, a start/stop recording of available AV streams were presented.

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[5] **PC Specification:** Ebuyer Extra Value Desktop, Pentium Dual Core E5800 3.2GHz, 4GB RAM, 1TB Hard Disk Drive, DVDRW, No Operating System

IP/web Cameras: Each school was provided with two cameras. Three different camera models were tested[6] through the course of the project as different cameras allowed for flexibility during deployment. Placement often depended on classroom set-up.

The Logitech web camera[7] was used in classrooms where size was a main concern. However, software configurations for deployments using such cameras would differ from those using Edimax based wireless IP cameras.

Microphone: Each school was provided with one microphone kit. Two microphone options were tested during the course of the project. These were the Olympus ME-30W Conference Kit and the Sony WCS 999.

Wireless router: A Tenda wireless router was provided to fulfill a number of roles:-

- All communication between the wireless IP cameras and PC would occur across an internal network rather than through the school network. This allowed for all the other pieces of equipment to be configured with valid network configurations before they were delivered to the school.

- Port forwarding would be used to bridge the internally connected PC to the external school network by allocating a valid school-network IP number to the PC. This would allow for users to access the HTTP/web based recording interface on the PC through entering this IP number into the web browser.

- Control and configuration of the device could be passed on to IT technicians within the school (such that they felt a sense of ownership and could ensure the security of network related aspects without altering configuration details of the recording mechanisms, located upon the PC). The Tenda wireless router provides a simple to use web-browser based configuration interface via which all settings can be controlled.

The router contained a built in firewall, that was pre-configured to accept only incoming SSH and HTTP connections (SSH facilitating remote management of the internal PC, should the local IT team approve).

Before the kit was installed a number of communications had taken place with the school. Prior to kit installation the aim was for discussions to have taken place with;

- those responsible for NQT programme and mentors

- the nominated NQTs

- the network manager.

In practice no network managers were available for discussion prior to kit installation.

Although a number of discussions had already taken place with Head Teachers and their SMTs little information concerning the project had been passed down and hence most discussions with those responsible for NQT programmes were via telephone and email and, again, took longer than anticipated.

Due to delays in the selection of NQTs (page 3) the explanation of the project objectives, installation of the kit and training on the use of the software took place in during one meeting rather than spread over several meetings as had been the original project intention.

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[6] Edimax IC-1510WG and Edimax IC-3030Wn Triple Mode 150Mbp wireless IP cameras.

The primary difference between the Edimax IC-1510WG camera and its more recent IC-3030Wn counterpart lies in the video formats that the camera produces and streams to a connected network. Both cameras are capable of outputting Mjpeg data streams (though at slightly different qualities, dependant upon video resolution), with the IC-3030Wn also capable of outputting Mpeg4 and H.264 based streams.

The IC-3030Wn camera would be offered in preference over IC-1510WG cameras, however this was sometimes hampered by availability. In use however (largely due to the software configuration options chosen) there was no difference in recording quality between either Edimax camera model.

[7] The model used was the LOGITECH C270 HD Webcam

In four out of five schools NQTs were present and involved in placing the kit in classrooms. This was important because;

- The NQTs might need to move the kit if they moved rooms or if the camera were not in the correct places;

- NQTs knew best how they moved around the room and could indicate the best place for the camera and micropphones;

- It was hoped that involvement in placing and testing the kit would empower NQTs and thus improve their confidence;

- Test recordings could be made immediately so NQTs would have instant feedback knowing how the video looked and audio sounded rather than be left uncertain;

- Training on use of the software could take place at the same time.

In one school hardware was installed before the NQT had been selected. Although not a project ideal this was because the individual responsible for NQTs had been absent for a long period and the team were in the area installing kit in a partner school. In fact the installation of the hardware moved the project up the school agenda and a replacement NQT leader, and a willing NQT, were found shortly after the kit installation.

Meetings were arranged around the NQTs timetables, although four of the five meetings to install hardware took place at the end of the school day. This meant that the network manager was often not available because they had either left the site at the official end of the day (two cases) as they stated they were busy sorting out network issues for the following day (two cases).

In an ideal circumstance the network manager would have been involved in placement of the kit because:

- the PC IP could be assigned immediately and the kit could be fully tested by the technical project manager while on-site and the NQTs could test the software as it would be used in the classroom by the project;

- conversations with the project technical manager would improve the confidence of the network manager that the firewall was correctly installed and the new hardware could safely be placed on the school network;

- the network manager would understand the aims and objectives of the project;

- the network manager would feel some ownership of the project and understand (s)he was an important part of the process in allowing the project to take place and develop.

In practice in only two of the schools was the network manager present during part of the installation. In one of the schools the IP could not be assigned as the management of the school network was outsourced and in the other school the network manager only appeared when the hardware was installed and was too busy to take part in any discussions. Consequently most communications between the network managers and the project technical manager took place at a later date via email and phone calls. This proved to be a project constraint and is dealt with later in this report.

Training for all NQTs took place despite the lack of an assigned IP which meant the hardware was not running fully on the classroom machines. A web browser running the system in trial mode on the project technical mangers laptop was used to train the NQTs but this was not the same as seeing the software running on the classroom machines. The result was that NQTs undertook a number of test recordings when the kit IP was assigned. The laptop did, however, enable NQTs to check the placement of the cameras and microphones.
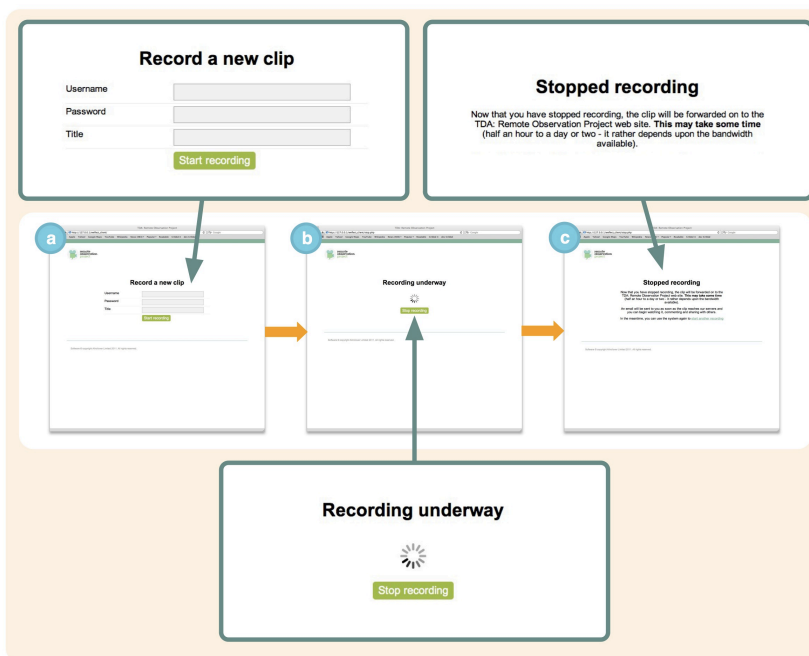
Software

Software components

In developing the new TDA Remote Observation Project application platform several ubiquitous open source technologies were used. Details of these can be found in appendix 3.

