

Designing a mixed mode Masters module in Science Education to support shared construction of knowledge and critical reflection

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ABSTRACT

Foundations of Science Education is a core module in the Masters in Science Education course. The main purpose of this module is to promote critical reflection in the main aspects of science education incorporating teaching, learning, philosophy and policy. This paper reports on the purpose and development of a mixed-mode (blended) course in which online discussions and tasks complement and extend face to face teaching and discussions. It discusses how the re-structured module is designed to support the construction of knowledge and critical review of that knowledge through the dimensions of shared practice. Most of the course participants are science educators, mainly London-based but with some international students, and the course draws on their growing theoretical knowledge in combination with shared experiences. In this paper we discuss the possibilities and constraints of the course design.

INTRODUCTION

This article reports on the introduction of an online component to an MA module, which has until now been wholly face to face. Taking into consideration the aims of the module and the pragmatic needs of the students, the purposes for introducing the technology are to promote critical reflection more effectively than hitherto and to provide increased flexibility of study.

Foundations in Science Education is a core module in the MA in Science Education course. Study of the module not only aims to provide systematic knowledge and critical awareness of the foundational aspects of science education in all phases of education but a grounding for further study in the MA course. Students on the course are explicitly encouraged to relate their developing theoretical understanding to their own professional context thereby promoting further reflection on practice.

WHY CHANGE THE PRESENT MODEL

Until autumn 2007 the *Foundations in Science Education* module had been run as a series of ten weekly face to face sessions, each session of three hours duration, comprising a variety of strategies such as presentations by the tutor, peer presentations, discussion of pre-session readings, follow-up tasks, seminars, group activities, feedback and consolidation work.

The advantages of such an approach are that the tutor presentations are a rich source of information and a valued opportunity for students to engage deeply in the subject matter. Group work tasks help students learn from each other and to scrutinize diverse experiences and arguments, throughout and beyond the module. Peer presentations offer opportunities for individual students to present their work to their peers, thereby enhancing their presentation skills and receiving immediate feedback through resulting discussions. Students of this module are generally experienced professionals and make important contributions both to the subject matter and the collaborative learning process. Face-to-face sessions facilitate this process and also augment informal learning relationships within the group, so essential for a community of practice (Wenger, 1998).

There are, however, pragmatic and cognitive aspects, which could be addressed and improved through the incorporation of a Virtual Learning Environment (VLE). Face to face sessions are mandatory and, while they run outside of typical teaching and office hours, some students cannot attend all the sessions because of parents' evenings, curriculum and exam board meetings, and for personal reasons. Part-time students at work often tire towards the end of the evening. Recent module evaluations suggest that the amount of lecturing is perceived as too much and can be addressed through reflective reading and individual study tasks. Finally, the module is based on printed learning materials, which may not always be flexible enough for this very mobile professional target audience.

PROMOTING CRITICAL REFLECTION

There have been obstacles in promoting critical reflection in the face-to-face format. Separate face-to-face sessions in the module built on, and complemented, each other in terms of content and skills, through set texts and guided post-session and pre-session questions but there was a lack of continuity. The hiatus in communication between weekly sessions made it difficult to develop lines of argument which were supposed to be threaded through the module. While the immediacy of group tasks, oral dialogue and discussion offer opportunities for critical exploration of diverse points of view and experiences, they lack the deeper collaborative reflection processes which online asynchronous exchanges might offer (Duffy & Cunningham, 1996). Rather than a model of separate and loosely linked sessions the module can then be thought of as a seamless web of interconnecting ideas.

The idea of an online platform, which could sustain discussions through the week, was appealing. Research suggests that the use of online forums can generate a type of discussion that gets beyond what is discussed in face-to-face formats, aid students in taking a more active role in their course, and promote deeper understanding (Althaus, 1997; Clawson et al., 2002). However, the following conditions needed to be taken into account.

- a) Sufficient time for participants to contribute. Many of the participants are full-time teachers and have relatively little time between sessions to contribute to online discussion. Discussion would be expected to incorporate readings reflected through learning and teaching experiences of the participants. Time would need to be made available to participants to read, structure their reflections through their professional

