Teaching "Computers & Society" - The Medium and The Message

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Introduction

Of late there has been a concerted move within the computer science community to have courses on computers & ethics, or computers & society, given more prominence within the computer science curriculum. However as reported by Jewett (1996), and others, there are a number of significant challenges faced in teaching such courses. These include their inter-disciplinary nature, unsuitability for the traditional lecture format, large class sizes and less than total support for such courses from within the computer science community.

The research described in this paper is based upon experience with teaching one such course. Given the problematic nature of the course different strategies have been tried, over the years, to improve the quality of the course and these have met with some success, as outlined below. This success, however, begs the question as to what specific pedagogical forces are at work and whether or not the lessons learned can be generalized.

In order to explore what is actually occurring in the learning environment, significant events in the course have been recorded and analyzed. Specifically, video recordings were made of the preparation and final delivery of student's in-class presentations. New technologies for capturing classroom data, including digital video cameras, are making it easier to involve more of the research community in interpreting classroom data. The work reported here was done in co-operation by computer scientists and educationalists and images will be presented as part of the data in order to make explicit our assumptions of what we consider effective learning. The research presented here is part of a larger on-going analysis of the course.

Background

The education model in Ireland is similar to that of the UK. Entry to university is highly competitive and is based solely on the results of a national examination. This promotes a very exam-oriented approach to learning. Furthermore, the trend at third level has been towards specialized professional degrees with a strong emphasis on immediate relevance in the marketplace. Thus the prevailing educational climate is a long way from Newman's "Idea Of A University", as a place dedicated to liberal education, despite the fact that employers are now beginning to demand those very attributes that a liberal education instills.

The Computers & Society course discussed here is given as part of the first year of a four-year specialized computer science degree. The course objectives are to encourage students to take a broad look at the relationship between (information) technology and society and to expose them material, and methodologies, from outside their core discipline. The idea of the "Information Society" is critically analyzed. Giving the students experience of teamwork, improving their communication skills, and their ability to construct a reasoned argument are also key objectives. (For further details of the course see www.cs.tcd.ie/tangney/ComputersAndSociety.)

Within the author's institution the problems listed previously are further compounded upon by the fact that the subject has traditionally not been taken seriously by students, and in some cases fellow staff, who tend to regard it as a token subject. Furthermore it counts for a small component of the overall workload for the year, one contact hour per week, and was not examined by an end of year written examination. The class size is not small, 70 or so students, thus ruling out a tutorial or discussion type approach to teaching. Finally while there is an ever expanding literature in the area of Computers and Society the vast majority

of it, in English at least, is from a North American background and thus lacks a certain direct relevance to the immediate lives of the students.

The Teaching Strategy

During the first few years that this course was taught students did not engage with the subject matter, the quality of average student work was poor and attendance at lectures fell to 25% as the year progressed. In order to get the students to fully engage with the material presented in lectures, in the prescribed reading material, and in the overall learning process a number of different pedagogical and assessment techniques were used, some of which are based upon methods described in Schulze (1996).

 In order to give the course stature within the student population an end of year written examination was introduced. This is far from being an ideal assessment technique but was crucial for the credibility of the course. A course web site contains not just the course description and links to on-line resources but also samples of selected pieces of work done by students each year. Thus the efforts of previous students are available as a reference point for current students. Inclusion of one's work on the web site also generates a certain amount of internal competition within the class.

During the year students engage in two different types of exercise, writing papers and giving presentations in class. The paper writing is a relatively straightforward. A major paper is submitted in each of the 3 terms and this is returned to the students with some comments. The papers are assessed based upon content, breath of reading in the area and depth of understanding of the material. Marks are also awarded for the coherency of the arguments presented and the proper use of bibliographies and citations. Sample papers are placed on the course web site. Further work needs to be done to improve this aspect of the course but this is outside the scope of this paper.

Group debates are the corner stones of the course. We believe that this is the activity which generates the best learning experiences and this is the aspect of the course that is the focus of this study. The class is divided into 4 groups, of 15-20 students each, and during the year each group must give a series of presentations in the form of in-class debates. The debates are organized on a league system with a prize for the overall winning group. Topics debated have included "IT the workers friend", "Technology is but an improved means to an unimproved end", and "The neutrality of information technology".

The debates are judged not by the course lecturer but by 3 other academic staff: one from the Computer Science department and two others from different areas in the university. This requires the students to pitch their presentations at a level which is not technology focused, which is not something that comes naturally to computer science students. The 3 adjudicators give very useful feedback to the students on what worked in their presentations and what areas need more improvement. In addition to the formal class presentation each group meets with the course lecture to give a dry-run of their presentation and this has greatly improved the quality of the final presentations.