Using the software

Recording process

1) NQTs viewed the "recording-initiation" interface through an open web page, running on their own personal, classroom computer ("**2**" for example a laptop or a PC (**3**) located within the classroom). The IP address allocated to the installed router by the network manager during initial installation was used as the url.

2) The initial web-page (**a**) required the NQT to enter a username, password and title for the new video recording. Upon submission a HTTP POST request was sent to the local recording server (PC) containing the details.

3) The PC (LRS) transparently forwards (**4**) the username and password data (via CURL over an SSL encrypted connection) to the Central Server for authentication ("**5**" the CAS). The CAS authenticates the details against a table of all registered users, and responds with a message containing the unique ID for the user. If no corresponding data was found, an empty response was returned.

4) Should the user be successfully authenticated, the PC (LRS) performs several actions:-

- A new directory was created on the disk within a directory designated to contain all new recordings. The newly created directory contains details of the new recording, and resultant AV clips. The creation time was used to name the folder (in UNIX time format).

- The unique user ID returned from the CAS was written, alongside the new clip title to a text file (meta.txt), located within the newly created recording-folder.

- The PC (LRS) initiates recording by calling the start_recording.sh shell script. This script opened a HTTP connection to each local IP camera video stream and locates the audio-in signal (**1**) before proceeding to capture and record the data, in a usable format, to disk[8]. The new recording files were created within the recording folder.

- Finally a new web page (**b**) was returned to the users web browser showing that a recording was underway. This web page also provided a link to "stop recording".

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[8] FFMpeg is used for this task, recording video and audio feeds to MPG4 and AVI formats, respectively.

If an empty response was returned, indicating that no corresponding user data can been found, the web browser was redirected back so that the details provided could be modified and re-submitted.

5) On clicking the "stop recording" button, a HTTP GET request was made to stop.php, located upon the PC, which in turn called the stop_recording.sh shell script. This file was responsible for ending any currently recording by severing connections to the IP cameras, and ceasing import of all AV data.

At this point, the session recording was complete, and the users web browser was directed to a web page (**c**) indicating as such. A message on the web page highlights the the video's were next to be forwarded to the Central Server and indicated the likely timescale for this to happen.

Uploading videos for review and sharing

6) CRON was used upon the PC to trigger the upload.php CLI script at one or more times each day (as specified through discussion with the school network manager). The script was responsible for managing the upload of newly created recordings to the Central Server. As the size of files to be uploaded could be large (approx. 600mb per hour of recording), the time(s) of upload were negotiated with network manager so as to minimise impact of file upload on the school network during peak times. By default the system was configured to initiate upload at 11pm in the evening.

Upload.php scanned the recordings directory for newly created sub-directories (each containing files for one recorded session). Each folder found was first compressed using a combination of TAR and GZIP to create a tar.gz file. This compressed file was then sent via HTTP POST over an SSL encrypted connection to the Central Server using CURL. Though not used during the trial, it is suggested that future iterations of the software instead use a HTTP PUT mechanism which would allow for the continuation of upload of files should a network error occur.

The Central Server stored newly received files to a temporary directory for later asynchronous processing. This was to avoid bottlenecks on the Central Server which might have occurred should several files have been received at the same time from different schools. In this case synchronous processing would have adversely affected performance and reliability.

7) A CRON task, running once every ten minutes, scanned for newly received compressed recording files. For each new file found:-

- the triggered script unpacked the compressed file to a temporary directory.

- The newly unpacked directory was scanned for a meta.txt file, containing details of the user who created the recording, and the name of the recording. A new record was created within the local MySQL 'recordings' table, linked to the user ID, and containing the clip title and creation time (as extracted from the archive file name).

- FFMpeg was used to process the received MPG4 and AVI files ready for later display through a web browser. The act of encoding took into account that errors might have occurred during earlier recording, and modified its behavior accordingly. Specifically, the encoding took into account that one or more video file, and the expected audio file might be missing:-

  - In the case that two video files and one audio file are present, video file 1 and any available audio file were combined to create a new compressed web-ready .flv (flash video) encoded file. Video file 2 was compressed without addition of audio to a web-ready .flv file.

  - Should video file 1 or 2 be missing the remaining video file was combined with any available audio file creating a new web-ready .flv encoded file.

  - Should both video 1 and video 2 be missing no further action was taken and the video was flagged as faulty.

At this point, media clip processing was complete and the recording was ready for review and sharing via the Central Server (**6**).

Reviewing, sharing and commenting
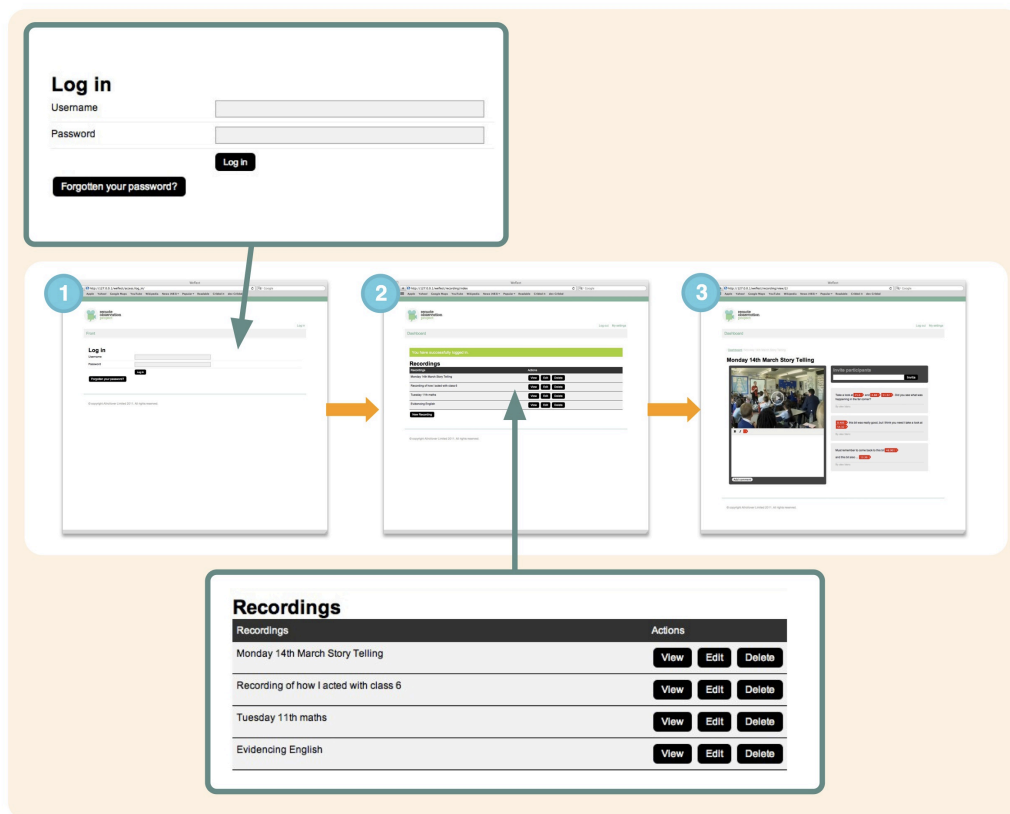
To review, share and comment upon uploaded recordings, the user undertook a number of actions:

1) They logged into the community web site using their assigned username and password (www.weflect.me). The username and password used were the same as that used during the recording phase.

