From the physical classroom to the online classroom – providing tuition, revision and professional development in 16-19 education

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In recent years Mathematics in Education and Industry (MEI) has undertaken extensive work to develop techniques for utilising online classroom technologies to deliver tuition, revision and professional development in 16-19 education. Interaction using these technologies has involved tens of thousands of students and many hundreds of teachers.

In this paper a short background section on online learning will be presented, before discussion of how MEI has evolved its work to move from the 'physical' classroom for tuition, revision and professional development, to that of using online technology. An overview of feedback from online participants is then given. Techniques and strategies for utilising the technology are then discussed before final conclusions of the work are made.

Keywords: online, tuition, revision, CPD, 16-19.

Introduction

This discussion paper reports on how online classroom software has been used to support and, in some instances, replace the more traditional practice of teaching and learning via a 'physical' classroom. The online classroom has been used for tuition and revision of mathematics in 16-19 education within a national project, as well as for associated teacher professional development.

The work has been developed by Mathematics in Education and Industry (MEI) for their national Further Mathematics Support Programme (FMSP) project. The FMSP has existed since 2009 having followed on from the successful Further Mathematics Network that began in 2005. The primary aim of the FMSP is to give every student who could benefit from studying AS/A level Further Mathematics the opportunity to do so. The origins of the FMSP can be seen in Stripp (2010), though in the past few years the remit of the FMSP has continued to expand over and above those outlined for 2009. More recently Lee and Searle (2012) reported on an evaluation of the FMSP in respect of stimulating an increase in the uptake of Further Mathematics through a multifaceted approach.

In respect of the primary aim of the FMSP, data from the Joint Council for Qualifications shows that the uptake of A level Further Mathematics in England has increased from 5627 in 2005, to 13 821 in 2013. An even greater increase has been seen in AS level Further Mathematics entries, up from 5054 in 2005 to 22 601 in 2013.

What follows in this paper is a short background section on online learning that then leads into how MEI has evolved its work to move from the 'physical' classroom to that of using online technology. Feedback from online participants is then presented before techniques and strategies for utilising the technology are discussed. Final conclusions of the work are then made.

Background

Though there are numerous pieces of software that could be used to facilitate an online classroom, see Karabulut, and Correia (2008), the FMSP trialled Blackboard Collaborate's Elluminate software and subsequently took out a full license.

Elluminate is also the software used by the UK's largest distance-learning provider, the Open University. Mestel, Williams, Lowe and Arrowsmith (2011) detailed the main features of Elluminate, which include, but are not limited to:

> In addition to audio communication, there is a whiteboard with a wide selection of writing and drawing tools (including some very basic mathematical symbols), a text-chat area, a limited selection of emoticons and ticks/crosses for feedback, polling to facilitate whole class interaction, breakout rooms for small group discussions, webtours (taking the class on an internet journey), application and desktop sharing, file exchange, webcams and a recording facility. (2011: 1).

A screenshot of the Elluminate software once open and in use can be seen in Figure I. The main features of the software are also indicated.
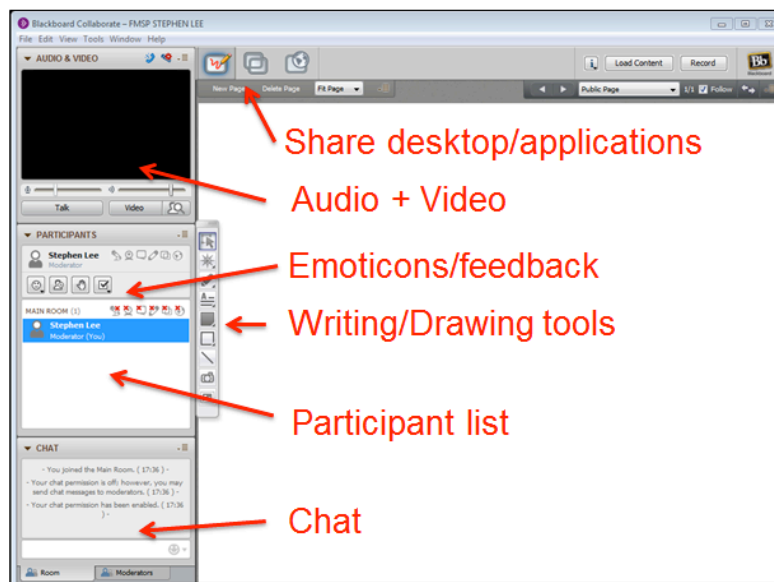

Figure I – Screenshot of Blackboard Collaborate's Elluminate software (version 12).

The 'physical classroom', where a lesson/lecture takes place both 'face-to-face' and 'live', and takes the form of "one person speaking, more or less continuously, to a group of people on a particular subject or theme", Fardon (2003: 701), has this widely accepted definition. The idea of an online classroom itself is also quite clear, but how one is used is less well defined. For example an 'e-lecture' was defined by Jadin, Gruber and Batinic (2012: 282) as "a media based lecture including (such things as) an audio or video recording, synchronised slides, table of contents and optional complementary information (e.g. external links)".

