Using asynchronous discussion tools in engineering education

Conference or Workshop Item

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ABSTRACT

This paper considers a number of uses of asynchronous discussion in engineering education, highlighting the benefits to learners and the issues which need to be considered. The main context is the use of computer conferencing by distance learners of technology at the UK Open University. The paper focuses on two courses where computer conferencing has been used in different ways: for optional peer support; and for assessed group activities. A number of questions about the use of asynchronous discussion are considered in the light of experience from these two contexts. The paper also indicates where more research is needed, considers how this research might be carried out, and discusses the difficulties involved.

1. INTRODUCTION

Constructivist and collaborative models of learning focus attention on the processes of learning rather than on the content of what is taught. According to these models, learners support each other in building their own knowledge, rather than simply accepting information. In order to build knowledge, learners need tools; these learning tools should help students to do things, and to interact with each other (Jonassen, 1995). One example of a tool for learning is an asynchronous discussion system. This is a text-based communication tool which can support a variety of collaborative learning activities. For students of engineering, discussion tools provide a means of broadening their perspectives and exploring understanding with other students.

Asynchronous discussion has been used for many years in higher education, primarily in distance learning. Moreover with the increasing availability of Virtual Learning Environments (VLEs), many conventional institutions are now considering how they might use the discussion forums typically included in these systems. This paper will therefore present a number of uses of asynchronous discussion tools, highlighting the effects on learning, and the issues which need to be considered. The main context for these discussions will be technology courses at the UK Open University.

The paper considers a number of questions about the use of asynchronous discussion tools by distance learners of technology:

- What are students' reasons for participating, or not participating, in a discussion forum?
- Can students really learn from each other, or is tutor intervention essential?
- Can group work be carried out by student teams whose members never meet?

The paper explores possible answers to these questions. It also highlights areas where more research is needed, and considers how such research might be carried out.

2. COLLABORATIVE LEARNING FOR ENGINEERS

There are a number of motivations for using asynchronous discussion tools in engineering and technology courses:

Firstly, students of technical subjects can gain a better understanding through discussing problems. At a purely informal level, students can ask others for help in understanding a concept which they find difficult, or solving a particular problem. Other students are more than willing to respond to such requests, and the benefits are broad. The student who asks for help gains a different perspective - one which is from a peer rather than a teacher. Those who respond (and this is often more than one student) gain from sharing their own understanding in written form. Students who observe the dialogue benefit from seeing different kinds of explanations, and may gain help with problems they are experiencing themselves. Equally important are the effects on motivation and levels of confidence. If a student is struggling with difficult technical ideas, it is reassuring to discover that others are facing similar difficulties. If a student can also give help sometimes, this can be a real boost to morale.

Opportunities for discussion can also be used to broaden and contextualise a course. Engineers and technologists need to consider the role of their discipline in society, and peer group discussion can be useful for this purpose. Discussion helps students to see how their subject affects and is affected by social and cultural issues.

Asynchronous discussion also helps develop students' communication skills. Engineers need to communicate effectively with each other, with professionals from other disciplines and with members of the public. In discussion forums students of engineering can practice their skills in using words to convey ideas. Students also develop skills in electronic communication which they will need when using e-mail and other communication tools in the workplace.

One final and important reason for using discussion tools is to support group work. Every engineer needs skills in working as part of a team; but it can be difficult, even for campus-based students, to organise and carry out group work. Finding times for the group to get together is not easy, and this problem increases significantly for distance learners. Asynchronous discussion systems can help overcome this difficulty by enabling group members to communicate with each other when they are apart in terms of distance or time.

2. TOOLS FOR DIALOGUE

There are a number of tools which support asynchronous group discussion. Some of the earliest systems were bulletin boards, modelled on the idea of a shared notice-board. Mailing lists are another simple form of shared discussion. On the Internet, newsgroups serve the same purpose, as do a range of different web-based discussion forums. A number of universities, particularly distance learning institutions, use computer conferencing systems; these systems are specifically designed for group discussion, and include facilities for creating and following conversational 'threads' on different topics. Many universities now use the discussion forums provided by Virtual Learning Environments (VLEs), such as Blackboard (www.blackboard.com) or WebCT (www.webct.com).

