Designing within a computer-mediated-communications environment: a current investigation.

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Abstract

This paper describes ongoing research that is located within the context of the changing culture of the design classroom and the rapid growth in the exploitation of telecommunication networks on teaching and learning. The research investigates the use of ICT for international collaboration in the design classroom and the implications this might have for design curriculum development. Design education could benefit from the 'added value' of communication technology as could design students from being exposed to cross-cultural and international perspectives. If developing technology is to impact successfully on educational design practice then design teachers need to adopt a professional attitude towards the use of ICT while students will need to develop skills and abilities to deal with it for learning and research. Developments such as computer conferencing already offer alternative pathways for collaborative activities and group-to-group collaboration is now possible at a distance and encourages shared experience and co-operation. Incorporating aspects of this technology into design education could develop students’ cognitive abilities in making decisions, problem solving and being flexible in formulating ideas and handling information (Goodfellow & Kukulska-Holme, 1996).
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Introduction
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Late modernity requires openness of mind and a continual re-evaluation of assumptions and frameworks of knowledge. A critical design education could provide the reflexiveness that the complexity of modern society deserves. Although it may be uncomfortable for teachers, design students need to test ideas and themselves with critical evaluation in a collective environment. Design educators should provide an educational environment in which students acquire critical capacities not taught but won by the students. Consequently design educators should provide for a pedagogical environment that allows for epistemological space and personal space as well as practical space (Barnett, 1997). Critical perspectives need critical frameworks and so design educators should organise pedagogical practice that relates to contemporary design practice and the increasingly global world. Despite the growth in the use of computers within education over the recent past the large scale uptake of computer-based techniques for teaching and learning has only recently begun to occur. This research could contribute to the development of effective methods for incorporating ICT into future collaborative design group work projects. The introduction of ICT into the classroom could alter the pattern of design education. At the same time by introducing alternative sources of authority, via the Internet, and multiple frameworks of knowledge, through multi-disciplinary collaboration, it could enhance design students learning.

The research question
The results obtained from the first stages of this research indicate that the introduction of international collaboration into the design curriculum, bringing with it a global and multicultural perspective, motivates design students (Fraser, 2001). Computer mediated communication (CMC) by ‘collapsing’ space make international collaboration more feasible in joint design projects by allowing students who might otherwise be unable to meet, to share ideas and work together. This research investigates design students design-making while using CMC for communicative interaction. In order to reflect the contemporary design context as well as the increasingly global nature of teaching and learning the students were drawn from internationally disparate educational institutions. While acknowledging the importance of cultural difference on international collaboration this research focuses on how design students go about negotiating meaning and making decisions as they generate ideas and develop artwork for a design brief. The research investigates the collaboration between design students when working on joint projects at a distance via technological interfaces including 'Blackboard' and other audio and visual links. Specifically the
The methodological approach of the research

The approach that was adopted for this research is intrinsically linked to the aims for the study and the research questions and has been influenced by the work of Asimov, 1926; Rowe, 1991; Cross et al, 1994; and Scrivener and Vernon, 1998. The research is essentially interpretative and involves a detailed analysis of aspects of the social interaction that the students engage in while working on their collaborative projects. The methodology focuses on context and meaning and uses a holistic approach that recognises that what happens in the classroom generally has complex layers of meaning, interpretation, values and attitudes. However it has been suggested that there is no single best description of what might be happening in the design studio and that the selection of what is seen or recorded might be influenced by the purposes which the description is to serve. Therefore participant observation through reflective journals and semi-structured interviews was used. This allows for qualification of actions, ideas, values and meanings through the eyes of the participating students. The research stance hypothesises that the reality of designing is subjective and multiple as seen by the participants in the study. Consequently the research adopted a basically qualitative and ethnographic methodology.