To illustrate how this works in practice take the following example of a class presentation on the topic "IT - the worker's friend". Students research the topic on the web and in the process come to realise its advantages and disadvantages when compared to a library. They must work as a group, using e-mail to support the activity. The actual topic for debate is the relationship of IT to work and the students work extensively with IT in preparing the debate. The topic must be presented to non-IT specialists forcing them to frame their arguments for the lay person. The slide show used to support the presentation requires the students to structure their argument into coherent bullet points and all presentations are in turn published on the course web page turning the exercise into one of information production as well as consumption.

Assessment of group projects is always problematic, how does one prevent some students free-loading on the work of others? The solution adopted is to monitor the e-mail distribution list for each group. Students are awarded a mark based upon the overall performance of the group AND their own visible contribution to the preparation.

Results and Analysis

The approach just described appears to be paying dividends. Students are engaged with the course and it is seen as a subject to be taken seriously to the extent that the end of year examination has been dropped and the course is now evaluated purely by continuous assessment. The quality of the work produced by the average student in the class has improved. This is a reflection of the seriousness with which students now take the subject and that some of the techniques described above are working. Attendance at lectures is up to 75% or more.

The data analyzed here comes from videotaping two weeks of classroom debates as well as the pre-practice sessions. In order to reduce observer bias the recording procedure used was to first pan the classroom back and forth over a 10 second period. Then to the camera was focused on the front one-third of the class for a ten second period before moving on to the middle and back sections for similar periods. The process was repeated throughout the class. The presentations were held in one of the University's old lecture theatres and were well attended. The use of lightweight wireless laptop and data projector was somewhat incongruous in the setting and acted as a metaphor for the current debate on the role if IT in education.

The slide presentations, or successive bullet points, make students focus their arguments and leads to a hierarchical presentation of materials. In Mayer (1980) the effects of elaborated and hierarchical methods of organization of instruction on cognitive processing were compared. It demonstrated that students who had learning material presented in hierarchies were better able to elaborate and understand the deeper meaning of the information than the elaborative group. Mayer argues that cognitive skills would be supported by allowing learners the opportunities to chunk information into smaller, meaningful parts. The experience reported here, of groups breaking into sub-groups to prepare the bullet points for each speaker, would support that view. As the lecturer mentioned in the first practice session, "You need to focus your argument and make it sharper and doing slides would help you with that."

Analysis of the first set of debates shows strong differences in interaction and collaboration between students who were members of the two teams involved in the debate and those who were not. This is

 captured in the accompanying still image which shows the higher levels of engagement and interaction of students in the front compared to the row of students who had presented the previous week and thus were sitting, quietly, in the back row. During the class students from the two presenting groups found plenty of opportunities to speak, e.g. when speakers rotated or when the judges left the room. Interaction among the students who are not presenting were limited to one or two instances. However, the audience was quick to react to presenter's jokes pointing to a clear interest in the debate but the lack of interaction and activity is probably an indication of a more passive role on the part of those not presenting. Although one would expect that students who were presenting would interact more than those who were not, the absolute lack of any sort of activity (from taking notes, to making comments to each other) was unexpected. This was even more noticeable when tapes were viewed several times and the key players from the previous debates were seen sitting quietly in the back. The initial findings point to an idea of a learned classroom role on the part of students, in this case different behaviors were considered acceptable by those who were the audience and those who were the participants.

A marked difference was noticed between the behavior of the groups even over the short period of observation. There was a considerable increase in group work and interactive behavior in the second presentation from the first one and this points to the rapid development of a collaborative learning strategy. In the first presentation recorded members of the same team as the presenters spent 3 minutes (out of a possible 51) interacting with each other. While in the second presentation, one week later, 18 minutes (out

of a possible 54) were spent carrying out some type of supportive collaborative activity, from passing notes to whispering together. In the in-class presentations the members of the teams opposing the presenters spent 10 minutes communicating during the first week compared with 26 minutes of group work exhibited by opposing members the second week. This included the passing of slips of paper from the group members to the student in charge of the rebuttal. The flurry of small sheets of paper may have grown out of the groups' expertise with using email. There was interaction in the green team (2nd week) between female and male students as well as between those of the same sexes. All other classroom interaction was between male students. This is partly due to the lower numbers of female students in the class and that in these presentations all the presenters were male. Although it could be argued that the interaction patterns are simply a factor of the personality of those involved the fact that even the most active students from the first week sat quietly in the back of the class in the second week points to a different force at work than simply the people who made up the group. Future presentations will be videoed as more research is needed here to explore this issue.

One of the key aspects of the course is to provide students with examples of good practice from their peers. A common comment from judges at the presentations is that they quality rises from presentation to presentation. This suggests that significant peer learning is taking place during presentations. Students who are yet to present are able learn from those they are watching, i.e. they take in the form of the presentation, as that is what would transfer over to their own future experience. It may be, therefore, that the way their peers present information is more important to their fellow students than the content. The role of the first presentations would, therefore, be one of the setting of a standard. The second groups both had a benchmark to try and best. This type of in-class learning would have implications for examining participation in a learning environment as a key area of delivery of information. Further research is needed and the effects of posting of exemplar essays to the course web page should also be explored.