2) A list of all recorded videos (both those made by the NQT and shared with other users) were listed on screen with options alongside to 'view', 'edit', and 'delete' any recording. "Editing" would allow the user to alter the clip name (entered in the recording phase). "Deleting" removed the clip from the screen but not from the database.

   Note: no files were automatically deleted from disk (as a precaution against accidental deletion), though deleted files were no longer visible to the user online.

3) Clicking "view" alongside a recording, took the user to a new web page where the available web-optimised AV files (as processed upon the Central Server following upload) were made available for viewing. The new page contained an in-page video playback interface.
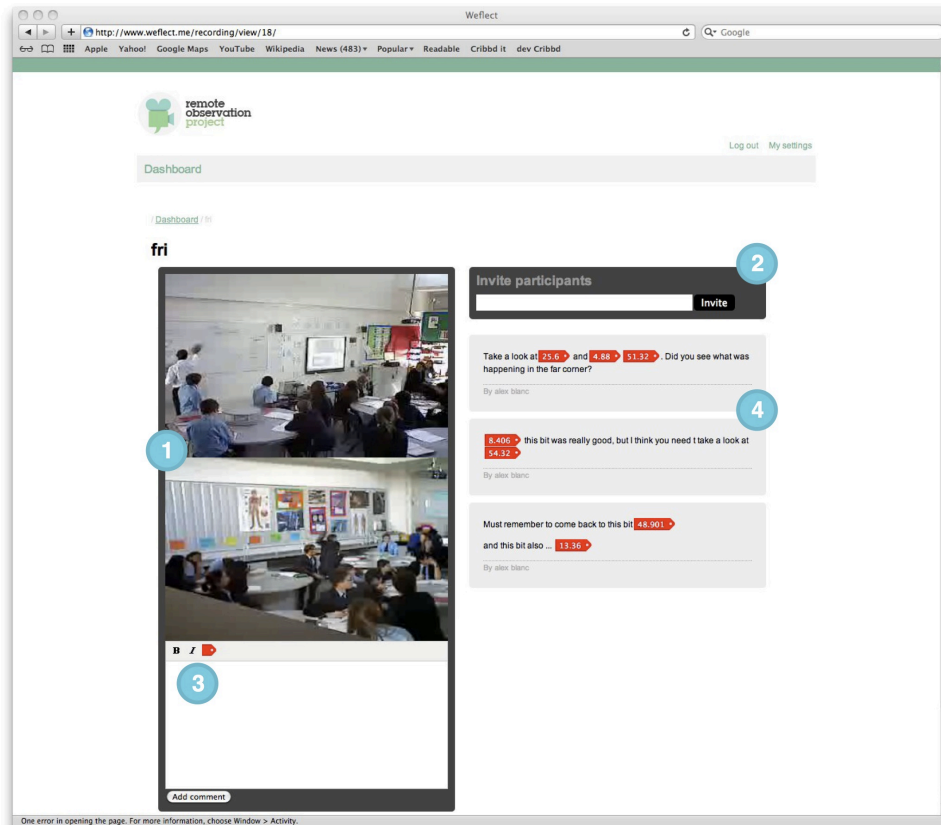
1) Playback: Video feeds from the two classroom webcams were displayed stacked vertically and were started/stopped/paused (etc.) synchronously through interacting with one set of playback controls. These controls are consistent with those used by any web viewed video.

2) Sharing: Sharing was enabled by the owning NQT entering an email address for the person they wished to share their recording with. Upon entering the email address, an email was sent to the new invitee containing the name of the recording, and name of the NQT sending the invite and an embedded web-link back to the recording to allow the invitee to "view" the recording

Should the email address already exist in the 'user' database, upon loading the link contained in the sent email, the new participant would be directed to log-in using pre-existing details (they would then view as in step 1, above). Invitees could in turn invite further participants (this feature is currently restricted to owners of recordings).

Should no record exist with a matching email address, upon clicking the link contained in the email the new user would be required to first register as a user (supply and confirm a new password and give a first and last name) before proceeding to view the clips.

Commenting: All viewed videos could be commented upon. Located under the video windows (**3**), the comment box allowed the user to post new messages, using plain text, italics and bold (as selected from the comment box toolbar). The comment box allowed for the insertion of AV time stamped links in the message. To do this the user located the relevant video and clicked the tag icon using the comment-box toolbar. Many such links could be included within any one comment.

Comments were submitted to the Central Server and associated with the video. An AJAX based interface was used to constantly (**4**) check the server for new comments pertaining to the currently viewed recording and load new messages onto the page without the user needing to continually reload the page.

All comments were attributed to the author and were time stamped.

Hardware and Software rationale

Hardware

Hardware was adapted as suggested in phase 1 but not all the schools had identical equipment because:

- it enabled the project to test and compare kit options;

- classroom set-ups varied;

- NQTs had differing practice depending both philosophy (theirs and the schools), pedagogy and subject;

- lack of availably of kit at the time of installation.

Cameras used varied in size and were either wired or wireless. The Logitech web camera that was used in two classrooms was used where size was a concern as the camera was actually much smaller and therefore discrete. However this camera is hard wired. This means that the location of the camera is fixed by the availability of electrical plugs (school health and safety regulations would not allow trailing leads). This camera is therefore less flexible; moving the camera around to fit the lesson or where two NQTs teach in the same classroom is not an easy option. Consequently it was used in classrooms where teachers tended to move least in lessons or where NQTs were not likely to move the kit themselves.

The Olympus ME-30W Conference Kit was used in four of the five participating schools, and consisted of a pair of good quality omni-directional microphones. This kit is specifically designed for conference recording, and has a wide area of coverage with good quality voice pick-up. The Sony WCS 999 - Wireless microphone system was tested as a low cost, flexible alternative. The set consists of a microphone/transmitter that could be used where there was a suspended ceiling (so the lead could be hidden in the ceiling cavity) or as lapel microphone, and receiver unit. Both uses required batteries, and would need to be individually switched on, to operate. This later kit was used in only one school, the primary setting, as the year one class NQT moved continually and was rarely in one place.

To ensure the NQTs were fully involved issues were discussed with them and they made guided choice concerning web cams and microphones used. Initially unsure of the lapel microphone the NQT used it for a period before switching it on and soon got used to the microphone and was less intimidated by its presence.

Software

A number of changes made to the software were designed to empower the NQT involved, for example the ability of the video owner to delete video from the viewing page. It was anticipated that NQTs would want to carry out 'test' recordings and that they would not wish this to be viewed. This facility also allowed NQT to remove videos where they felt the lesson had not reached an acceptable level.

The software only allowed the NQT to invite selected viewers to each video which meant some videos could remain private to the NQT themselves, whilst some could be shared. Viewers themselves were not able to invite additional participants to view the videos. This meant the NQT was in control of the whole process and they were aware who had access to view the video online.

As the software was designed to be used by NQTs as a professional development tool the ability to select, tag and annotate video clips was added.   It was anticipated that professional educators would wish to highlight areas of practice. The ability to annotate enabled the viewer to 'collect' clips as examples of good or bad practice, comment on these clips and save them for the NQT. The NQT could add their thoughts and understandings to the comments. Thus an online dialogue could develop between two or more parties who had viewed the video. In addition the NQT could themselves 'collect' clips which demonstrated strength or weakness to view at a later date, to compare over time etc. Each video, and their associated comments, were time stamped to ensure the collected clips could provide a comparison over time

As this was a professional tool there was no facility for anonymous comments.