- knowledge, read other contributions and respond thoughtfully and courteously. (See figure 1)
- b) Commitment on behalf of the participants to contribute. If full, critical and open discussion is to be sustained from week to week then all participants need to contribute online and commit to continuous social and intellectual participation (Harasim, 2002). Online sessions bring the risk of non-participation, and Levine (2007, p. 71) warns that 'indications of nonparticipation can go unnoticed for quite some time'. Addressing non-participation can be difficult because learners report a variety of reasons for their behaviour (Anderson et al., 2005).
 - c) Online etiquette. For the majority of the participants this would be their first experience of online discussion and some would feel reluctance in 'showing themselves up'. Since this is the first module of the course the participants would not know each other well enough to feel confident that their online voice would be understood. Committing ideas to scrutiny from colleagues you do not know well can be a very daunting experience (Daly et al. 2006). Most participants live and work in London while others have come to study from overseas, mainly from West Africa, Singapore and the Asian sub-continent. Home-based participants need to be aware that they use language which is readily understood by everyone and they do not become too parochial in elaborating on their experiences. Such problems can be monitored easily in face-to-face discussions but are more difficult to handle in online discussion. One problem we occasionally come across in face-to-face discussion is conversation dominated by teachers in the secondary phase and there is a need to ensure that the smaller proportion of primary, further and higher education teachers have their voices heard. In addition participants need to be aware about tone in the online voice, equality of participation in terms of not dominating conversation, understanding that every participant has something to contribute and that points of view need to be acknowledged and treated respectfully. Nunes and McPherson (2006) mention such 'online social skills' and 'online etiquette' as skills that learners are expected to develop in order to succeed in the online learning environment. Conrad (2002) highlights how important such skills are, as they help the group deal with conflicts, orphan postings, varying levels of participation among learners, and the non-anonymous commitment to one's personal arguments and opinions. In face-to-face discussions the tutors and participants encourage open, honest, free and critical discussion and it would be important to sustain these attributes in the online format, not least to build social presence online, which Garrison, Anderson and Archer (2000) classify as a key pedagogic issue in computer-mediated conferencing.

These problems were addressed by

1. Substituting face-to-face sessions for online sessions by incorporating blended mode learning, the online sessions would be dedicated to enhancing critical reflection through discussion based on readings. The online mode appears to be particularly suitable for this task: Garrison (2006, p. 28) for example lists a number of studies which found that online discussions 'produced more important, justified and linked ideas' when compared with face-to-face interaction. Kim and Bonk (2002) came to a similar conclusion in their cross-cultural analysis of online collaboration. Face-to-face sessions will incorporate tasks which involve online participative exchanges monitored by the tutor. Participants will then have to submit their task online to their tutor during an online 'session' and they will receive feedback from the tutor by the beginning of the

following week. (An example is given in figure 1). The number of face-to-face sessions will be reduced in order to free up time for participants to work on the online tasks. Overall student workload should not increase, and the aims of the online tasks and the tutor monitoring are to enhance flexibility for the students, to build the group features of a community of practice and to stimulate critical reflection. The means by which this will be achieved are largely corresponding to the three typical definitions of blended learning, as reported by Graham (2006): the combination of instructional modalities, instructional methods, and online and face-to-face instruction, meaning a mixture of self-paced and directed learning, of teacher-led and peer-to-peer activities, and of text-based interaction and high fidelity face-to-face conversation (Graham, 2006).

2. For each online discussion two participants will be nominated to provide the opening contributions. It will be emphasized that participants had to draw on their own learning contexts and explain any local terms that referred to science education in England such as ‘GCSE’, ‘national tests’, ‘How Science Works’, parliamentary reports, e.g. from the House of Commons Science & Technology Committees..
3. The introductory session to the module is to be face-to-face but to incorporate an online component. The session is on the *Aims of Science Education* and includes a task where participants have to interpret a set of aims in the light of their own teaching and learning experiences. This session will take place in a computer suite where participants are able to communicate in an asynchronous online environment but can actually talk to each other at the same time. Participants’ digitized photographs will be taken and situated in a location on the online platform so they can be recognised. During this session participants are to be encouraged to devise a set of procedural rules for addressing each other and responding online.

A BLENDED LEARNING MODULE FOR FOUNDATIONS IN SCIENCE EDUCATION

Considering the factors and issues above, a ‘follow-up’ blended learning template was adopted (Jara and Mohamad, 2007). The ‘follow-up template’ has more face-to-face than distance components, and while the core learning activities are carried out in face-to-face class sessions, online learning activities serve as either preparatory or follow-up activities and should plug directly into the face-to-face activities. The main reason to use a VLE is to maintain communication and active engagement of students in-between sessions. (p. 13)

Jara and Mohamad (2007) particularly recommend this approach when students are working full time and when they ‘have a tendency to not carry out the tasks set between sessions as required, making face-to-face sessions more difficult to manage because of lack of student preparation’ (p. 14), which is particularly relevant for this module. One of the clear advantages of online sessions is to give participants the opportunity to mould their arguments deliberately, support, respond and critique each other in a more extended way than was possible in weekly face to face sessions while giving more time to read. This template is therefore regarded as highly relevant, and the authors’ recommendation of example online activities will serve as guidelines not only for the design of the online environment, but for the overall pedagogic strategy.

