Supporting the Collaborative Learning of Practical Skills with Computer-Mediated Communications Technology

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ABSTRACT
Based on a collaborative approach to learning, a student cohort taking an introductory level University course in computing was provided with information and asynchronous communications technology (including learning resources, e-mail, bulletin board and FAQ), as a means of enhancing their collaborative efforts on a web authoring exercise within a flexible learning environment. The qualitative investigative paradigm used was ‘action research’. By use of ethnographic techniques (questionnaires and focus group interviews), evidence was gained indicating that while a collaborative approach promoted improved learning, usage of computer-mediated communication technology and its contribution to collaboration was limited in an activity that was skills-oriented, requiring practical experience. Reasons for this are then discussed and a number of barriers to the take-up of communications technology are identified, and implications for educators are drawn from these.

Keywords
Computer-mediated communication, Flexible learning, Computer-supported collaborative learning, Action research, HTML authoring

Introduction
'People and Computers' is an undergraduate module provided for students by the School of Business and Management at Brunel University, London. It acts as an introductory module mainly for first year Computer Studies students, and for some Business Studies, Sports Science and Leisure Management students. It introduces students to the Internet and World Wide Web and covers aspects of web site design, HTML authoring and evaluation. It also teaches students how to use leading office applications. Until recently, besides researching and producing a business report using a word processor and spreadsheets, students taking the module were required to individually design, implement and document the development of a web site. The quality of the coursework varied considerably for this latter activity. We observed that many students who handed in poor work or who failed seemed to do so through lack of motivation and poor attendance. A specific factor that appeared to contribute to the poor work of some students was the technical nature of work related to web site construction. These students often found themselves being left behind due to the apparent complexity of the subject matter, and as a result gave up through frustration. To successfully construct a web site students need a conceptual understanding of how the Web works, and skills to use the authoring tools. Students with little or no experience of these elements of the module can find authoring on-line difficult to understand and a complex skill to learn. In addition, time restraints imposed by the timetable and the relatively large number of students attending lab sessions means that lecturers cannot always provide the levels of intensive face-to-face instruction desired by some students to learn these complex skills.

In the British context, Light et al. (1997) explain that increasing demands on lecturer time are due to "the rapid expansion in access to university level education with diminishing funding per student", and suggests that "underfunded expansion prejudices the viability of traditional modes of teaching and learning". Laurillard (1993) argues that British Universities must change to meet the financial pressures that they are under, but that "academic values, not accountancy, should guide the direction of reform". Sosabowski et al. (1998) also
highlight pressure from the Teaching Quality Assessment exercise and recommendations from the Dearing Report of 1997 as being other factors that are compelling change in Higher Education.

In an attempt to meet these pressures, many academics are beginning to use the Web for delivering learning material and the Internet for Computer-Mediated Communication (CMC) to foster collaboration (Crook, 1997; Light et al., 1997; McAteer et al., 1997; Sosabowski et al., 1998). Brahler et al. (2000) argue that "the combined effects of increased workloads, changing learner needs, and improved instructional technologies have resulted in increased demands for on-line learning material". Crook (1997) notes the potential of the Internet: students can search for disciplinary resources and lecturers can distribute teaching materials. To highlight the rising use of the Web for delivering learning material, Crook also explains that although such "initiatives are often accessible from within the author's own campus, the amount of activity that is world-readable suggests that disseminating hypertext lecture notes is an increasingly common practice among university academics". However, Crook also warns that a poor pedagogical model - the passive absorption of pre-packaged authoritative information - is being offered to students, and that a hypertext style of delivery does not use the full potential of the Internet. In fact, "the immediate concern is whether such developments in teaching practice are effective, practically and pedagogically" (McAteer et al., 1997).

Wolz et al. (1997) define CMC as "any form of interpersonal communication that uses some form of computer technology to transmit, store, annotate, or present information created by one or more participants". In support of its use for educational purposes, Kirkpatrick and McLaughlan (2000) argue that "advances in communications technologies have both increased the pressure for changes in education and made new modes of delivery possible". Taylor (1997) explains that a main consideration when deciding whether to use CMC technologies to assist teaching and learning is to ensure that they provide 'added value' to the learning: "CMC must offer something extra to the learning experience, rather than being used to reproduce text-based learning." In favour of the use of CMC, Wolz et al. (1997) argue that it can help to achieve fundamental educational objectives such as: focussing on active learning, placing the responsibility for learning with students, and encouraging peer review and teamwork.