Testing the Software

Considerations: Technology

In developing the new technology platform upon several challenges were identified and addressed. These are all documented below.

Updating of the software

During the development period a decision was taken to upgrade the version of Ubuntu running on the PC (LRS) to the most recent version, 10.10. In doing this issues arose relating to the recording of audio[9].

To function efficiently software needs to be updated and, as seen, this can cause issues and loose momentum when updating results in unpredicted changes.

Configuring for HTTP Proxies

It was realised that any system placed within a school would likely have to negotiate with a HTTP proxy device or service in order to communicate with the Central Server (for example during user authentication or the upload of recordings).

A configuration file was created upon the PC within which the details of any HTTP proxy could be entered and would affect all outward-bound HTTP connections made by the application. This was a successful strategy.

Fixed IP

In order to gain access to the recording interface on the PC (LRS) the NQT would need to enter into a web-browser address bar the IP number (as assigned by network manager) allocated to the provided wireless router (see Hardware).

It was early realised that IP numbers would prove hard to remember, and therefore during set-up the project team recommended that a web-page shortcut should be placed upon the Desktop (or an another memorable location) on all machines through which recording functions might be accessed. This enabled NQTs to easily locate the web page for recording.

Lights on cameras

Both the cameras used had bright activity lights (that show when the camera is working) on forward facing surfaces. It was suggested that these lights be taped over to enable students to accept the presence of the cameras without reacting, or acting differently, when a camera light showed the camera was active. All school followed this advice and taped over lights. This worked well and would be recommended in any future camera installations with forward facing recording lights.

Power (and other) cables

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[9] Research highlighted that in transition between Ubuntu version 10.04 (the previous version) and the latest operating system, subtle but significant changes had been introduces relating to how audio hardware would be represented within the Ubuntu Linux file system. This in turn would impact how audio recording would need to be undertaken. Specifically, two issues arose and were dealt with:

In version 10.10, the filesystem representation of the audio-in device (as previously used to inform FFMpeg of the location of line-in, from which to record), previously found at '/dev/dsp' was no longer present. Instead hardware would need to be accessed directly using the address hw0.

Although now correctly addressed, it was noted that the line level signal was muted. In order to address this it was realised that Alsa-utils (and in particular the command line alsamixer utility) could be used to increase signal levels

Despite using wirelessly networked IP cameras in many classrooms, every camera still needed a wired power cable to be attached. Further, both the Logitech web cameras and Olympus microphone kit would connect to the PC via USB and audio leads respectively.

In order to ensure that the widest range of freedom would be afforded during the positioning of these pieces of equipment, a range of extension leads were used in each school. Health and safety requirements meant that care needed to be taken when using the extension leads. Trailing wires had to be avoided and this limited the flexibility of the equipment.

Positioning of equipment

The positioning of cameras and microphones was completed through discussion with the NQTs in most cases. In securing the pieces of equipment in the best locations a range of fasteners had to be used, including: pull ties; self-adhesive plastic hooks; tie-wraps; drawing pins; and large flexible foam/rubber bend-bars. These fasteners made the equipment less discrete and also limited locations of the equipment.

Signal strength, data throughput and network latency

As found in phase 1 steaming video is network intensive. Several tests were run across a wireless network to ascertain optimal settings for the wireless cameras. The wireless cameras chosen universally provided Mjpeg output streams and as a result this was chosen as the default stream that the PC (LRS) would look for and record.

Testing showed that correct configuring the Mjpeg output of each camera would allow for two simultaneous streams (one from each of two wireless cameras) to traverse the wireless network and remain of sufficient quality to be recorded upon the PC via the FFMpeg application. The settings chosen were 15fps at 320 by 240.

It was anticipated that using a dedicated wireless network (rather than relying upon a contended school network) would minimise network latency and slow-down. This provide to be the case.

Media encoding overhead

Testing proved that the relatively modestly specified PC would be capable of encoding two video streams at a minimum of 320x280 pixel resolution at 15fps delivered via an Mjpeg based IP stream, or locally via connected web-cam and the video4linux device driver, simultaneously alongside recording audio from the local audio-in port.

This was important because the specification was price dependant; as the modest specification proved adequate the project was able to keep costs down.

Upload time and continuity

In order to minimise impact upon the local school network, the system was designed to first record all AV files to the PC and upload the recorded files later to the Central Server (in a compressed format), at a time provided by the network manager. Files would be uploaded at this time every day.

By default the system was designed to upload new recordings at 11pm each day. Should any problems occur, they would be detected and further attempts would be made at 12pm, 1am and 2am.

Most schools kept the default timing and there were no complaints or concerns expressed, unlike in phase 1, regarding impact of the project on the school network.

Security and Remote administration

In order to ensure the integrity of the systems deployed, extensive use of https was used to encode http transactions between user and system, and system component to system component (for example transmission of passwords and upload of video).

SSH would be used to allow for remote administration, at the discretion of the network manager. Log in credentials were also given to local IT teams to allow access to all delivered hardware components (where applicable), so that those teams could implement and maintain their own internal security audit should they so wish. This was to give the network manager confidence in the system installed and ensure they felt they had some control on the project kit which was, after all, on their school network.

Minimising configuration

In order to minimise time spent within schools, and to allow for speedy installation, equipment (where possible) was supplied pre-configured and remote-administrable by the project technical manager (subject to alteration by the network manager as outlined under "Security and Remote administration", above).

Research Methods

The effectiveness of the system was established by collecting data in a number of ways:

- questionnaires completed by involved NQTs at project completion;

- interviews with NQTs and professionals in each school responsible for the NQT programme;

- an examination of email correspondence with those directly involved in the project, including network managers;

- Data was collected from the project database.

The quantitative data collected from the project database enable the triangulation of the interview data which was collected qualitatively.

The questionnaires were semi-structured and sent to participating NQTs via private email. Email was the main means of communicating with the NQTs during the life time of the project and an email 'group' of all NQTs was set up for general project discussion and communication. Although most emails from NQTs did not use the email group the policy on the part of the project team was to email responses to the whole group where ever it was appropriate.

The questionnaire were designed to establish how the NQTs used the system.

Interviews with NQTs were face to face in four of the five schools and via telephone in school five. Three of the five interviews with those responsible for the NQT programme were via telephone as they were not available on the day of the school visit. Interviews were informal and unstructured. The basis of the interviews was to develop a friendly, casual approach which sought to understand any change in professional practice which had taken place during use of the system, rather than how often or how the system was used.

In addition the interviews collected information on how the hardware performed and asked NQTs for their suggestions for software and hardware modification.

Data collected from the database was designed to provide a check against answers to the questionnaire. Although the NQT could delete recordings made the record remained on the database as an item. This meant that data collected via the database included;

- number of recordings made and deleted

- number of recordings made remaining

- number of recordings shared and number they are shared with

- number of comments

- number of clips saved

This data proved valuable and insightful in gaining a developed understanding of how the NQTs used the system both initially and as time progressed.