Interaction is an important element in this research and the relationship that exists between the tutors and the students is informal, value-laden and biased. This approach lends an essentially interpretive ontology to the research in which the act of designing is regarded as the product of processes through which the students together negotiate the meanings and understandings that underpin their design actions and processes. As they develop solutions to the design problem each student group record: the means and extent of their collaboration; the amount, type and quality of their communication; and the contribution and integration of their design ideas. The research focus is on the way design students go about negotiating meaning and making decisions as they generate ideas, develop artwork and focus on solutions to a design brief. The initial questionnaire established the students past experience, skills and attitude toward using blackboard as a communication medium. The final questionnaire concentrates on concrete details of their experience while working
on the project. The videotaped interviews focus on encouraging the students to reflect on the meaning for them of the project experience. Each of these three stages provides a level of detail that helps to illuminate the next stage. Epistemologically knowledge about designing is derived from the students’ re-descriptions of their role in the design process. Participant observation is used to gain insight into the activities taking place through students’ descriptions of the sequence and timing of their activities. Qualitative discourse analysis through structured interpretation of language is made of recordings of ‘on-line’ and taped discourse to evaluate the communications stratagems developed by the groups and how meaning is negotiated. An initial analysis of the data focused on identifying common themes and categories related to design process stages. The identified material was further analysed and coded and compared to the information obtained from a quantitative analysis of the questionnaires. Methodological triangulation was used to ensure some substantiation of the data collected from the different instruments.

The research design
‘DesignLinks’ is the title of a collaborative design program currently involving nine universities in five countries. The first stage of this program focuses on designing within a CMC environment. It does this by: investigating the collaboration between design students when working on joint projects at a distance via technological interfaces including ‘Blackboard’ and other audio and visual links; assessing the behavior of groups of students to using CMC in their project work; and by questioning the effectiveness and efficiency of their social interaction and collective performance when engaged in the work. Junior and Senior Design and Communication students from the University of Nebraska at Kearney (UNK) and Richmond American International University in London (RAIUL) took part in the first stages of this research in the spring of 2001. The research compared the communication and collaboration that took place between co-located pairs of students working on the same campus and distributed pairs who were assigned to work ‘at a distance’. The program’s curricular objective was to give design students the opportunity to produce artwork for a four-week course project while working collaboratively across national and cultural borders. The research objective was to examine the decision-making involved during idea generating and solution-seeking. Primary data gathering methods consisted of a student questionnaire, students systematic recording of their ‘on-line’ discourse and collaboration and video taped semi-structured interviews. An analysis was made of the various design and communication stratagems developed by the groups. The brief for the graphic design project required each team to collaborate to gain approval for their proposal, organise logistics, communication, and individual responsibilities and develop final artwork. Each group collaborated using proprietary computer-conferencing software set up on Richmond's server. This allowed them to e-mail, use discussion lists, use a whiteboard and exchange graphic files. A web page on the RAIUL web site was set up to serve as a portal for the project. This page included a hyperlink that connected the student design groups to the DesignLinks web site.

A summary and analysis of the data from the first phase
The students were asked to complete on-line questionnaires at the start and end of the project. Questions were set identifying the students, their discipline area and their assessment of their computer skills and previous experience. This section was followed by sets of questions dealing with the perceived usefulness of ICT at various stages in the design process, student assessment of facilities available and finally student attitude towards the use of ICT (see figure 1).
Figure 1: The questionnaire

The responses from six distributed groups and six co-located groups were analysed. On comparing the distributed groups (D) to the co-located groups (C) certain significant differences can be established (see Table 1). The C groups opted for ‘Blackboard’ being most useful during the initial stages of problem identification and idea-generation whereas the D groups who had to rely on using it felt it came into its own during the later stages of verification and finalising the artwork. The C groups tended to use ‘Blackboard’ even when working together in the same studio. This might be attributed to the fact that the project emphasises communication, deadlines for the project were tight and ‘Blackboard’ allowed students to continue developing their projects outside class times. At the same time the C groups did not have the problems of time differences and benefited from initial communication being verbal and face-to-face. A frequent comment from D groups was the difficulty in fixing meeting times due to time differences, different class times on each campus and so the different deadlines. Although the D groups expressed more prior experience it was the C groups who rated their computer skills higher. This may have something to do with a more realistic assessment on the part of the D groups about the demands of the collaborative project.
The questionnaires from both phases indicate that the students considered the lack of face-to-face contact most problematic. This was also identified as a major concern in the semi-structured interviews (see below). Students were less bothered about the question of anonymity. This contrast with many studies where the fear of not being able to cope with the equipment and therefore looking stupid to your peers is often quoted. Generally however they were less positive about the notion that ICT provided easy communications. Surprisingly, given the popularity of the Internet for researching information only a minority of students used this facility during the projects. This might however simply reflect the tight time scale and subject matter of the project. Interestingly both the C and the D groups felt the project was very exciting, not in the least frightening or a waste of time. They felt ‘Blackboard’ was easy or very easy to learn and was of positive benefit in improving their designing skills. The D groups were much less confident initially in their computer skills that might indicate a concern about using computer-mediated-communications (CMC). After working on the project eighty-five percent agreed that using ICT would improve their design skills. Interestingly eighty percent of both C and D groups would use ICT even when collaborating in teams on the same campus. Most students were not concerned about showing themselves up when