In an attempt to address the difficulties some students were having, especially HTML authoring, we made a decision to adopt a more flexible approach to teaching and learning in which students would work together on an assignment. At a later stage, we extended this approach to learning by using Internet- and Web-based CMC to aid student collaboration, with Web-based learning material to support skills development. We tried to be careful, however, not simply to provide students with passive information sources, but rather to augment our traditional teaching practices, of lectures and lab sessions, with an integrated information and communication environment. The intention was to provide a supportive and flexible learning environment, with rich and positive feedback for the student, to enable learning to progress more effectively. Additionally, this approach was seen as a possible means of improving the quality of student work.

In order to develop a flexible learning approach of the sort envisaged and to evaluate its success, an on-going action research study was initiated. This involved the iterative design and evaluation of a flexible learning environment. Two iterations were conducted in which incremental changes were made to the existing student learning environment. Firstly, group assignment work was introduced, and secondly student collaboration was supported by the introduction of on-line learning material and CMC technology. These changes and the effect they had on the learning experience of the students are reported in this paper.

To design our flexible learning environment, we began examining the notion of flexible learning and associated concepts, such as distance learning, open learning and collaborative learning, to determine the required elements. To provide a conceptual background to this study it would be useful at this point to consider these learning approaches. Following this, the way in which CMC can aid collaborative learning is considered.

**Flexible Learning**

Varieties of learners exist in Universities today, with respectively different backgrounds and purposes for learning. The 12,000 students attending courses at Brunel University differ in terms of their experience and maturity (which is often associated with their age); in their ethnicity, nationality and mother tongue; in the number of hours a week they attend university (which is no longer simply part-time or full-time); in the distances they must travel to get to a campus; and in their initial skills (which may or may not be appropriate for the module being taught). Additionally students differ in their personal circumstances and obligations: many
students are now obliged to work a number of hours each week to finance their studies; others have familial and care responsibilities.

To ensure that universities meet the needs of such diverse learners more completely, teaching and learning strategies need to be adapted to make educational provision more flexible. Cooper (1996) uses the term *flexible learning* to describe an approach to the provision of education and training that is intended to make teaching more adaptable to the needs of different learners. To facilitate flexible learning, Cooper notes that a university should provide modularisation of courses, accreditation of prior learning, learning technology, open & distance learning, and collaborative learning. Thus, flexible learning is inclusive of, but is not restricted to, open and distance learning.

*Distance learning* or distance education are both established concepts whose routes go back to the pedagogy of Isaac Pitman (1813 - 1897) and his shorthand writing courses delivered by post to an international audience. Keegan's (1988) definition of distance learning includes six elements:

1. Separation of lecturer and learner,
2. Influence of an educational organisation,
3. Use of technical media to unite lecturer and learner,
4. Two-way communication,
5. Possibility of occasional meetings,
6. Participation in an 'industrialised' form of education.

*Open learning* is a term that is becoming increasingly popular in the UK. Like distance learning, it can include the notion of distance from the lecturer, but it also emphasises personal autonomy over studies (Kirkup & Jones, 1996).

*Collaborative learning*, on the other hand, involves various types of students working together on a given learning task, with the lecturer adopting an advisory role in each group. Hiltz and Turoff (1992) define collaborative learning as a learning process that emphasises group or cooperative effort among students. They further explain that it "stresses active participation and interaction on the part of both students and instructors". The focus therefore shifts from lectures to group coursework. In this way, collaborative learning brings students directly into contact with subject material instead of leaving them on the outside as passive observers, as sometimes happens in lectures with large numbers of students. So, instead of relying on simple memorisation skills, students must engage in higher-order thinking and enquire into a given problem with their peers in order to work out a variety of solutions or outcomes. There is now a large body of literature on the value of collaborative learning. Gokhale (1995), for example, describes how such an approach "enhances critical thinking of students by improving their ability to analyse and synthesise data and to evaluate concepts. Collaboration should play a central role in a flexible learning environment, resulting in students feeling a "part of the learning community so that their contributions subscribe to the common knowledge pool and [...] foster the community spirit" (Hartley, 1999).

**Computer-Mediated Communication as an Aid to Collaboration**

Internet-based CMC technology allows numerous people to communicate at a distance, and can be used asynchronously or synchronously. Asynchronous technology is normally text-based and there is a time gap between messages sent and responses received, so people cannot communicate at the same time. Hundreds, if not thousands, of people can join a discussion that lasts over several weeks or months. Furthermore, many different topics of discussion can be intertwined. Asynchronous technology includes email, listservers, and bulletin boards. Synchronous technology includes text-based on-line chat, and audio and video conferencing. With these technologies people communicate simultaneously, but only a handful can effectively converse at any one time, as otherwise discussions become fragmented and confusing.