Trenholm, Alcock and Robinson (2012) undertook a comprehensive review of current research in the area of 'Mathematics lecturing in the digital age' and determined that an increasing amount of research has been done in the area in recent years. They also cite the widespread use of different terminology for this online teaching and learning: (in addition to e-lectures) "Other terms used are web-based, digital or online lecture, webcast, screencast, podcast or lecture case" (2012: 1).

The majority of this teaching/learning is occurring within Higher Education, though citations are also evident in Further Education to a lesser extent, e.g. Becta

(2005), Golden, McCrone, Walker and Rudd (2006). The work of the FMSP, specifically in respect to its tuition, lies somewhere between these two contexts – it takes place in a Further Education context and level, but the techniques are highly aligned to those practiced in Higher Education. This can be seen in subsequent sections.

From the physical classroom to the online classroom

Online technology, as described in the previous section, means that there are now more options than to simply deliver tuition, revision and professional development via a traditional 'physical' classroom. In this section detail is given of how MEI has developed its work to have online technologies complement, and in some cases replace, the more customary classroom approach.

Tuition

A key aspect of the work of the national FMSP is to be able to have the flexibility to meet the needs of a local situation. In respect of tuition of AS/A level Further Mathematics students, delivery options have been developed to include:

- Face-to-face tuition
- Live online tuition (LOT)
- A mixture of the two – Live interactive lectures for Further Mathematics (LIL FM)

The face-to-face tuition usually takes place either at a local school (possibly a student's own) or at a local university. Typically an external tutor delivers a weekly session to a small group of students. An extensive virtual learning environment of specific mathematics resources (called Integral) is made available to students and they are required to do an amount of self-study using Integral between sessions. Detail of the construction and pedagogy behind Integral was given by Lee and Browne (2011) and the precursor to Integral, the 'MEI Online Resources for Mathematics', by Button, Lee and Stripp (2008).

LOT is very similar in principle to the face-to-face tuition – students meet with an experienced tutor weekly and then use Integral to support their study – the only difference being that the tutoring takes place online, rather than in a physical classroom. Button and Lissaman (2011) and Lissaman, de Pomerai and Tripconey (2009) provided discussion of the pedagogy and practicalities of LOT.

LIL FM is a much more recent development and originates as a mechanism to also support teacher professional development. On a bi-weekly schedule, students participate in dedicated online 'lectures' one week, and have classes in their school with their own teacher on the alternate week. Materials are provided for the teacher, and students also have access to Integral. This is somewhat similar in style to what might be seen as standard university teaching, where a large class lecture is followed up with smaller problem/tutorial classes.

Revision

To aid students in their preparation for their mathematics AS/A level examinations the FMSP offers a national programme of 'physical' revision events across the country, as well as a comprehensive selection of live online revision sessions via Elluminate.

The physical days are either a half or full-day event covering a whole AS/A level module held at a university. In previous years, with over 100 such events taking

place across the country attendance might vary from relatively small numbers to several hundred students, as well as a number of teachers, at each event. The online revision sessions are one off, live events taking place in the early evening for 90-120 minutes. In 2011-12 70 sessions took place attracting a handful of students for the more specialised higher modules, to many hundreds for the required Core modules.

Professional Development

It is worth acknowledging that there isn't one widely accepted absolute definition of what professional development (also known as teacher development) is (Evans, 2002). However, we adopt the general definition cited by OECD (2009: 49): "Professional development is defined as activities that develop an individual's skills, knowledge, expertise and other characteristics as a teacher."

In the same way that FMSP tuition models have developed to include wholly 'physical' and wholly 'online', to a combination of both, so too have the models for providing teacher professional development. These courses fall into one of three categories:

- Face-to-face events
- Live online professional development courses (LOPD)
- Extended 15 month professional development courses, including study days/events and online sessions, e.g. Teaching Further Mathematics (TFM), Teaching Advanced Mathematics (TAM)

The face-to-face courses are usually one-day in length, held at a university, or suitable school/college and aim to improve teachers' subject knowledge and pedagogy skills. The day courses centre on either AS/A level module(s) or specific areas of interest, such as ICT software/hardware to aid mathematical teaching and learning. Consideration of integrating ICT into classroom mathematics teaching is becoming an area of greater interest recently (Tripconey, de Pomerai and Lee. 2013).

LOPD courses are either five hours (short course) or 10 hours (long course) in duration, with teachers meeting live online in Elluminate during the early evening on a weekly basis. Details of the practicalities, advantages and disadvantages of such professional development were considered by de Pomerai and Tripconey (2011).

Extended courses are 14-15 months in duration and teachers attend several 'physical' study days as well as online sessions. They receive email and online support, including having access to specific course materials in Integral.

Participation and feedback from the online classrooms

With the emergence of online classrooms and their integration into several areas of MEI's work, it is useful to gain a sense of just how many people are interacting with this technology. This section will give indication of the number of participants via MEI's work, as well as an outline of feedback received.