The change in group processes were even more noticeable in the practice sessions than in the class presentations. In the first session, the lecturer spend 28 (out of a possible 42 minutes) coaching the students, giving them advice and asking questions. In the second working session the students initiated a great deal of the activity and during the first 25 minutes the lecture's total coaching time was 3 minutes (in total 18 minutes of a possible 60). The students who had arrived for the second working session had already met the previous day to practice the presentations together. Over half of the students present (as opposed to 5 key players /presenters in the previous week) contributed to the discussion as to what could be done to improve the presentations. Exchanges occurred between male and female members of the group in the 2nd working group (partly aided by the increase in numbers from 1 to 3). In the photograph you can see the 1st working group. Students are alert and interested but not working together and the nature of their exchanges were mostly one student interacting with the teacher as opposed to the 2nd group where the flow of information was multidirectional.

The first group spent more time listening to the lecturer coach them but the second seemed to provide some of the same sorts of critically supportive environment for their fellow students as the lecture did for the class as a whole. The lecturer exhibited a number of intellectual skills when working with the students and modeled them in his explorations of their arguments. He promoted coaching as a collaborative effort stopping to ask what students thought of the presentation and encouraging them to help each other. He cut short any comments that were not constructive or that were unnecessarily critical. Students were, therefore, given an environment in which they could begin to take over the role of the teacher – teaching each other, working together to construct knowledge. There lecturer would often ask the presenter to reword their

arguments and then provide scaffolding for the learner's intellectual growth by focusing on the development of key points and issues. The results were more reflective and refined articulation on the part of the students. This is in keeping with Vygotsky's theory that higher-level cognitive skills are formed as the result of social interaction. In his model, learning takes place between students and teachers when there is active intellectual interaction taking place. The students will in time take over and internalize these processes individually thus forming cognitive processes (Brandt, 1989).

As is often the case with using IT in the classroom there were occasional glitches. On one occasion this

 resulted in a group being forced present without their supporting slides. The lecturer introduced the group with the following remark.   "Now we have a classic example of the effect of technology which is beyond anyone's control. The Red Team do not have their slides. That's fine and is not a problem. The slides are meant to structure the talk so let's see how we get on without them." The group then had to spontaneously adopt an alternative presentation strategy with one very creative student jumping, at one point, onto the lecture podium actually replacing the same physical space as that taken up by the slide he had prepared to support the point he was making.

The role of students in creating their own learning environments is of increasing interest in education. The use of computer-assisted learning environments (Chee, 1994; & Hilem & Futtersack, 1994) has been heralded as a way to provide a type of cognitive apprenticeship (Kurt & Miller, 1997). Promoting learner responsibility is seen as a key aspect of constructivist learning (Freedman, 1998). In this course, the structure of the course itself provides for the embedded situated cognition. Specifically the debates not only provide increased motivation and interesting content delivery but also a way for students to articulate their learning processes in aiding their peers improve presentations. This is in keeping with Mayer's (1980) work which explored the contributions of cognitive science to learning design in computer literacy and recommends that in order to promote the development of cognitive abilities, learners be provided with opportunities to restate information in his or her own words.

Conclusion

Obviously the course described here has benefited from the approach adopted and the research undertaken to date is beginning to shed light on the underlying reasons for this improvement. Key to the success of the research has been the use of digital video to record and analyze classroom behavior.

Orey and Nelson (1994) point out that the learning environment is key to the development of intellectual skills. The idea of situated cognition is supported by the creation of a cognitive apprenticeship where learners have a chance to become participants in a community of practice. This is very much the approach followed here. In terms of the information technology and society focus of the course all six attributes that Hancock (1997) points to as being characteristics of information age schooling are found in the learning environment of the course, namely interactivity, self-initiated learning, a change in the teacher's role, media and technology specialists as central participants, continuous evaluation, and a discussion-centered classroom environment.

Finally previous research on classroom performance of teachers points to how the foundations of their discipline became the foundations for restructuring of content knowledge for pedagogical purposes (Gudmundsdottir, 1987). Hence the sub-title of this paper – the medium and the message. The message of the course – issues to do with the "Information Age" – is embedded in the medium – information age schooling!

It is suggested here that the lessons being learned from this course can be generalized. Instructors can explore ways of going beyond the specific content of a course and allowing the course structure to provide a vehicle for transmitting important aspects of the discipline. Not only did designing delivery provide

structure for increased student learning it also helped to overcome many of the original difficulties of teaching the course.

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