McAteer et al. (1997) explain that within *distance education* CMC is "portrayed as an ideal means for providing opportunities for group discussion, student-centred interaction, and collaborative tasks". In a study conducted at the Open University by Wilson and Whitelock (1997) it was found that distance learners primarily used CMC technology for gaining a deeper understanding of subject knowledge, due to such collaborative activities as problem solving, revision and discussions. McAteer et al. (1997) add that it is also increasingly being used in traditional campus-based Higher Education classes. Light et al. (1997) argue that in such learning environments text based CMC "affords a possible means of providing for greater interaction between tutors and students, and between students themselves", because it encourages discussion due to the ability to quote and comment on the
statements of others. It is this potential for improved group work and learning, and the possibility that student participation throughout the course might be maintained that prompted our study. Text based asynchronous technology was chosen because it enables large groups of people to interact, discussions are captured and permanent, and it only requires low Internet bandwidth.

Research Methodology

The study of the impact of CMC on collaborative learning is complex, and one that would be imperfectly examined using quantitative research techniques. Traditional quantitative approaches and positivistic science have failed to fully describe and adequately explain the impact of computers on learning (Levine, 1990; Gunn, 1996). An established body of literature recommends the use of qualitative, naturalistic approaches when confronted with such complex problems (Maykut & Moorhouse, 1994; Hoepfl, 1997). The approach we have used to both design our flexible learning environment and to study its effectiveness is one of action research: this qualitative approach has been used fruitfully to study educational practice since the early 1950's (Kemmis, 1993).

Action research is a form of self-reflective enquiry, based on an iterative approach to research where ideas and solutions evolve over time. A study of this type is conducted by introducing changes into a known system, assessing and then explaining their effect. 'People and Computers' was an established module within the School when we began to teach it in the 2nd semester of 1996/97. In the following semester we introduced collaborative work, and as the module lecturers we were well placed to study its impact. A major criticism of the traditional scientific approach to research is that it is not situated in the ‘real world’. In line with a key tenet of educational action research we, as the lecturers, were participants in the learning environment itself.

Following a method propounded by Taylor (1994), with regard to action research, we first speculated about the problems within the existing learning environment, then we determined what action would be likely to generate improvements, and finally, we collected data to evaluate the effects of our actions and revised our initial understanding of the problem as a result. Two iterations of the study were conducted. The findings of the first, although only small in scale, helped to formulate the action for the second iteration. The findings from both will be presented here, with the second iteration forming the majority of the following discussion.

First Iteration - Collaborative Learning

The year-on-year increases in students taking 'People and Computers', combined with the overall complexity of skills and understanding required to complete the module successfully, meant that, according to our understanding, there was insufficient time to meet the learning needs of all our students. So in an attempt to solve this problem we decided to introduce collaborative working on the web site development activity in which some students were performing poorly.

The first iteration of the study was conducted in the 1st semester of 1997/98. 74 students took the module. These were split up into three separate groups for lectures and lab sessions, each with its own weekly morning slot. They were, as usual, mainly 18/19-year olds with a few mature students. There was an approximate 50:50 split of male to female students.

In common with the 15-week University semester, teaching provision for the module lasted 12 weeks, with the remaining three weeks given over to student assessment. The first five weeks attempted to lay down some of the theoretical underpinnings and technical practices associated with 'office' applications, including word processors, spreadsheet packages and email tools, and their societal and business contexts. Thus, by the end of Week 5, the cohort had gained a grounding in office software manipulation. Weeks 6 to 12 were then given over to Internet applications and the authoring of web sites. In Week 13 students were required to make demonstrations of their assignment work. This was then followed by a University exam timetable lasting two weeks to complete the semester.

In this 20-credit module was by way of two assignments that contributed 50% each to the final module mark. The module was held in a laboratory equipped with 25 PCs, one for each student. Each week's session lasted three hours, from 9.30 am to 12.30 pm, with a first period given over to an hour-long lecture. Students then attempted practical exercises related to the subject matter of the lecture, with support made available by the lecturer.
For the second assignment, presented to the cohort in Week 7, students were asked to build a fictional local authority web site that provided information on a variety of local services. To carry out this task, students self-selected themselves into groups with four or five members, though they were to report on the development of the web site on an individual basis for assessment purposes. The web sites were developed and submitted on-line, enabling them to be assessed on-line also. Each student was expected to contribute at least five interlinked web pages on a particular service, and produce an individual report concerning the design and implementation. It was emphasised that a conceptually-integrated web site that demonstrated a consistency of style should be produced by the group as a whole. This required technical, design and research skills. On the technical side, students needed to master HTML in order to construct web pages. From a design perspective, the web pages required a systematic presentation of information combining text and graphics. The research element of the task necessitated students finding relevant texts and graphics as content for their site. So, the intention was that students could share the skills they had learnt and help contribute to each other’s problem solving.