Given the options described above, it is not particularly difficult for educators to provide asynchronous discussion facilities. What *is* more difficult is to use the facilities in a way which is educationally valuable. There is a temptation to simply

open a discussion forum for students and hope that positive learning outcomes will result. This is unlikely to be successful. Like any other aspect of a course, a discussion forum needs to be pedagogically designed. It needs to have a clear purpose which is known to students, and a structure which meets this purpose.

Because of the open-ended nature of discussion forums, it is sometimes thought that they are best suited to the arts and humanities. However, there are many examples of successful use in science, mathematics, technology and computer studies (see, for example, Hiltz, 1997 and Carswell, 2000). The UK Open University has used computer conferencing for students since 1988, when the CoSy conferencing system was first used in a course in information technology (Mason, 1989). The University currently uses the *FirstClass* computer conferencing system. The next section of this paper discusses the use of *FirstClass* in two Open University technology courses. The discussion will highlight the purposes for which conferencing is used, the method of use, and the issues which arise.

3. COMPUTER CONFERENCING FOR TECHNOLOGY STUDENTS

The UK Open University is a distance learning institution. Students of the University's Technology Faculty typically study an undergraduate degree part-time, while also working full-time. For a given course, each student is a member of a local tutorial group of around 20 students with one tutor. On most courses tutorials are held about every six weeks, but not all students attend. Students complete written assignments about once every five weeks, and these are marked by their tutor. Some courses also have multiple-choice assignments which are marked by computer. All courses culminate in an examination or some other form of end-of-course assessment.

Most Technology Faculty courses provide computer conferences for their students. In many cases the conferences are optional, and are provided for peer support. However some courses integrate computer conferencing more closely into the course, and include it as part of the course assessment strategy. In this paper examples will be given of these different approaches, as used in two technology courses: *T305 Digital Communications* and *T209 Information and Communication Technologies: People and Interactions*.

A. Peer support in T305 Digital Communications

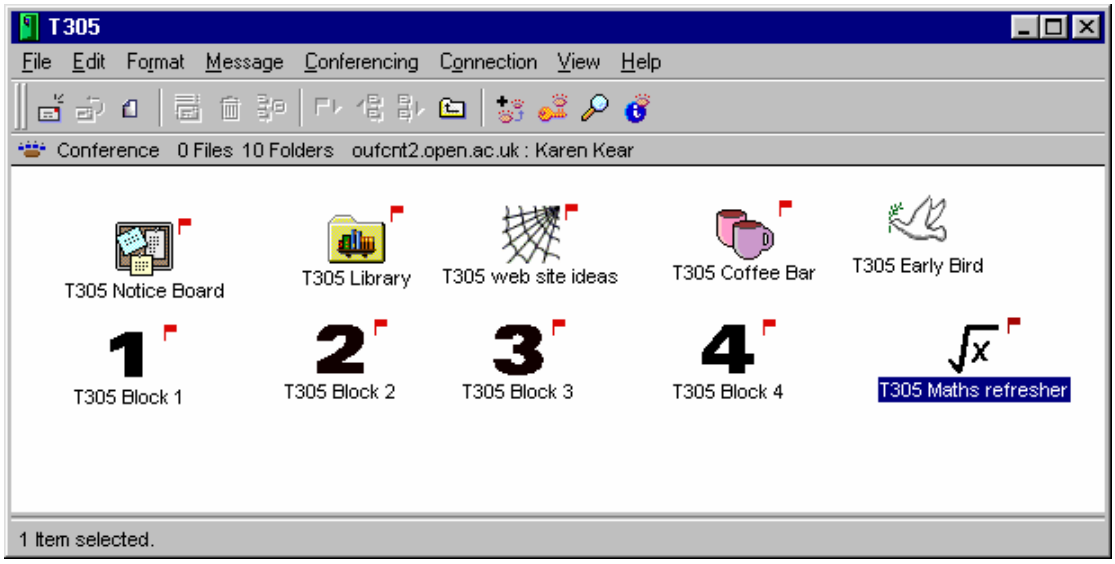
T305 is a level 3 course which was first presented in 1999 and attracts over 1000 students each year (Chapman, 2001). A suite of computer conferences is available to all students on the course. The purpose of these conferences is to allow students to support each other in their studies. The conferences are not a compulsory part of the course, but they are presented to students as a valuable resource, and are moderated (facilitated) by members of the course team.