Effectiveness of the System Developed

The aim of the project was to provide easily usable software and easily installed hardware at a cost affordable to every school. Although there are propriety systems available to allow teachers to record lessons in one room and observe synchronously in another room these are costly (around £20,000 per system) and do not allow remote or asynchronous viewing.

These systems are designed mainly for assessment, to enable an assessor to assess a teacher without their physical presence distorting the classroom activity. The system developed for this project could be used for this purpose but was designed to be much more than a blunt assessment tool. **The aim was to create a professional development tool, that could eventually be used by all teachers to self-critique and reflect on their own practice, as well as share that practice with others, within their school, nationally and even internationally.**

Cost

Cost was an important factor when considering what equipment to use for this project. The costs are documented in appendix 4. As will other ICT projects a cycle of continual improvement of equipment would not necessarily increase costs; typically ICT equipment costs tend to reduce over time. In the case of cameras and microphones used in this project it should be expected that cost would fall whilst quality would improve.

Developing a truly flexible system should be possible within a short period of time, as devices (for example the iPod Touch) which can process and display AV files become ubiquitous and affordable.

Professional Development

Eight NQTs from five schools took part in this project. There was little difference in the use of the system for NQT in different geographical locations or teaching differing age groups. Where differences were found they are stated in below. The quotes are those of NQTs unless otherwise stated in the text.

All NQTs recorded video using the system and all stated they found the software easy to use,

> *"Actually it was much easier than I thought although I did keep forgetting to stop the recording"*

All NQTs did test recordings[10] and all bar one deleted their test recordings. The majority of the test recordings were obviously designed to check the equipment. Other deleted recordings included full lesson recordings. All bar one had been viewed before deleting. NQTs were asked why they deleted viewed recordings; the reasons stated are below with the number of times the reason was mentioned in brackets,

1. accidental full length recording which was designed as a test recording (1)

2. the lesson was not worth recording (3)

3. I chose not to keep the lesson (6)

4. there was a technical issue (4)

For all responses apart from 1., the reason was investigated further by follow-up questions.

Where 4. was stated, in the majority of cases, the NQT had either moved out of camera view or the audio had failed to pick up the lesson fully. In three of these cases the NQT subsequently moved the camera and/or the microphone to cover more fully the used classroom area. In one case the technical project manager needed to contact the network manager to solve the technical problem as the recording failed.

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[10] A test recording was defined as being under 5 minutes of video

Reasons 2. and 3. overlapped. In all cases where 2. was stated the NQTs felt the lesson had simply not been of sufficient quality to keep. They stated that either the class had been difficult or the lesson had not gone well. Two quotes made at interview below emphasis this,

"usually they are a good class but they were not interested in my lesson that day"

"I hadn't really planned well enough and it showed!"

Reason 3. elicited some interesting responses. One NQT stated,

"It's a difficult class but I really wanted to look more closely at what they did and how I responded. I know they make me cross a lot of the time and I miss a lot of what goes on in the lesson. I really wanted to see how the pupils were behaving when they thought I was not looking."

Questioned on why they did not want to share this video the NQT commented,

"Actually I might share a lesson with this class but not until I have got the measure of them"

The other five responses under this category demonstrated the same nervousness concerning sharing video and the feeling that the lessons were interesting to themselves but not to others,

"well it showed what I did wrong which was really interesting but I wouldn't want anyone else to see it (the lesson). I watched it three or four times and learnt masses but would I want someone else to see it ... well no!"

Asked what was learnt from reviewing the video a number of times the same NQT stated,

"I learnt it was as much about me as the class. I really don't enjoy teaching them but when I watched how I came into the class, my face and body movements, I thought no wonder they behave that way. I was all aggressive and loud and ready for trouble."

This last comment demonstrates the use of classroom observation as a tool for self-reflection and critique and was echoed time and again by six of the NQTs who stated that they;

"learnt such a lot from watching the class reactions"

"I saw myself as my pupils see me and this has helps me understand why they do some things."

"I never realised how much I let some students just get on with it"

All the above comments contain a strong element of critique and only two participating NQTs appear to have not had this experience. One of these is in a primary setting in a school where there is a stronger element of observation, for example she often shares a classroom and frequently has additional adults in the classroom (parents, visitors, teaching assistant etc) It could also be argued that year 1 children are more open and less likely to engage in 'under the radar' activities in the classroom.

Only two NQTs remotely shared the video with another individual. In both cases this was their mentor. These NQTs annotated the video before they shared it. Both NQTs viewed the video more than once before annotating it, which again demonstrates a reflective process in action. Neither of these NQTs saved video clips. Both these NQTs were in rural locations and saw their mentor irregularly due to the travel between schools. The mentor reported how useful the remote observation aspect was in allowing her to support her NQTs more effectively.

Five other NQTs shared video face to face, that is they sat at the computer with another individual and watched the video, stopping the frames and discussing it where it was felt necessary. Asked why this was the case four mentioned technological considerations, three stating that they were not confident their mentor had the technical skills to register, access the comments and video and one mentioning her own lack of technical skills. All NQTs and mentors felt this face to face viewing had been an extremely valuable experience and more useful than a physical classroom observation because,

"we have the video there and can continually review it so it acts as a prompt. Although I have my notes from the observation she (the NQT) does not always properly understand the point I am making but when she can actually see what I am getting at it makes such a difference!"

One NQT shared none of his video and was not fully engaged in the project. He was not selected by the school until later, missed the first briefing visit, was not present at the installation of the equipment and had just returned from paternity leave when the project started in the school. It is difficult to judge which of these factors was important but it is likely that all three contributed to his lack of involvement and his feedback stated that he was glad to have taken part and could see the gains but felt he had not had sufficient time to become fully engaged in the project.

Two NQTs at the same school saved a number of video clips as evidence for their NQT folders. Both felt this was a really good use of the system and expressed a wish that the system could be further developed to support this use.

One NQT was interested in lesson starters and collected a number of short recordings to compare and share with her mentor. This was a use of the software not anticipated by the project.

In their final feedback seven NQTs expressed regret that they had not had a longer period to use the software and understand fully its use. All referred to the pressure present during the NQT year mentioning their inability to take on activities which did not directly contribute to them passing the year. It is a sad reflection that even though participating NQTs recognised the value of the process they were engaged in during the project, because it was not officially something they needed to do it tended to be sidelined.

This lack of time was expressed by one NQT when they said,

"I somehow feel there has not been enough time to understand everything we could do (with this software). I keep thinking of ways I could use it and then think .. well I don't have time to try that"

Challenges

Wireless signals are unreliable

Through the course of the project it became apparent that wireless signals could not be relied upon to provide consistently "fast enough" operation. Interference, it is conjectured, could be attributed to unique radio-impeding aspects of each environment (despite clear unblocked line-of-sight between wireless camera and wireless access point/router), and interference from other competing radio devices within the vicinity.

As a result, wireless speed proved variable to the point of interfering with the transmission of video signals (resulting in loss of frames and slowdowns, discussed in greater depth below).

In schools where problems were observed, it was recommended that the cameras instead be connected directly to the wireless access point/router using standard cat 5e ethernet cables (not supplied).

Wired connections did not exhibit the same problems, however they did require the routing of cables around the teaching space which in turn limited the flexibility (in terms of re-positioning the equipment and of movement) available to the teacher within the space.