In our previous experience, students had expressed concern over the assessment of group work, when members of their group had not contributed significantly to a project. For this reason, an approach was taken up for ‘People and Computers’ where the consistency of the group’s design formed part of the assessment, rather than their ability to work together. Although students were expected to work in groups, their ability to do so was not formally assessed. Assessment was based on measuring the quality of their work in terms of individual effort, with premium marks being given for the consistency of their group’s web site as a whole. In this way, if a group member failed to contribute, there was no detrimental effect in terms of assessment on the rest of the group.

The results of this approach were evaluated by asking the students to consider in what ways and how well their groups had worked together and to report back on this. About two thirds of the students reported their group’s dynamics in sufficient detail to draw conclusions. 24 of these attested to the success of their group work, whereas 22 explained how their groups had failed to work together to any great extent.

The groups who attested to successful collaboration reported that they had met or communicated regularly. Taken together, the groups stated that they had collaborated by doing one or more of the following activities:

- discussing the coursework and sharing ideas;
- planning the work to be carried out;
- highlighting problems and finding solutions;
- sharing HTML authoring expertise;
- checking each other’s work.

For the groups that had failed to work together successfully, all problems were attributed to a breakdown in communication. Some students described how other members had missed meetings and/or had been uncooperative. They further explained that sometimes problems had arisen from the conflicting timetables of group members, making it difficult to organise meetings and work outside of timetabled sessions. On the whole, these students ended up completing the coursework individually or at best in pairs. According to one student, the amount of practical time allowed by timetabled sessions was insufficient.

These initial results highlighted a number of issues that needed to be investigated and they were used to formulate a plan for the next iteration of the action research study. It seemed that encouraging students to work together was not always enough to guarantee a high quality of work. Some part-time students called for a more flexible approach to learning, because on the occasions when they were unable to attend lectures they simply ended up studying alone mainly at home. These students missed vital lab work and had no obvious means by which to collaborate on assignments.

By considering the ways in which the successful groups were apparently working, along with the problems reported by the unsuccessful groups, we identified four conditions that must be present to foster collaboration, and thus to enable a learning community to develop. Students need easily to be able to:

1. maintain group dialogue
2. organise meetings
3. share knowledge
4. problem solve

It was decided that a way to ensure that these conditions were present in the learning environment was to provide students with a means to communicate with members of their group when face-to-face meetings were not possible. Thus, in the second iteration of this action research, the Internet and Web were explored as a means for
mediating collaborative learning. More extensive data gathering techniques were used to ensure that this action could be effectively evaluated.

**Second Iteration - Computer-Supported Collaborative Learning**

Group work normally requires that students meet face-to-face. This approach not only creates disadvantages for students who do not attend regularly, but also for students with busy schedules who are unable to meet with their group outside of timetabled sessions. Problems of this sort can lead to a breakdown in communication and collaboration. Attempts to encourage collaboration during the module were being impaired by students’ inability to form sustainable groups.

Despite this limitation, we decided to continue with a collaborative approach to learning because of the benefits it provided. At the same time, however, in order to counter the problem described, we decided to deploy asynchronous CMC technology so that dialogue should not necessarily be hindered by lack of physical proximity. Even though students had recourse to other communications tools such as fixed and mobile phones, it was felt that CMC provision would offer a significant means by which to collaborate.

The first iteration of the action research found that some groups had worked well together, but that others had found difficulty in continuing their collaborative dialogue outside of teaching sessions. These latter groups found difficulties in organising meetings, sharing knowledge and problem solving effectively. So for the next semester of study a computer-supported collaborative learning scheme using Internet and Web technologies was introduced to augment group coursework and classroom teaching. These on-line resources were centred on a syllabus containing hypertext links to locally-held lecture notes and useful teaching resources on the Internet, two assignment briefings (made live when the assignment was given out) and a series of practical exercises. Students were also expected to use email, and a Web-based bulletin board created for the module. The intention was that such a scheme would provide a framework for enriching classroom learning and that when established could be easily applied to distance learning courses being developed within the School. Again, as was the practice in the previous semester, students worked on the web development activity in self-selecting groups of 4 or 5.

The second iteration of the study was conducted in Semester 2 of academic year 1997/98. For this iteration, various ethnographic techniques were used to collect data so that a more detailed study could be conducted. This would also allow us to assess the validity of the findings. We intended to examine more closely whether collaboration aided the learning of web authoring skills and associated knowledge, and to determine whether CMC mitigated against the problems some students were having in their collaborative efforts.