1) Method of use

The course is organised as six sequential blocks; each block has a computer conference with sub-conferences for discussion of each assignment, and of the course CD-ROM. In addition to the block conferences there is a 'coffee bar' conference where students can socialize, a 'notice board' for announcements to students, a 'library for document delivery, a conference for maths support, and one where students can suggest useful web sites. Figure 1 illustrates the FirstClass conferences for T305, as seen by students on their computer screens when they have reached Block 4 of the

course. (The 'early bird' conference was for students to use before the course officially started.)

Figure 1. The T305 computer conferences



This suite of conferences has been carefully structured so that the purpose of each conference is clear to students. This helps to avoid a common problem with conferencing systems, where messages are put in the wrong place, and the resulting discussions become muddled and confusing. The use of a 'coffee bar' conference is particularly helpful in avoiding too many 'chat' messages in the other conferences.

Because the purpose of the conferences is peer support, the conference moderators try to let students help each other, rather than intervening straight away with 'the answer'. This approach has the added benefit of reducing the amount of time the moderator spends writing messages. Nevertheless, the workload is significant (up to an hour each week day) because it is necessary to read every message and judge when an intervention is needed.

It is clear from reading the conference messages that students are providing help and support for each other. There are many messages asking for explanations or advice. Almost without fail, these messages elicit one or more responses from other students offering help (or confirming that they have the same problem). For example, the response below was to a query about what happens when different parts of a computer network have different data rates.

> *Hi Stephen,*
>
> *Try looking at this like a road system. The FDDI ring is a motorway with a max speed of 100 mph and the LANs are the local roads where the max speed is 10 mph. When you drive a car down a local road you can't go at motorway speeds! Neither can you add together the various speed limits so that you can go faster! Remember also that the 'real' speed of a network is only as fast as its SLOWEST link.*
>
> *I hope that helps.*

Frequently the advice or information given by one or two students is sufficient to help the enquirer, and the discussion thread stops at that point. Sometimes, when the enquiry relates to a difficult concept or problem, a longer discussion ensues, involving

a number of students who each contribute their own understanding. Such dialogues are rewarding for both learners and teachers; often there is evidence of real knowledge building among the students. Occasionally the discussion is misleading, or goes round in circles, and then it is time for the moderator to intervene.

2) Issues

Given the apparent value of the peer support in these conferences, it is a pity that more students do not make use of them. The proportion of students who read the conferences varies during the course, but is typically around 70%. Those who do not use the conferences give their reason as lack of time (or that they think the time is better spent on other aspects of their studies). Only about 15% of students post messages to the conferences. The reason for this low figure is not clear, except that some students find that by the time they think about posting a message there already seem to be enough responses.

One interesting aspect of the conferences is that the 'atmosphere' in them is different each year, even when the structure, subject matter and moderator are the same. It appears that the tone of the conferences is highly dependent on the early contributions of certain students. For example, in the first year of the course, the Block 1 conferences had a very supportive atmosphere, but the equivalent conferences the following year contained a number of quite aggressive messages. This affected the atmosphere of the whole conference, with other students becoming annoyed and frustrated. Evidently even a computer conference on a technical subject quickly becomes a community with a unique character and style. Careful moderating is sometimes needed to maintain the community as a supportive and productive one.