<table>
<thead>
<tr>
<th>Co-located Group</th>
<th>Distributed Group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RATING</strong></td>
<td></td>
</tr>
<tr>
<td>Computer skills</td>
<td>.66</td>
</tr>
<tr>
<td>previous experience</td>
<td>.33</td>
</tr>
<tr>
<td>develop idea</td>
<td>0</td>
</tr>
<tr>
<td>communicate idea</td>
<td>17</td>
</tr>
<tr>
<td><strong>MINUSES</strong></td>
<td></td>
</tr>
<tr>
<td>not face 2 face</td>
<td>.5</td>
</tr>
<tr>
<td>lack immediate feedback</td>
<td>.5</td>
</tr>
<tr>
<td>Only digital comm.</td>
<td>.17</td>
</tr>
<tr>
<td>Communicate any time</td>
<td>.5</td>
</tr>
<tr>
<td>Ask questions - embar.</td>
<td>-.33</td>
</tr>
<tr>
<td>Easy exchange artwork</td>
<td>.83</td>
</tr>
<tr>
<td>Web research &amp; exchange</td>
<td>.66</td>
</tr>
<tr>
<td><strong>PLUSES</strong></td>
<td></td>
</tr>
<tr>
<td>Getting idea</td>
<td>.33</td>
</tr>
<tr>
<td>Developing idea</td>
<td>.5</td>
</tr>
<tr>
<td>Executing idea</td>
<td>.17</td>
</tr>
<tr>
<td>Use Bb if co-located</td>
<td>.17</td>
</tr>
<tr>
<td>Add features</td>
<td></td>
</tr>
<tr>
<td>Order of use</td>
<td></td>
</tr>
<tr>
<td>Order of preference</td>
<td>EM/FE</td>
</tr>
<tr>
<td><strong>FEATURES</strong></td>
<td></td>
</tr>
<tr>
<td>Frightening</td>
<td>-.66</td>
</tr>
<tr>
<td>Exciting</td>
<td>.17</td>
</tr>
<tr>
<td>Waste of time</td>
<td>-.66</td>
</tr>
<tr>
<td>Easy to use</td>
<td>.5</td>
</tr>
<tr>
<td><strong>ATTITUDE</strong></td>
<td></td>
</tr>
<tr>
<td>Improves design skills</td>
<td>.17</td>
</tr>
</tbody>
</table>

Figure 2: Averaged responses of the six distributed and the six co-located groups. (Values range from 1 indicating the most positive response to -1 the most negative response)
using the equipment and felt positively about sharing Internet research and very positive about working jointly on the artwork.

The D groups were very positive in suggesting that ‘Blackboard’ was of most use during the second and third stages of the designing process while being negative about its use in the early stages. This contrasts with results from the C groups where the students felt it was most useful during the early stages. They expressed a negative feeling to the idea of using ‘Blackboard’ for collaboration if the team were co-located perhaps reflecting some frustration about their experience with the application.

There was a quite a lot of agreement among all students about the central question. Most agreed that ICT was neither frightening nor a waste of time and were supportive of the idea of using ICT in design work. They felt positive and excited about the benefits ICT might have for developing and communicating ideas. What was most striking was the similar attitudes that all students whether working together or at a distance held. In general they all felt that using ICT benefited their design skills and supported incorporating ICT into their design studies.

A set of categories was devised to code student activities such as reflection, decision making, general discussion, informal conversation, brainstorming, and idea-generation, sketching and drawing. The students were asked to keep timed and coded observations logs of those various activities they engaged in during the problem-solving process. The advantage of this sort of log is that it records the sequence of major events although it omits minute-by-minute detail and other real time variations in design behaviour.

Figure 3: The activities sheet.