Hard to synchronise the start of recording

Due to unexpected network-slowdowns and latency between IP camera's and the Local Recording Server, videos from different sources (i.e. two different IP cameras) would begin recording at different times, resulting in recordings of different durations.

Although not addressed within this project, it is recommended that future iterations of the software should use the recording 'stop-time' to synchronise recordings as opposed to assuming start time is synchronised, as recordings across all streams could be terminated almost simultaneously.

Remote administration is hard and network managers are key

Although the intention was to involve network managers at the earliest stages and gain their 'buy in' for the project this did not in fact happen and so communication was difficult and developed slowly. This mattered as each school (and agents such as regional broadband consortia) maintains its own policies, and technologically enforced restrictions governing remote access to systems used within the school. Only the network manager can act as an intermediary between the broadband consortia, where they exist.

As school policies and the willingness of the network manager to allow an external machine onto the network varied the level of remote access available to the school based system differed between the schools. Only two of the five participating schools were able to arrange for remote access to the system for maintenance and observation:-

- WF Comprehensive was able to provide full external SSH access to the local recording server within the School.

- SN Academy was able to offer remote management by appointment using a 3rd party web-based service, "Logmein". In order to access the machine, it would first need to be unplugged and moved to a different location within the premises (thus the need for prior appointment).

As a result, when a technical issue arose, and certainly in the early stages of the project when the team were attempting to gain access to the PC installed in the school, remote-debugging proved hard to do, if not impossible. This resulted in more trips made to schools to address any issues raised. In turn this directly affected the speed at which the project could proceed.

Cannot rely on school infrastructure

Despite trying to minimise the systems reliance upon in-school IT infrastructure, the system would still be reliant upon a school network to pass data to and receive data from the Central Sharing Server. When this failed the willingness, or otherwise of the network manager to intervene varied between schools.

A mis-configuration of network equipment in one school rendered the system unusable for long periods of time (The Local Recording Server unable to connect to the Central Sharing Server to authenticate users, nor upload recordings).

Similar issues occurred within another school when the Local Recording Server could not consistently navigate the in-school HTTP proxy, resulting in a variable user experience (dropped connections and slow page load times).

The wrong video format

Mjpeg proved not to be the ideal format to use when recording video across unpredictable wireless (and other) networks.

Mjpeg, a stream of conjoined jpeg images-as-frames, acts much like the download of a continuously expanding file through a HTTP based network connection. As the file is downloaded new frames are appended to it at source, thus the file size is ever increasing and the download is continuous.

In theory, if 15 frames are appended to the file at source, and the network can support the transfer rates to download 15 frames worth of data per second, and the receiving machine can record 15 frames worth of data to disk per second then the download should be constant and predictable, and the resultant file will be received and recorded in real time.

Should however the network or receiving system experience a slowdown to the point that it cannot sustain that rate the download should be severed (the network stream is not sustainable with the back-up of data filling any intermediary network buffers), or will block with intervening data being lost.

Mjpeg does not contain timing data. Should 30 frames be send out from source over a 2 second period, and due to network slowdown the recipient receives only 15 of the frames over that period, the receiver will determine that to equal 1 second of video. One whole second would be lost.

This in turn causes problems in matching recorded audio (without network latency problems and thus of the expected length) to the shorter recorded video.School ethos

School ethos

Tensions arose in two schools taking part in the project. These tensions surrounded the control over the system given to the NQT and although care was take at the start of the project to explain that the project was about observation for self-reflection and critique rather than formal observation for the assessment, educational professionals at these schools were concerned that NQTs were able to delete videos without them being shared with anyone. In their view, a judgement about which lessons had not reached an acceptable level should be a management decision rather than an NQT one, since they were responsible for school standards. Furthermore they argued that NQTs needed to share video and accept constructive criticism to be able to learn from their mistakes.

This tension is essentially one of school ethos. Where the ethos is of trust and exchange the system worked well. Where professional development is very top-down, or that trust is very hesitant, the system was less helpful.

We do very much believe that this remote observation tool could be very effectively used to demonstrate and progress an NQT's professional development. This short trial confirmed our belief.

School location

As explained above, a large number of schools were approached to gain their involvement in this phase of the project with many reasons for their eventual non-involvement. Typically in this selection process the project lost city schools in close proximity to other schools.

Those schools most interested in taking part were in this project were rural schools. In the case of rural schools professionals involved in NQT development were most enthusiastic in using the system. The feeling expressed in feedback was that NQTs could be supported more effectively by a remote observation system; those struggling could be identified earlier and supported through difficulties rather than being lost to the profession. Early intervention was mentioned by both staff in rural schools.

NQTs willingness to participate and share

The difficultly recruiting NQTs for the project and their initial reluctance to participate indicated just how much observation had become a tool of assessment, rather than exchange and professional development, in the minds of young teachers. All participating NQTs expressed concern in the first meeting and needed reassurance that control of the system would be in their hands rather than their Head of Department, a member of the SMT or their mentor. This is a worrying finding from the project.

At initial conversation the project expressed the wish that NQTs would be willing to share video, not only with mentors but with each other. Given that NQTs covered the full teaching age range the classroom observation project offered them an opportunity to observe lessons conducted with differing age groups, an opportunity not many NQTs receive. An email group was set up so that NQTs could communicate with each other and had each others email addresses. The project philosophy was one of sharing and collaborating; all questions and responses were distributed to the whole group rather than to individuals. Despite this none of the NQTs shared their videos with each other. When asked why all mentioned time to get used to the system and unwillingness to be the first to share with others. There was little exisiting habit of exchange.

The project team would still maintain that encouraging NQTs to share with each other would be a valuable outcome of the developed system.

Duration of the project

This project took a long time to get schools and NQTs onboard and engaged. For an expereinced research team this took longer than expected and the team reflected that this indicated a significant change within schools. In short term activity, reflective practice appears to be increasingly "squeezed out" by a very direct focus on specific high stakes tests.

Had the project had a longer life cycle the project team are confident that NQTs would have used more aspects of the software and more sharing would have been observed given that in feedback most NQTs recognised the strengths of the developed classroom observation tool.

Flexibility of the system

Although the system was configured to be flexible, and some NQTs did move the cameras and microphones, moving all the kit from one classroom to another proved to be more difficult, time consuming and complicated than we would have wished. For the system to be useful to all teachers in schools it needs to be more easily moveable. This is possible but within this project's specific hardware configuration it is not the case. A flexible system could be developed but it is outside the parameters of this project.

Conclusions

Phase 2 of the classroom observation project has succeeded in installing hardware and software in five schools. The software was able to record and store video/audio clips and enables registered users to view, annotate, and tag clips. Annotations and tags are stored and can be viewed by other registered viewers of the video clip.

All NQTs have used the software to record video, although the use of other aspect of the software has been limited. The majority of NQTs have shared their video, however most of the video shared has been shared in a face to face environment rather than remotely or with other participating schools. Despite these caveats feedback from NQTs and their mentors has demonstrated that the system is effective in enabling NQTs to reflect and self-critique.

NQTs were all enthusiastic concerning the use of the system and had begun to understand its fuller possibilities. The system has encouraged experimentation of practice, indeed NQTs many had ideas for use of the software not considered by the development team, for example NQTs can record small parts of a lesson (lesson starters) to compare the value of a number of approaches. The equipment remains in the schools for their use.