Thus, Figure 1 is the specific online activity participants were asked to do after the first session. This includes an activity which asks students to think about what are appropriate aims for science education informed by reading articles with highly contrasting viewpoints. Online discussion allows students to present any problems, queries or puzzles with the text for the consideration of other participants. Students then have to submit a short assignment to the tutor which summarises their ideas.

- Continue this discussion but you will also begin to formulate your own aims. You will need to read at least three more pieces, by Mike Golby, Derek Hodson and David Perks. You will find the Golby and Perks readings on Blackboard. The Hodson article can be accessed through e_journals. Further readings will help to elaborate your arguments.
- Carry on thinking and talking online and building up your ideas. The first exchanges could be your thoughts on the articles but you are free to present ideas and thoughts which are relevant.
- By the end of week 3 we want you to submit a short account online to me which can also incorporate or respond to any views online. Your account must include:
 - your own view of a just society (this need not necessarily be the U.K.: it can be another country or simply an ideal) (about 100 - 200 words)
 - a list of your three most important aims for science education in such a society (100 words);
 - a brief justification of your aims based on at least two readings which you should refer to (200 - 300 words)
 - predict at least two changes in your own field of education (e.g. primary, secondary, further, informal) giving a reason for each (100 words).

Figure 1: Online activity

Technology integration

We decided on an approach which is on a rather low level in terms of technology integration. This is mainly because of an anxiety towards technology on behalf of the tutoring team, and concerns about technical support capacity, especially as students were likely to engage with technology outside of standard office hours. The technology selection process was particularly guided by a wish to create a pedagogically sensible blend of face-to-face and non-face-to-face components.

Non-text delivery options, such as podcasts, were briefly discussed. A heavy reliance on such media was not regarded as appropriate, considering the module focus on production of critical texts. However, video-streaming from sources such as Teachers TV or videos of students' own practice were seen as a possibility for integration into the study of the module, particularly where some theoretical aspects of learning and language use could be exemplified through classroom practice.

As a consequence, we decided to go with the Institute of Education's standard VLE Blackboard, which we share as the Bloomsbury Learning Environment¹ with four other University of London colleges. The VLE has been enhanced in the past two years with more interactive and student-empowering tools based on comprehensive evaluations (IOE Learning Technologies Unit, internal report). From the available tools, we chose to use the built-in discussion boards, and to replace the standard announcement tool and the digital

¹ <http://www.ble.ac.uk>

drop box with multiple instances of a third party blog component, which would be configured differently: An announcement blog, for example, would not allow students to post blog articles, whereas a private drop box submission blog would only allow students to see their own articles and comments from the tutor.

We also decided to enhance the interface and make it more usable than Blackboard's standard interface, in order to represent the course appropriately and as accurately as possible in the VLE (Vogel & Oliver, 2005). This would need a technical workaround, including inserting CSS code, in order to create a 'module planner' as a central hub, from where all content and learning activity functions can be accessed. This module planner would take the form of a timetable/table of contents, listing all relevant sessions and providing access to all session materials. The planner would be produced by learning technologists, whereas tutors would be able to upload their session materials themselves.

Topic	Date	Tutor
Aims in Science Education	4 Oct	Ralph Levinson
Learning in Science	11 Oct	Shirley Simon
Aims in Science Education	18 Oct	Ralph Levinson
Learning in Science	25 Oct	Shirley Simon
Language in Science Education	1 Nov	Adrian Day
Historical and International Perspectives	8 Nov	Steven Chapman
Philosophical Aspects	15 Nov	Ralph Levinson & Jon Gurney
Philosophical Aspects	22 Nov	Ralph Levinson & Jon Gurney
Perspectives on Science Education	29 Nov	Michael Reiss
Coursework Review & Evaluation	6 Dec	Ralph Levinson

Figure 2: Module Planner

For the design of the overall pedagogy, the module leader developed a session template, which every session leader had to submit well in advance. This template, shown in Figure 2 organised subject background, pre- and post-session activities, resources and other information under defined headlines, thus ensuring both conformity across sessions and embedding a blended pedagogy: some of the pre- and post-session activities would be designed as collaborative or individual online tasks, and three sessions would even run wholly online and thus reduce the amount of required face-to-face attendance by about 30%.