This intensive data gathering exercise was mounted using 'entry' and 'exit' questionnaires, in Weeks 7 and 12 respectively, to assess the nature of their collaboration and their intended and actual use of CMC. A cohort of 75 students was expected to complete the questionnaires in hardcopy form; voluntarily 65 completed the entry questionnaire, and 60 completed the exit questionnaire. The questions asked were similar on both questionnaires, with the students predicting their intended practices in the entry questionnaire and actual practices in the exit questionnaire. Eight questions invited self-reports on practice relating to collaboration and the use CMC technology. A further four questions required the students to indicate preferences regarding collaborative learning and the use of CMC from a pre-defined list of options.

Additionally, three focus groups of five members each (one from each of the three classes taking the module) were recruited and interviewed during the study to provide in-depth reflection on student experience. A conscious effort was made to choose focus groups that reflected different levels of ability based on lecturer perception of students (using class observation and knowledge of previous assignment performance). At the outset we explained the purpose of the interviews in terms of the research exercise and informed them that contributions would not affect the way their assignments were assessed. We interviewed the three groups on a weekly basis using a semi-structured format, and all the sessions were recorded on tape. These interviews were used to shed light on the student experience with regard to the four conditions for collaborative learning identified above (maintaining group dialogue, organising meetings, sharing knowledge and problem solving). The questions put arose from the on-going interpretation of data obtained from the entry questionnaire, previous interviews and from observations made during the taught sessions. Discussions focused on the extent, nature and usefulness of collaboration and communication, and motivating and inhibitory factors. Student contributions were transcribed and interpreted through the identification of common themes into which all responses were categorised.
Finally, contributions to the bulletin boards were counted and categorised according to the four conditions.

**Overview of the Computer-Supported Collaborative Scheme**

A new web-based study guide (including syllabus and lecture notes) was introduced for the beginning of Semester 2 of 1997/98. Further information and communication technology was introduced for the beginning of the study period in Week 7 when the groups began work on their web sites. Additional web-based provision consisted of more extensive learning resources, an assignment briefing, a FAQ and practical lab exercises. CMC technology consisted of email and a bulletin board (though the previous student cohort had also had access to email). The combination of these resources was designed to support a flexible learning environment to enable the groups to discuss, develop and manage their coursework collaboratively.

During the Week 7 session, students were given a reprise of the available web-based resources for the module, and were then introduced to the new learning resources and CMC technology. Following explanation of their potential value to students on an individual and collaborative basis, students were shown how to access and use the new resources, especially the bulletin board. Each group was provided with a common area of workspace in which to develop their web site with the condition that they use this area as their ‘master site’ with regular updating. All groups were able to examine each other’s workspace using standard browser access.

Students were encouraged to use email to circulate ideas and organise themselves. In this way, the absence of students from meetings or practical sessions would not necessarily be critical as work could still be assigned and completed at a distance (given Internet access). The bulletin board was set up to allow students to post questions as they met problems. It was then open to fellow students or lecturers to post advice and solutions as answers to the questions. The view was that students would turn to this mechanism for help after they had exhausted other immediately available sources. Additionally, the content of the bulletin board was used as one source of material for the FAQ. So the FAQ was seen as an organised reference source, evolving in close parallel with the bulletin board.

Students were in a position therefore to seek out information sources and to collaborate using a variety of resources and CMC tools. In addition, besides meeting face-to-face, students could choose to communicate synchronously using their own mobile and fixed telephone resources. In this flexible learning environment it was intended that group work would gradually evolve, exploiting the various forms of CMC provided, to become an accessible learning resource for the benefit of all students. This approach would enable group members to examine each other’s work as it progressed, and be a contributing factor in ensuring that all students managed to complete the web building requirements necessary for assessment. Using the 'View ... Source' facility of the web browser, for example, fellow students could examine each other's HTML code. This had obvious implications for plagiarism and the security of work, but it was felt that, if anything, it would help to reduce plagiarism by bringing the development of web coursework into the open.

**Findings: Collaborative Learning**

An overwhelming majority of the study group felt that collaboration had helped improve the quality of their work. 55 of the 60 respondents in the exit questionnaire attested to this. Asked to detail the manner in which collaboration had improved the quality of their work, students cited ‘different ways of seeing things’, ‘working together and sharing ideas’, ‘discussion’, ‘bouncing ideas off each other’, and ‘problem-solving’, amongst other comments. In the exit questionnaire, students were asked who or what they would approach first when encountering problems: 44 respondents (73%) cited a fellow group member, 4 a lecturer, 6 a book, and 2 a fellow class member. Only one student in response to this question cited on-line resources. In the entry questionnaire, students indicated that they expected to be more reliant on the lecturer, with 13 saying that they would go there first for assistance.