Phase 2 of the project has moved from synchronous observation to asynchronous. Synchronous observation enables assessment. Using asynchronous communication has enabled the team to develop software that is better suited to reflection and self-critique, as well as avoid some of the technical issues encountered in phase 1. Using an asynchronous system, whereby the NQT could delete the video without sharing, has encouraged NQTs to take more risks in their use of the system. They have recorded lessons with classes they considered the most difficult. This has made the observation tool more valuable as it has enabled NQTs to reflect on their worst practice as well as their best. In addition two mentors reflected on how an asynchronous system could be used in a wider context; to demonstrate practice used by advanced skills teachers to NQTs, to show the effective use of differing classroom configurations, to demonstrate team teaching or large group teaching in practice. Both mentioned that the remote access facility would enable practice across geographical locations. Although they meant within the UK in fact the software could be used to facilitate international professional development projects.
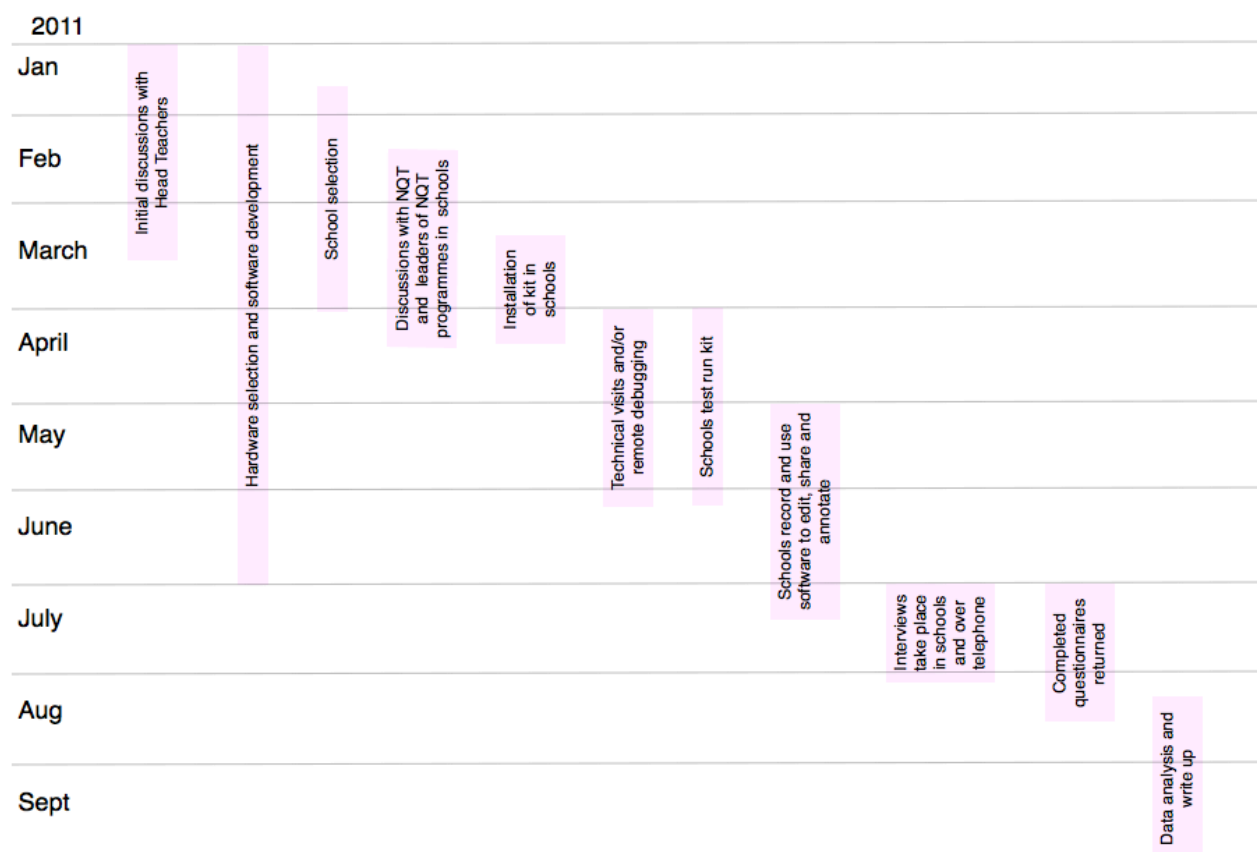
The costs of the hardware developed for the project is low enough to enable such a system to be purchased by all schools. It is recognised there is a need for a more easily portable system. This has not been developed for this phase of the project although the team recognise that such a system would be possible with a small increase in costs. A system whereby the video was recorded on site, the integrated cameras and microphones removed and the saved video uploaded from a portable device at a later date manually is possible and should be investigated. This would by-pass issues with the school networks encountered in this phase of the project and meet the needs of the schools.

The project has enabled the development of a classroom observation tool. Both the hardware and software have been tested and proved fit for purpose and robust. Many challenges identified have been overcome. NQTs have made good use of the software and the majority recognise the benefits of its use. However limiting this tool to NQTs would not exploit its full value.

The tool could and should be used for effective, affordable, remote continuous professional development; something valuable and much needed in a world where educational resources are finite and standards need to rise.

Appendix 1: Timeline

Phase 2 Timeline

2011	
Jan	
Feb	
March	
April	
May	
June	
July	
Aug	
Sept	

- Initial discussions with Head Teachers
- Hardware selection and software development
- School selection
- Discussions with NQT and leaders of NQT programmes in schools
- Installation of kit in schools
- Technical visits and/or remote debugging
- Schools test run kit
- Schools record and use software to edit, share and annotate
- Interviews take place in schools and over telephone
- Completed questionnaires returned
- Data analysis and write up

Appendix 2: Background to schools

GP School is in Wickford, Essex. Wickford is a commuter town serving London and its inhabitants are mainly white British.   The town itself has a population of only around 32,500 but it is close to large towns, Basildon, Pitsea, Southend. The Wickford area has 23 schools. The Grange currently has 311 mixed sex pupils on roll and is rated by OFSTED as good. The school caters for children from aged 4 to 11. The NQT teaches year 1 and has her own classroom. 30 children are in the class, seats being arranged around table clusters

D Middle School is one mile south of Bedford city centre and took part in phase one of this project. Pupils in D are aged from 9 to 13 years. The school has a small percentage of Asian students and has been subject to a considerable influx of East Europeans in recent years. There are currently 476 mixed sex pupils on roll. The school is rated as good by OFSTED. Two NQTs are taking part in the project. Both are English teachers who share the same classroom.   The classroom has desks arranged in rows and seats 30 pupils. Most of the classes have the maximum number of pupils in them.

WF C of E School is in a small rural village in Lincolnshire. Pupils are mainly white British. Three quarters of the pupils are bussed into the school. WF is a 11 to 18 mixed comprehensive school with 1,501 pupils on roll. There are two NQTs involved in the project, both teach maths and share the same classroom. The classroom is a traditional lay out with pupils seated in double desks. There are 26 desks in the classroom.