B. Assessing collaborative work in T209 Information and Communication Technologies: People and Interactions

T209 is a level 2 course currently in its first year of presentation, with over 2000 students. The course consists of a sequence of self-contained modules on different topics. Each module has a suite of computer conferences open to all students and moderated by one of the authors of that module. The main purpose of these conferences, as in T305, is peer support. In addition, each tutorial group has a conference moderated by the tutor. These conferences provide opportunities for closer links between students in a smaller grouping, and support the relationship between tutors and their students. Computer conferencing is integrated into the assessment for the course. Conferencing is used to enable students to carry out collaborative work, in order to develop their skills and enhance their learning.

1) Method of use

The first item of assessed computer conferencing is in the assignment for Module 2 'Talking with your computer'. Students read two discussion papers about issues in speech interfaces, and then engage in a discussion in their tutorial group conference. As part of the module assignment, students are asked to submit copies of a number of their conference messages, together with a written summary of key points from the group discussion. They are assessed on the quality of their contributions and their summary. The conferencing activity helps students to become familiar with the FirstClass system, and to practice computer-mediated communication.

The assignment for Module 3 'Managing networks' makes use of the email facility in FirstClass, as well as the conferencing facilities. Students work in small project groups to carry out a network modelling activity. Each student acts as a node in a network, passing 'data packets' in the form of email messages to other nodes, in order to send a complete message. As well as contributing to students' understanding of networks protocols, this activity helps students get to know the other members of their group, in preparation for the group project in Module 4.

Module 4 'Cyborg' is based around this group project, which forms the module assignment. Students are each provided with a set of resources about the cyborg concept, delivered on CD-ROM. The topic of cyborgs was chosen because it exposes students to a range of different perspectives on technology, and requires them to deal with material from disciplines other than their own. The students' group task is to create a suite of HTML pages which explain the main ideas about cyborgs. Throughout the module the group communicates via its computer conference in order to plan and review the work. Students are assessed on the process of collaboration as well as the product. The tutor uses the content of the group conference to make this assessment. The group project in Module 4 is based on similar projects in earlier courses (Kear & Heap, 1999; Kear 1999). A novel feature, however, is a peer-assessment activity which forms part of the assignment. Students submit drafts of their pages to the group conference and review the drafts of other group members. Each student then makes improvements to their work based on the comments they have received. This is a difficult activity for distance learners as it requires careful coordination of their work, but there are significant opportunities for peer learning. The current presentation of T209 will reveal the balance between the problems and benefits for students.

2) Issues

Assessed collaborative activities are a challenge for distance learners. Students who are used to working independently and at their own pace can find it hard to adapt to group working. Part of the problem is the timing of collaborative work for students who have work and family commitments. Students who travel as part of their work have particular problems, so T209 students who have serious difficulties of this kind are permitted to undertake alternative assignments.

Another difficulty is that some students are unhappy for their marks to be dependent on others' inputs. In fact, in the T209 project, only 20% of the marks are allocated on a group basis. The remaining 80% are allocated for each student's individual work, personal contribution to the group, and reflections on the collaborative process. In any group project, each student is dependent on the commitment of other members of the group, and gaining this commitment is a challenge. For distance learners this is particularly so, because the face-to-face contact which can be used to encourage (or coerce) colleagues is largely missing.

4. QUESTIONS (AND ANSWERS?)

In the introduction to this paper a number of questions were posed about the use of asynchronous discussions in technology education. These are partly answered by experience from the two courses described in section 3.

- What are students' reasons for participating, or not participating, in a discussion forum ?

If discussion forums are optional, as in T305, many students will not take part in them. The main reason T305 students give for this non-participation is lack of time; they are put off by the need to read so many messages. The students who do participate say that they value the exchange of information with other students, the contribution to their own understanding, and the opportunity to share problems.

Of the students who do take part, most read messages, but do not write them. The exact reasons for this are not clear, though research from other courses indicates that some students are daunted by the apparent quality of others' contributions (Wegerif, 1998). The main reason given by T305 students is that there are already enough messages on a given topic.