When asked if collaboration had interfered with their work, only 5 respondents (8%) felt that it had. The principal reason for the interference was put down to ‘a clash of design ideas’. The interview data supported this view. During the interviews, most focus group students maintained they could not have completed their assignments without collaboration. For instance, one student said:
I found that when doing the web pages, if I needed help, I got advice. Without that advice I would probably still be hacking now. It was invaluable really.

A majority of the study group completing the exit questionnaire felt they had learnt something from their colleagues during their collaboration with 50 (83%) attesting to this. A student explained that:

When you are in the computer lab, if there is someone else who happened to be in there, sometimes when you are talking to these people you pick up new things you have not thought of.

In the responses to the questionnaire, two distinct areas of learning could be identified as the result of group collaboration: practical learning and reflective learning. Practical skills learned from other team members included HTML authoring and the downloading and saving of text and images from the Web. Apart from imparting general information and tips on the workings of HTML code, one useful aspect of such collaborative efforts was that students could help spot another’s typographical and syntactical errors - common problems for HTML novices. Nearly as prominent was the comment that collaboration brought with it a general broadening of views and the ability to reflect on the quality of their own work and others. These comments chime well with the work of Gokhale (1995) who argues that higher-level cognitive skills, such as critical evaluation, is enhanced through collaborative learning. Other students then pointed to the teamwork and communication skills learned through the need for collaboration in addition to the necessity of good communications.

<table>
<thead>
<tr>
<th>Amount of Collaboration</th>
<th>Number of students out of 60</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 hour</td>
<td>7</td>
</tr>
<tr>
<td>1 hour</td>
<td>7</td>
</tr>
<tr>
<td>2 hours</td>
<td>8</td>
</tr>
<tr>
<td>3 hours</td>
<td>16</td>
</tr>
<tr>
<td>More than 3 hours</td>
<td>11</td>
</tr>
</tbody>
</table>

Table 1. Amount of collaboration outside the scheduled teaching sessions

According to the questionnaire findings, 49 respondents (82%) claimed that they had managed to continue their collaboration outside scheduled module sessions. Of these 49, 7 respondents maintained that such extra-class collaboration was for short periods of less than 1 hour per week, taking place in the main during the coffee break. The majority however (42 respondents) reported that they had maintained their dialogue for at least an hour a week, and 11 respondents registered in excess of three hours (see table 1). Students who had reported difficulty in continuing their dialogue outside class were further questioned about whether this had been due to ‘distance’, ‘existing commitments’, ‘other factors’, or a combination of these. With the 18 respondents indicating that ‘distance’ created difficulties, most of their accompanying comments pointed to the fact that group members lived far apart. In common with Universities located in metropolitan areas, students are drawn on a daily basis from a wide geographical area. This was pursued further in the focus groups. Of the 15 students who were interviewed, only 4 lived less than 30 minutes travel away from the University, whereas 9 were required to travel anywhere between 1 to 2 hours to reach the campus (see Table 2).

<table>
<thead>
<tr>
<th>Time Spent Travelling</th>
<th>Number of students out of 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 15 mins</td>
<td>2</td>
</tr>
<tr>
<td>15 to 30 mins</td>
<td>2</td>
</tr>
<tr>
<td>30 mins to 1 hour</td>
<td>2</td>
</tr>
<tr>
<td>1 to 2 hours</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 2. Distance travelled to University by members of the focus groups.

The 22 respondents citing ‘existing commitments’ indicated that part-time jobs and clashing academic schedules created difficulties for them in continuing their collaborative dialogue. This was even more evident in the focus groups. Data indicated that two-thirds of those students interviewed worked in the evenings or at the weekend for an average of 12 hours a week. This is a significant amount if one considers that they were all registered as full-time students. This necessity cuts into the amount of time available for study, let alone collaborative activities such as these. The very flexibility of the modular degree scheme also meant that study schedules were many and varied, making the possibilities of meeting up with colleagues in the normal course of a day less likely. Finally, for the one sixth of respondents citing ‘other factors’, the most prominent replies pointed to the ‘unavailability of computers at home’ and ‘personality clashes’, as disrupting their collaborative dialogue outside of scheduled sessions.
Findings: Collaborative Learning and the Contribution of CMC

During the first week of their assignment work, the focus groups were asked how they intended to use CMC as a means of helping them collaborate outside scheduled sessions. On the whole, they were quite favourable towards its potential utility, and two of the focus groups agreed that they would be using email at the very least. They observed that CMC would help them improve communication and feedback, especially if they were to miss a scheduled session. One person believed that it would help their group to bond. Another intimated that it would be unlikely that they would use it very much because of a preference for face-to-face communication:

*Probably, as a group we will mostly use face-to-face communication, because we are all doing Sports Science. So we will actually see each other in other modules as well, and in the canteen we can sit down and have a little chat. It depends really. All of us are going to be pushed for time, and if we are in on different days we will have to use whichever one of the methods that is going to be the most appropriate.*

This student was a member of the third focus group, who were generally less keen on the use of CMC. He further stated:

*We are probably not going to use the technology fully, because there are parts of it we don't understand. So I don't think we are going to make the full benefit of it. We will probably use email and the telephone.*

Another member of this group pointed out that it was unlikely that they would use CMC because she was the only one of them with a computer and modem at home. She said:

*Those three, who live off-campus, have to come in to check their email, which is a bit of a problem. So we will have to telephone or use other forms of communication. I have a pager for instance.*

By the second and third week, the focus groups had not used CMC to any great extent. They were asked if there was anything that might make them use it. A common response was:

*As we get near to the assignment deadline, when we start finding problems, we will probably start communicating more.*

By the end of the study it was apparent that as a whole CMC was being used only to a limited extent, despite the fact that useful information was being placed on the bulletin board and FAQ by the lecturers to encourage such use. Three students admitted to posting questions to the bulletin board and then not returning to check the replies. Email was the only success even if only to a limited extent. Some saw its asynchronous communication potential. As one student observed:

*With face-to-face [communication] you have to be with the person there and then, so it’s a case of getting together, which is not always convenient.*

All students were asked to email each member of their group at the beginning of the exercise to establish contact. In the exit questionnaire 37 (62%) students indicated that they had indeed used email, especially for organising their collaboration. However, the focus groups indicated a less favourable view of its utility. Though they liked the fact that email was quite easy to use, that messages had permanence, and that unlike the telephone the receiver would always be available, two factors were repeatedly cited as major obstacles: the possible delay in getting a response and the fact that some people don’t read their email regularly. To illustrate the former, one student described how:

*With email you can’t really have a two-way conversation. If you were to do that, you would have to take the time to send one, then wait for the reply, then reply back and forth, and that could take days. It’s really the delay in the time it takes to get a response to your questions, and you don’t know if the other person has actually read your message or not.*

Four of the fifteen interviewed admitted to receiving emails but to not having read them. This highlights the second obstacle. One student made this comment:
To give you an example, Mandy has apparently sent me an email and whether I can't be bothered to go and read my mail, or what... (the fact is) I haven't gone and read it. I don't even know when it was sent.

The reason for limited use of email may be due to lack of access. One student pointed out that:

*students like us have no everyday access to email......sometimes we do not have a chance to get to a computer to check our email.*

She contrasted this with the situation for the lecturer, saying:

*they have access and can read their email every day.*

Another student elaborated on this by stating:

*You need the hardware and the software, which I haven't got. I haven't got a computer at home, so I can't log-on. I can only log-on at college... in which case I will most likely see one of this lot.*

With regard to collaboration, the focus groups described how they had met outside the organised sessions to work on their web sites together, especially towards the end of the study period. One student explained that his group had come together spontaneously in the computer lab on one of their ‘days off’. Although this meeting had not been arranged, the group had managed to complete most of their web site during it. Overall, email and other CMC was not seen as having great utility for the students as in the event most meetings had been set up in advance when groups were face-to-face. Moreover, students felt that much of the knowledge they had needed was most easily learnt by observing others and through spontaneous discussion. This perceived lack of need for CMC was confirmed by one student attesting to the value of learning by observation:

*Yes, it was invaluable to just sit next to someone inputting the codes. I seemed to learn a lot by just watching the way they were typing them in, and where they were being positioned, and looking at the changes that occurred in the pages. It was invaluable to actually be in the room at the same time.*

**Conclusions**

In summary, two findings are clear. Firstly, collaborative learning was seen to be an effective means of assuring the quality of assignment work and fostering the learning of web authoring skills. Strong feedback indicated that the majority of students completing their assignment tasks had taken responsibility for their own learning and had found the collaborative environment to offer a richer educative experience than doing so on an individual basis. This also had the effect of freeing up a lecturer's time. When group members encountered problems, in most instances they had turned first to their fellow group members for assistance before approaching a lecturer. So rather than having to explain basically the same points on a repeated basis to individual students, more attention could be devoted to those with basic conceptual problems.