SN Academy is sponsored by a Foundation Trust. The Academy caters for mixed sex pupils aged 11 - 19. The school contains mainly white pupils. 1,340 pupils are on roll. The NQT is teaching in the science department, teaches all age groups and specialises in Biology. The Academy hope to move the kit during the recording stage to the Art department where they have an Art NQT who is keen to talk part in the project.

CH College is in Dartford near the Lakeside Shopping Complex. It is located on a new estate, near an old industrial area and although close to one of the main road systems into London most families whose children attend the school work in local industries including the car / car accessories industries located in or around Dagenham. CH Campus has over 50% pupils from ethnic backgrounds. The school caters for pupils aged 11 to 16, although the school is located on a campus, which also contains a nursery and primary school. From September 2011 the school will take pupils over 16 years, 815 pupils are on roll and the secondary school is rated outstanding by OFSTED with special credit being given to work related learning and business education. There are two NQT involved. Both are physicists who teach integrated science. The kit has been installed in a modern science lab with round tables.

Appendix 3: Software components

In developing phase 2 of the project application platform several ubiquitous open source technologies were used. These were:

PHP 5.3.2

Version: PHP 5.3.2-1ubuntu4.7 with Suhosin-Patch (cli) (built: Jan 12 2011 18:36:08)

PHP Hypertext Processor (a recursive acronym) is a scripting language primarily developed for use in creating dynamic web based applications. PHP would be used to create the various online components, triggering server based actions in response to operations submitted to a server (both the Local Recording Server and the Central Sharing Server) over http, returning an appropriate web-page response, and also in some cases via the CLI for reoccurring server based actions. Specifically, PHP would be used to to:-

Via HTTP:

Receive log in requests and either forward them via CURL to the Central Sharing Server, or interrogate MySQL locally to establish the authenticity of a user.

Initiate the recording of new clips (specifically recording from two video streams and one local audio stream), through issuing commands to local shell scripts (itself using FFMpeg to undertake the recordings).

Stopping the recording of a clip by calling a corresponding local shell script.

Receiving files uploaded overnight (or at any other nominated time) and storing them to disk for later processing.

Providing a personalised experience for logged in users, listing only those recorded clips for which the user has viewing and/or management privileges.

Upon receipt of a 'share-recording' request, add a new email to the outgoing Postfix mail queue addressed to the new participant. Further, accepting and adding a new participant to a clip (by creating a corresponding MySQL record linking the new participant to the correct recording record) upon the new participant clicking a unique link itself found in the sent email.

Respond to requests by a managing user to delete recordings under that users ownership. Such a request will result in the flagging of the corresponding recording database record for deletion, which in turn would stop the recording from being listed within a users personalised online view.

Provide a mechanism through which authorised users may comment upon a recording. Such a script would be responsible for creating new 'comment' records within a MySQL database (below).

Via the CLI:

Be called at timed intervals (using CRON) to check for newly uploaded, compressed recording-archives (an archive file, per recording, contains a meta file about that recording, and the recorded AV files themselves) and to go about extracting/expanding the archive. Thereafter the script would check the validity of the contents (checking the presence of the meta file and AV files, and the format of the meta file). Should all required information be present, the script would in turn create a database record of the newly received recording (see MySQL below), and trigger the conversion of the received clips, via FFMpeg (below), ready for web delivery.

Apache/2.2.14 (Ubuntu)

According to the June 2011 Web Server Survey (http://news.netcraft.com/archives/2011/06/07/june-2011-web-server-survey.html) the Apache web server is used to deliver the majority on web sites (64.88% of 346,004,403 web sites interrogated). Apache would be used to receive incoming http requests (mostly web page and file requests) and action an appropriate response (i.e. deliver the requested file or web page to the requester, or trigger the correct corresponding PHP action).

OpenSSL

Where required, http based interactions (i.e. submitting login-credentials; uploading recordings etc.) between user and server would be transmitted via https encoded connections. The OpenSSL toolkit would be used to achieve this.

MySQL 5.1.41

Version: MySQL Ver 14.14 Distrib 5.1.41, for debian-linux-gnu (i486) using readline 6.1

A MySQL database would be used upon the Central Sharing Server to maintain a record of valid users, along with information required to authenticate each user (username, password etc.); records pertaining to recordings made, themselves linked (via a many to many relationship) to the records of users whom have ownership of, or access to (i.e. via sharing) recordings that have been made; and records representing comments attached to recordings.

Data stored in the database would persist across browsing sessions and would be used (having been queried via SQL based instructions embedded within PHP constructs, above) to respond to web-based requests, populating each response with a personalised view specific to the action being taken and the currently logged in user. For example, should user X have previously have been authenticated having compared submitted credentials agains their counterparts found within a MySQL 'user' table, the only those recordings made by that user, or made available to that user (as per the recording_customer and recording tables) will be made visible to that user.

FFmpeg

Version: SVN-r0.5.1-4:0.5.1-1ubuntu1.1

"FFmpeg is a complete, cross-platform solution to record, convert and stream audio and video". FFMpeg would be used to record (on the Local Recording Server) Mjpeg based video streams as broadcast from network attached IP cameras and/or local attached web-cams (via the video4linux driver) to disk. Additionally it would also be used to capture incoming audio-in signals to disk. Such recordings would be made in response to requests received from pre-authentcated users (see PHP above).

FFmpeg would further be used to later convert recordings (upon the Central Sharing Server) in readiness for presentation through the playback web-interface (see PHP "via the CLI").

Flowplayer

Flowplayer is an open-source in-browser Flash/Javascript based AV playback interface, and would provide controls through which to start/stop/pause (etc.) the playback of recordings. Flowplayer was in turn modified so as to allow for two video's to be played back in a synchronised manner (one set of controls would start/stop both video feeds). Further, the Flowplayer API would be used to create a time-line based tagging system whereby authorised users could insert links into newly created comments, where those links would reference (and cause the Flowplayer based playback interface to skip to) a timestamped point within a recording. This would allow users to reference and talk about specific points within a video.

Ubuntu Linux

All of the above software components would operate on top of the underlaying Linux-based operating system, Ubuntu. The Local Recording Server would be deployed using Ubuntu 10.10. The Central Sharing Server would use Ubuntu 10.04.2 LTS. Ubuntu, itself derived from Debian, and as such would provide proven, good software installation and package management tools (apt-get) and command-line based remote management via Open-SSH.

Appendix 4: Equipment costs

Hardware is purchased at a moment in time and so costs are those experienced by the project at the time of purchase.

	Cost
School Hardware - option 1	
Sony Wireless Microphone x1	£78.55
TP Link PCI Adaptor x 2	£44.41
Edimax Wireless Camera x 2	£163.42
Pentium DC E5800 3.2GHz, 4GB RAM & Wireless PCI Card	£191.65
Tenda Wireless router	£10.40
Total	£488.43
School Hardware - option 2	
Olympus ME-30W Conference Kit x 1	£199.00
TP Link PCI Adaptor x 2	£44.41
Logitech Wired Camera x 2	£59.98
Pentium DC E5800 3.2GHz, 4GB RAM & Wireless PCI Card	£191.65
Tenda Wireless router	£10.40
Total	£505.44
All figures quoted here are minus VAT	

Other items were used during the equipment installation, for example bluetack and fasteners but these are not costed.

There were additional kit purchases but on testing this equipment was rejected for a number of reasons, the main one being that in classroom conditions the hardware did not provide adequate results.