Participation

As a national project FMSP provision is extensive and so too is the uptake. Over 350 students a year now receive tuition wholly or in part online. There are around 3000-5000 students in total attending the live online revision events and 5000-7000 views of the recordings of the sessions each year. Over 1000 'teacher days' of professional development is undertaken, with more than 450 teachers per year now participating in

dedicated online courses (LOPD), or extended courses (TAM/TFM) that incorporate online professional development.

It is standard practice to request that students and teachers complete feedback after attendance at any FMSP event. With online provision this usually entails a short online survey. It is noted that this methodology is likely to induce a smaller response rate than say a paper based survey (Nulty, 2008), but in many instances (specifically the online revision events) it is one of the only ways to feasibly attempt to obtain feedback.

Feedback

At the time of writing comprehensive analysis is still being undertaken for events that occurred during the 2012-13 academic year, preliminary exploration indicates unanimously positive feedback in line with that seen in previous years.

Of the approximately 1800 feedback responses from the live online revision events between January 2011 to Summer 2013, 92.5% rated 'Excellent' or 'Good' for 'Quality of delivery' and 91.8% rated 'Excellent' or 'Good' for the 'Online classroom as a platform for delivering the session'. Relatively few found any aspects to be poor, with 92.6% of respondents indicating 'Yes' to 'Do you feel better prepared for your examination?' and 96.8% indicating 'Yes' to 'Would you recommend these sessions to other students?'.

Students who received tuition wholly or partly online were asked to complete an online survey about their experiences. The Likert scale of 'Poor/Adequate/Good/Excellent' produced an average response equivalent of between 'Good' and 'Excellent' for the questions with that scale.

A relatively high response rate to the online survey has been seen from teachers on the LOPD courses, with almost 60% of the approximately 200 teachers who undertook a LOPD course in 2012/13 having replied to date. Furthermore, 97.4% rated 'Excellent' or 'Good' the 'Online classroom as a platform for delivering the session', which is higher than the equivalent question for revision events detailed earlier.

Within the online survey, in addition to questions with answers placed on a Likert scale, there are some open questions about the tuition/revision/professional development. Many participants completed these and although it is impossible to reflect upon all of them in this paper, there are many positives identified by respondents, such as:

> Tutor makes the topic engaging and fun to learn. Presentations are detailed, rigorous and well-planned. Elluminate is an excellent platform upon which distance teaching/learning is done. (LOT)

> I find the online sessions really helpful as you can go over the recordings as many times as you want to make your understanding clear. (Revision)

> Spreading the content out over time gives you time to reflect on what they have taught you and put it into practice. At the same time you can use that experience and speak to the instructors about how it went. (LOPD)

> This format worked well for us allowing Further Mathematics to be introduced into college. (LIL FM)

> All the benefits of a CPD course without the hassle of missing time at school, or difficult and timewasting travel! (LOPD)

Emerging techniques and strategies when using online classrooms

In its most simple form when considering utilising online classroom software the question that should be asked is – what works best in the 'physical' classroom and how can this be transferred to the online classroom? Though there are some inherent limitations, careful consideration of the 'tools' available mean practice not necessarily available offline can also be used effectively online. In respect to this it is pertinent to note that more and more technology is being used in the physical classroom in schools and universities to engage students, e.g. interactive whiteboards (Higgins, Beauchamp and Miller, 2007) and electronic voting systems (King and Robinson, 2009).

The concept of being interactive with participants who are in the online classroom to engage them in the teaching and learning is a key technique that was commented upon in the feedback. Some techniques and strategies to enable this to happen within Elluminate are:

- Seek feedback/confirmation of understanding throughout a session via the emoticons/chatbox
- Run quick quizzes via polling, which is particularly helpful with large groups
- Ask participants to annotate the whiteboard, including using different colours and adding to pre-created templates
- Share applications that are used outside the online environment, e.g. Geogebra, Mathematica, Matlab
- Give participants time to think and to do mathematics. For example, use breakout rooms to create smaller groups or areas for individuals to work in
- Get participants to use the audio option, i.e. ask them to verbalise the mathematics and the tutor writes it down
- Put hyperlinks into the chatbox, (which makes them active links) to direct participants to other resources etc.
- Record sessions, so that they can be replayed by participants at their own pace

The choice of using one or several of these techniques should be determined in respect of the specific participants and the objective of each session, be it a small group of students receiving tuition, hundreds of students in a revision session or a group of teachers receiving professional development. This consideration is in agreement with Fuller's "customised delivery of content" (2009: 88), which referred to both the content of the session and the means by which the interaction was initiated.

It is the case however that using online software can cause some issues for both those initiating the session(s) and those attending, these can include:

- Internet/firewall connection issues
- Sound issues
- Off-task communication, i.e. using instant messaging/chat
- Time to familiarise with previously unused software

Conclusion

As familiarity and expertise in online classroom software has increased within the FMSP over recent years, new and interesting teaching and learning strategies have been created, trailed and implemented. Such developments have enabled tuition,

revision and professional development of mathematics in 16-19 education to be undertaken by students and teachers across the country, in situations where they wouldn't necessarily have been able to benefit. Even though there are some technical issues and limiting factors with online classroom software, the usefulness of the technology to facilitate teaching and learning opportunities much outweigh these in respect of the work of the FMSP.

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