Secondly, in contrast, the value of the contribution of CMC to the success of collaborative learning remained unproven. At the outset of the study many students had thought that CMC offered the potential to enhance collaboration. However, upon completion of the exercise, CMC had not been exploited to the extent originally envisaged. Part of the reason for this may be ascribed to the fact that many students did not have access to a computer at home, so they would only have had recourse to CMC technology when actually on campus.

However another reason that became apparent for not exploiting CMC in this study was the asynchronous nature of the technology in our flexible learning environment. The students felt that that the collaborative learning of HTML authoring skills and the discussion of issues and problems associated with building a web site were better undertaken when a continuous and unbroken learning dialogue could be maintained. The students did not see asynchronous CMC technology as meeting this need.

The need for email, and CMC in general, was negated by the fact that there was an apparent preference for face-to-face communication so that collaboration was more likely to be undertaken when students were in physical proximity, in which case they were in a position to meet up with one another (whether by accident or design).
Only email appeared to offer utility, though this was limited by and large to the organisation of meetings, as students asserted that it did not lend itself to maintaining a dialogue. Even though the bulletin board would have offered a more suitable means (to our understanding) of undertaking such a dialogue, the fact is that students failed to see its utility and did not use it. In the same manner, little use was made of the FAQ. As a result the sharing of knowledge and problem solving in their collaborative HTML authoring exercise was, in the main, undertaken through non-CMC means.

In a similar study, Crook (1997) found that students did not use email or bulletin boards to any great extent despite the fact that these forms of CMC were integrated with on-line lecture material. Another study by Boddy and Tickner (1999) restricted to email usage amongst a group of MBA students was equally disappointing, even though the authors took considerable care to prepare students for the exercise.

Additionally, for the second iteration of the study, students may already have established their own patterns of communication in the first semester. While this for some will have included email (but obviously not other forms of CMC introduced by this study), a level of inertia towards using alternative forms of communication may already have become prevalent. Then, the fact that the bulletin board and FAQ were introduced only in Week 7 of the second semester may have further contributed to the disappointing lack of CMC take up.

A final reason that may be advanced for the poor use of CMC in this study is that students lacked confidence and skills in using the technology. While some of their number had had little exposure to computer usage at school, others on the other hand had experienced the opposite. Nevertheless, few of the students will have used CMC technology extensively. It is notable though that the small number of students who did attempt to use CMC in any extensive manner did not receive equivalent levels of CMC response from their groups. This suggests perhaps that a critical mass of students using the technology is required for its usage to be profitable, a view echoed by Boddy and Tickner (1999).

Our findings also show that CMC did not militate against the problems some students had in collaborating. For those groups that exhibited a disinclination to work together, it may be unsurprising to observe that CMC would not combat this.

The problems summarised here can be categorised as technological barriers and pedagogical barriers. In terms of the former, projected increases in the use of technology mean that the lack of access to CMC at home, and the consequential lack of confidence in their use, will gradually be removed as barriers. Oncoming cohorts of students entering the British university system will increasingly see a variety of CMC technologies as part of everyday life, so in time one reason for the lack of CMC usage advanced in this study will no longer hold.

At the same time, to gain maximum utility of CMC, educators must counter any apparent pedagogical barriers. One lesson that this study demonstrates is that CMC should be integrated not just in on-line teaching material, but also in learning activities. Hartley (1999) argues that a structured set of curriculum tasks is necessary to encourage students to participate in on-line discussions. Although email and the bulletin board had been intended for use during the web site development activity, their use had not been tied to specific tasks. None of the practical lab exercises, for example, required such participation. Clearly this was a major contributory factor in the disappointing take up of the CMC in this study.

Various implications can be drawn for educators intending to use CMC to support the collaborative learning of skills. Even though an extensive CMC system may be provided for students, there is no guarantee that such provision will be exploited. Given that incoming cohorts of students display variegated levels of CMC exposure, in order to ensure that take-up conditions for CMC are optimal, introductory-level University modules should not only include practical exercises in their use, but ensure that such exercises are fully integrated into learning activities. This may necessitate that part of the assessment scheme is tied to the demonstration of CMC usage. Additionally, such usage should be encouraged from the outset of students' University careers (preferably during induction programmes) otherwise alternative patterns of communicative behaviour, picked up in the early stages of degree-level study, may create inertia in adopting other means of communication.

While collaborative learning can promote the learning of complex skills, such as HTML authoring, asynchronous forms of CMC appear unlikely to further this process in traditional University settings, where students have face-to-face opportunities to meet and demonstrate the workings of code. It is possible that more sophisticated and synchronous forms of CMC (including videoconferencing and whiteboard technologies) that also offer the visualisation of HTML bug fixing may meet the instantaneous discussion and problem solving needs that students desire. Further research will evaluate this.
References