If conferencing forms part of the course assessment, as in T209, most students will carry out the activities in order to fulfil the course requirements. One advantage of this approach is that students may discover the value of computer conferencing when they are 'forced' to do it as part of an assignment. Once students have seen the benefits and become familiar with the conferencing environment, they may then continue to use conferencing voluntarily.

- Can students really learn from each other, or is tutor intervention essential?

In T305, intervention from conference moderators is kept to a minimum; most of the help and guidance is provided by students to each other. This seems to be effective, though inputs from the moderator are needed if the discussions become confused or misleading. Students who use the conferences report that the input from other students is more important to them than input from staff.

In T209 and its predecessor courses, students carry out assessed work in small group conferences with no contribution from their tutors. Students can learn from each other through discussion, sharing of resources and giving feedback on each others' work. The group conferences from the earlier courses have shown evidence of peer learning and the development of communication and team-working skills.

- Can group work be carried out by student teams whose members never meet?

In T209 and earlier courses, students carry out a group project via computer conferencing. Often student teams try to organise a face-to-face meeting, but find that this is impossible, so they are obliged to carry out most or all of their communication in the group conference. The quality of work from such projects in the past has been reassuringly good. However, the process can be a struggle. The requirement to collaborate means that distance learners lose some of the flexibility which they have become used to (Thorpe, 1998). They are more restricted in their time schedules, and more dependent on the schedules of other students. For this reason, additional time should be allocated for the work, and preparatory activities planned to help the groups to 'form' (Tuckman, 1965).

5. METHODS FOR FURTHER RESEARCH

The examples of computer conferencing given in this paper have provided some answers to the questions posed. However, care must be taken when generalising from one context to another. There are many different ways of using asynchronous discussion, and it is not easy to predict what will work well for a particular course. For example, in T305 a hands-off approach to conference moderating was effective. However, many T305 students are in the final stages of their studies. Would less

experienced learners need more support from staff, or would a non-interventionist approach also work for them?

There are still many questions to be answered in relation to computer conferencing in education, and research needs to be carried out in order to address these questions. For example, one issue for institutions with large numbers of students is how large the conferences should be. In both the courses discussed in this paper there are national conferences open to all students. The disadvantages of very large conferences in terms of overload are obvious, and are acknowledged by students. Nevertheless, students seem to value, and even demand, such conferences. This could be because a significant 'critical mass' is needed for the conferences to be worthwhile to students.

In researching the issue of conference size, it would be useful to consider contexts where different conference sizes had been used. Although it would be difficult to compare actual learning gains, levels of participation and satisfaction among students could be investigated. Data on participation could be obtained from the conferencing system records or through questionnaires. Levels of satisfaction could be ascertained via questionnaires or interviews. With large numbers of students, as on Open University courses, questionnaires can provide statistically significant data. This method of obtaining data has been used for T305 in each year of its presentation, and some of the results have been quoted in this paper. To obtain richer and more in-depth data on students' perceptions of conferencing, interviews with students could also be carried out, either individually or in a group setting.

This is just one example of a research question in computer conferencing, together with possible research methods. Similar methods could be applied to a range of other questions. However, it must be born in mind that in an educational setting it is very difficult to isolate a single independent variable, such as conference size. If comparisons are made between different courses, many factors will differ. If comparisons are made from one year to the next, some factors will change - the course materials, the staff involved, or the technology available. Trying to maintain all these factors constant in order to carry out the research would be fruitless - and would also be unethical if the changes were known to be improvements for students.

A somewhat different approach is 'action research' (Lewin, 1948), where small changes are implemented and then evaluated, in a cycle of improvement. Action research in education is embedded in practice, and carried out by those who are directly involved in the teaching. This approach has been used for the development of improved contexts for group work in OU technology courses. Changes, such as forming project groups earlier in the course and requiring students to carry out preparatory collaborative work, have been made on the basis of experience from earlier years of each course and from other courses. This process has led to the current implementation of assessed group work in T209. Lessons from the first year of T209 will no doubt inform future developments in that course and in others.

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