Tutor development considerations

The main purpose of the online discussion component is to promote critical reflection on theory and practice. The tasks have been designed for this objective there is relatively little research to suggest how this might be achieved. While openness, truthfulness and constructive criticality (Bridges, 1979) are all desirable virtues of discussion, participants might be unwilling to critique arguments of their peers online. Experience on another Masters course for education professionals indicates that participants, especially teachers, tend to be over-supportive and that exchanges lack critical substance (Daly et al., 2007). Intercalated face to face and online sessions will allow tutors to draw out critical points from face to face group discussions and set more critically focused tasks for the next online session, thus promoting the development of critical, theoretically informed debating skills. This has implications for module design and strategy which have not been fully incorporated for this coming year. Tutors running face-to-face sessions following on from online sessions need to highlight some of the significant critical points which have emerged in the online discussion, and hold them up to further scrutiny in group discussions. Logistical constraints need to be taken into account because six tutors teach on the module. Tutors running the online session and the subsequent face to face session need to collaborate to ensure consensus on the important critical points, that strategies such as mind maps are used to raise points and promote further reflection in group discussion on any critical points raised and that these feed in to subsequent teaching. Therefore all tutors will be involved in the design of the module.

A further problem in online discussion is the role of the tutor. The main body of literature on online discussion highlights the importance of active, skilled tutor participation, and while evidence of higher-order learning with low levels of tutor engagement exists (Fox & MacKeogh, 2003), this pattern of engagement seems under-researched. However, experience of other online courses suggests that tutor intervention in a discussion, however well-focused, might not always be welcome. Students might be wary of making incorrect statements which are then picked up by the tutor and tutor comments might stanch discussion even when this approach might be purely facilitative and raise further questions. Furthermore, tutor involvement may negatively impact on the development of new student conceptions of 'the self-as-learner as an individual in relation to others' (Daly et al., 2006: 7), which according to Daly et al. supports community support, mutual respect and appreciation of one's own and other people's learning. A strategic decision has been taken that tutors will review the discussion neutrally only after it has finished and that they will not intervene in the discussion while it is active, with the aim of gathering exemplary data on a particular online discussion engagement pattern that is not highly represented in current literature. We will review this strategy once the module has been completed and evaluated.

There are nine tutors (including five part-time) on the course but only two, including the course leader, have experience with online tutoring of a Masters level course. Tutors will attend at least one staff development session, and they will be encouraged to attend those sessions provided by the Institute of Education's pathfinder project PREEL². Furthermore,

² <http://www.lkl.ac.uk/research/benchmarking>

it is not intended to design a fully online course, but to put the focus on using some moderate aspects of online technology to address the learning objectives more appropriately. Staff with online learning experience will take the lead in the design and implementation of online activities. Monitoring online discussions and responding to the tasks of individual students is likely to increase staff workload during the first year of the presentation of the blended mode as experience needs to be gained in responding to the requirements of the task. However, it is expected that the overall staff workload will not increase in subsequent years as staff will not have to teach so many face to face sessions.

NEXT STEPS

One of the advantages of the selected set of technologies is that they all are centrally provided and supported. While we acknowledge that this does not represent a major innovation in the e-learning field, the module team emphasised their preference to properly introduce e-learning into their module, based on research and other people's experiences, than to experiment with concepts and techniques for which there is no large body of local experience to draw on. This way, the module can be used as a model for other modules of the MA in Science Education and beyond to swiftly introduce technology components that bring real and measurable improvements in achieving the module aims.

A particular issue in our approach is a low level of tutor involvement during the online discussion phases. This approach is not very well documented in current research, and the prevailing opinion appears to favour a high level of tutor-student interaction in order to facilitate online discussion. Experiences from this module will therefore contribute to the understanding of the importance of tutor involvement, which may raise questions on resourcing online teaching. Initial comments from students collected during the presentation of the module suggest that students appreciated the blended mode, and that the online discussions contributed significantly to their learning, despite the low level of tutor involvement. These views are supported by quantitative indicators, such as the number and average length of discussion board messages, which show that significant online discussion took place.

More thorough answers to these issues can only be gained through a more comprehensive evaluation, which also addresses the process of learning particularly with regard to the promotion of critical reflection. For this purpose, three of the face to face sessions, which draw on and lead to the online sessions, were videoed as well as a final feedback meeting. We also have data of standard module feedback questionnaires, and we plan to analyse the online discussions for their interaction patterns and the final essay assignment for the depth of critical thinking. Our aim is to use this data to research how exchanges in whole class discussion, group discussion, online discussion and individual online tasks work as interconnected components in enhancing criticality and the enhanced social construction of knowledge.

We hope that the evaluation study will provide insight into the success of the blended presentation mode of this module and of the selected approaches of blended learning in general.

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