The data gathered from the activities sheets was inconclusive. Records were either produced later on reflection or were sketchy. Sometimes they were summations of total activity ignoring either sequence or short intervals of activity that might have highlighted their thought processes during the design process. In other words the detail of the collaborative nature of the work was often recorded as for instance ‘half an hour spent e-mailing during the first week’.
Students were asked to list their timed activities sequentially as well as completing a graphic representation. Graphs illustrating each student’s activities were produced. However an analysis of the time sheet graphs would not support the idea that problem solving can be explained adequately by observing the participant’s measurable and replicable patterns of physical behaviour. Rather the random and different sequences of activity recorded by the students in this study would support Rowe’s (1991) assertion that designing is a complex business influenced by the initial constraints of the problem and sometimes by the personal attitudes of the designers (see Diagrams 3, 4 & 5 below).

Figure 4: London – Nebraska Link: Time Sheet of a Distributed Group. Note the regularity of movement between partner discussion and use of software.
Here is one example of one distributed groups use of the chat room. It highlights some of the difficulties the students were having with their communications and with the technology: It is also one example of the way students went about their work.

- Joe,
  I am on-line and trying to get in touch with you. It is 7 my time. I am going to scan the CD cover and send it to you. Write back if you get this. [1 Message]
  [All]
- April,
  I am here now as well. It is 12:30 Wed. The message you sent may be from yesterday, I did not get here until later. I could not see your ideas, (I'm sorry if you keep hearing that, I am not sure which message will get to you) it would not let me view them through Blackboard, and when I downloaded them, the programs had trouble recognizing the file type. I'll try again. Joe [No Messages]
  Monday....1:15
- I am now online it is Mon at 1:15. The virtual classroom is not opening up fully for me. I sent you some preliminary ideas. The X looking pict I thought could be reversed out to emulater spotlights, with the background a solid color. The type shown on some is very rough, but Dave uses a lot of san-serif font. Also, picture the hand idea as degraded by copying the black and white image of someones hand upraised, as in cheering for the band, but degraded by photocopying it, taking that image and degrading it further (by crumpling or folding the copy) then running that damaged image back through the copy machine. Each time it goes through it will get more unrecognizable until it becomes almost a texture that will 'diffuse' into the background (Saying we decide on a black background) I will send you an example.
  Anouther thing is that sence we are both from the States, My instructor asked if we design the poster for a concert in London, or surrounding area. Maybe if you have an idea how concert posters might differ in their appearence from here that would help. Also, any info on a concert
hall or event we could use locally to have this show be held in would be needed. I'm gonna try the virtual classroom one more time...It's 1:35 here, [ No Messages ]

- **Tues @ 1pm**
- April,

Did not see you in pogo. Thats alright I think I confused you a little with that long explanation. I am sending you some more work on a further idea from one of my thumbnails. Any word on information for a concert event in your area for Dave Matthews? Or a location for a show we may want to invent? Let me know please. Anyway I will remain online for awhile today. If you read this write me back on the discussion board, this computer does not have java, i guess, and will not connect to the classroom. Joe   [ No Messages ]

- **Problem**
- I did what you said and downloaded the files. The file types are photoshop '.psd'. Photoshop will not open the files saying that there is not a suitable graphics importer. I then tried picking the application to download to (photoshop) and was told that the files are invalid. I honestly do not know why they are not opening. The case was the same when I downloaded and tried to open them at my home system. When the files I sent are opened, they are viewed directly in Blackboard. Please see if there is something we may have overlooked. Try clicking on your files and see if they work for you there. I would like to see them. I will also send some images of the band and what I have been working on as well. Could you try saving a copy of the files as a TIFF and attach to an e-mail to my hotmail account, that way I could at least view it there. Thanks Joe   [ No Messages ]

- **Virtual Class**
- It is Fri Apr 20 at 12 noon. The Virtual classroom will not open here at school. Cannot talk in real time. Check the file exchange for files.
of the project, of being able to establish a necessary relationship and get across their varying points of view. Some students indicated that they were not too concerned about having immediate feedback on their ideas. However this was at odds with most students who said that their greatest difficulty was not being able to communicate directly with their partners. This attitude was confirmed in the interviews where again the students expressed frustration about a lack of immediacy and the difficulty with CMC when trying to develop their ideas together. They were much happier about facilities for exchanging artwork. The file exchange facility was identified as both one of the most used as well as the most preferred facilities. E-mail was the other popular communicative device. However these are both generally asynchronous methods of communication and one extra facility that many students identified as necessary was some form of easy to use synchronous chat device. For reasons mainly to do with time differences and different class days most students found the chat room facility difficult to use. However some students managed to work with the chat room facility successfully. There was a significant difference in opinion between co-located and distributed groups as to when CMC was most useful. Most co-located groups felt happy using it during the earlier stages. Sara, a Richmond co-located group member, when asked about when ‘Blackboard’ was of most use during the project, said:

‘I think maybe at the beginning stages where you’re coming up with ideas and you’re both (sic) are coming from two separate ideas. At the end we ended up working together side by side and that was our most productive time (sic) is when we were sitting at two computers side by side working together’

This was typical of most co-located students who found ‘Blackboard’ very useful for communicating their ideas in the time between classes and for research but used it less and less in the later stages of their work. Again Justin another co-located student said ‘during the week Deidre and myself we don’t have any other classes together, we don’t live in the same dorm, so we would be able to communicate by going on to Blackboard but we found ourselves on it for a good amount of time. I think it worked well. It helped us out a lot Justin went on to say that in the later stages they spent most of the time face to face finalising the work.

This use of ‘Blackboard’ contrasted quite significantly with Richmond students who were in distributed groups working with a partner in Nebraska. Julia identifying a common complaint from distributed groups about using computer mediated communication for collaborating in this kind of creative work said

‘we couldn’t just sit down face to face and talk to each other. It took maybe about two or four or five e-mails back and forward – ‘do you like this’ or ‘do you want to do this’ which made it kind of difficult. Maybe a five or ten minute conversation took us about two weeks.’

and Shannon was more explicit about using ‘Blackboard’ in a distributed group saying

‘I think definitely at the end. That’s when it works out the best when you sit down and exchange thoughts. At the beginning, at the very raw stages – just a pain.’

Students from both RAIUL and UNK described an increase in their levels of interest and motivation when working on the collaborative projects. This is supported by findings from a range of research including surveys and evaluation studies undertaken in the early to mid nineties evaluating the use of CMC in education in the UK (Starling, 1994; Schnurr & Smith, 1995; Mumford, 1996; Howard et al 1996). These studies found a lessening of problems of social isolation and students being keener after the introduction of communication software into the classroom.
One student described the excitement that many of the students reported about being involved in the project.

‘File Exchange Oh Yeah that was a big help with us because its so much faster and easier than e-mailing. Just drop the image in and it comes right up on her screen and she can see it. Oh Yeah and we had the chat on at the same time. The virtual chat room chat . Oh Yeah ‘I like that one that you did’ or ‘No maybe that could be changed a little bit’. Just back and forth. We had so many images. Like I’d alter one Drop it in. She’d look. Alter it. Alter it a little bit more and drop it back to me. That was very convenient very fast.’

The interviews did not seem to support some findings from previous reports which indicated that students will often erect resistance barriers when dealing with CMC in an attempt to avoid the fear of looking stupid to their peers when encountering problems with the interface. Similarly the students did not report worries about breaking the equipment, or being spied upon when they were effectively in a private study situation (Goodfellow & Kukulska-Hulme, 1996).

The weakness of the time sheets as a method of data collection was carried over into the second study. It might be that the design for future work reconsidered the appropriateness of using this data collection method. Recording of e-mails of some of the groups produced a comprehensive record of their communications, which was of interest in illustrating the way they began to overcome distance in developing ideas and a body of work. This data collection might be of greater relevance than time sheets. It might be sensible to include written material handed in by the students as another source for collecting data in future work.

Conclusion

What is common to all research is the goal of being able to apply the findings of the research undertaken to other contexts, to enhance its generalisability, to predicate from a particular sample to a larger population of which the sample is representative. I hope that as a result of this ongoing research a little more light may be shed on the processes and procedures involved in designing. The results so far indicate the potential of information and communication technology (ICT) for design and designing. The continuing research will focus on designing as a social process. Stumpf and McDonnell (2002) suggest that the design process dynamics for the social process paradigm highlight a move towards a consensus through an argumentative process. This they say results in a design method comprising of negotiation and conflict resolution which results in completed designs which realise collective approval. Initial results indicate that one of the ways that design students can develop their decision-making skills is by participation in collaborative projects using computer-mediated communication.
References


