TALKING IN CLASS: THE ROLES OF SOFTWARE AGENTS AND OTHER PARTICIPANTS IN THE SOCIAL CONSTRUCTION OF KNOWLEDGE WITHIN ONLINE LEARNING ENVIRONMENTS

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Abstract

Our current enthusiasm for online education leaves unanswered a number of questions regarding the social interactions that mediate learning within these new environments. This paper explores some of these issues in relation both to the human participants and to the roles of pedagogical software agents in the electronic classroom.

Keywords

Online learning, Computer mediated communications, Social interactions, Computer mediated writing, Social construction of knowledge, Pedagogical software agents, Cultural issues, Social implications.

Introduction

Australian universities, in common with others, are currently embracing a range of new and still-developing technologies and pedagogies. These include the merging of a number of techniques and delivery formats traditionally associated with distance education with some of the new capacities of information technology. Increasingly such projects make use of the Internet not merely as a delivery mechanism for information, but also as a medium for communication and interaction, either wholly or partially replacing face to face learning environments such as lectures, tutorials and workshops.

The degree to which computer mediated personal interactions can be regarded as simply equivalent to their face-to-face counterparts is problematic. Research and commentary within the broader arena of communication strongly suggests that the electronic medium imparts particular qualities to such encounters. If we are to take seriously the notion of knowledge as being socially constructed, then an understanding of these subtleties is a necessary part of the process of designing online courses.

The recent emergence of a new participant in the social interactions that mediate online learning, raises further questions in relation to the pedagogical efficacy of the medium. Designers of computer mediated learning environments are increasingly incorporating within their products significantly personified software entities intended to fulfil a range of functions including that of instructor, personal assistant, record keeper, even fellow-learner. To what extent are interactions with these 'agents' likely to be genuinely helpful in promoting learning?

Communicating in the online classroom

In the physical world one represents one's identity or persona to others through a range of signs and symbols. In most of the computer based environments currently available to us, this richness of information is not available, the burden of self representation falling upon computer generated text. What we write is who we are. This becomes particularly interesting and potentially problematic when we consider the body of research which suggests that particular qualities of screen based environments lead us to express and thereby represent ourselves 'differently'. It has been suggested for many years that even word processing, a computing application generally accepted as a straightforward translation of an off-computer activity, can involve subtle but sometimes quite significant changes to the way in which we constitute ourselves through language (Ong 1982; Poster 1990; Heim 1993).

As Poster writes, "… electronically mediated communication upsets the relation of the subject to the symbols it emits or receives and reconstitutes this relation in drastically new shapes" (Poster 1990, p. 14). In similar vein, Heim suggests that, " … the word processor creates a new relationship to symbols, to language, and, by extension, to reality" (Heim 1993, p. x). It is argued by some researchers that the apparently infinite malleability of computer based text may itself militate against the realisation of a coherent and integrated personality through this medium. If there is no limit to the changes I can make to my textual representation, is there actually a 'real' me? At a practical level, factors such as keyboarding skill can exercise quite marked effects on our written expression and its interpretation by others. For example, lack of fluency in typing can lead to the use of shorter words and less complex sentences than would normally be employed. This often results in text giving an impression of bluntness, even of rudeness, which may be quite at odds with the intentions of the writer.

Translating these theoretical perspectives into practices with which we are all familiar, one has only to consider, on the negative side, the many reported instances of harassment and flaming occuring in computer mediated environments. However the news is not all bad. On the positive side, examples of unwelcome electronic interactions are well balanced by accounts of the many groups and individuals who describe with considerable eloquence supportive, even intimate relationships and experiences of community which they have been unable to achieve in face to face situations (Rheingold 1994; Turkle 1995; Spender 1995, Preece 1998). It seems that 'different' does not inevitably equate with 'worse'!

While particular qualities of computer based environments may inadvertently encourage differences between the physically present and the textually realised self, there are also plenty of opportunities for the deliberate adoption of different online personae. Examples and discussion of flexible self representation within electronic environments, including the often contentious area of gender identity, are well documented (Dery 1994; Spender 1995; Turkle 1955; Cherny & Weise 1996). Such opportunities for the deliberate creation of alternative manifestations of our selves are embraced with enthusiasm by many computer users.

As the saying goes, "On the Internet, no-one knows you're a dog". Where the problems arise is often at the interface between electronic and face-to-face identity, where the person one 'knows' turns out to be somewhat different 'in the flesh' or, as we are still wont to say, 'in person'. Where should we draw the line between flexible self-representation and mis-representation?

Is all this cause for serious concern? Even in the physical world we accept that people often behave very differently in different contexts. It can be argued that the exploration of dimensions of our personalities which are denied expression within the traditional ideal of the integrated persona is not necessarily detrimental to our wellbeing. Turkle, for instance, suggests that, " . . . the many manifestations of multiplicity in our culture including the adoption of online personae, are contributing to a general reconsideration of traditional, unitary theories of identity" (Turkle 1995, p. 260), and that, "You can have a sense of self without being one self" (Turkle 1995, p. 258).

However, while not necessarily damaging to the individual, the fact that those with whom we choose or are required to communicate may manifest themselves differently through the medium of computer based text certainly has the potential to destabilise and disrupt our usual patterns of interaction.

In the traditional classroom both teachers and students quickly become 'known' through the many aspects of their physical presence, both as individuals and as elements of the social dynamic of the class. The fact that our 'telepresence' may differ in certain respects from our physical presence lends an unprecedented degree of uncertainty to the extent to which we can be said to know our fellow participants in online learning environments. Special challenges may also arise as a consequence of a tendency towards 'democratisation' which is felt by many to be an inherent quality of online communications environments, and from the likely inclusion of participants from a range of cultures, whose understandings of appropriate modes of interaction within educational settings may vary considerably (Dowling 1997, 1998, 1999).

In addition, these contexts incorporate wholly new possibilities for styles of interpersonal interaction through which we may be able to move beyond the mere replication of the social organisations which exist in face-to-face settings.

Pedagogical software agents in the online classroom

A fascinating area of research and development in relation to computer mediated learning is that of pedagogical software agents. While the concept of agency in computing is not new, it has found a strong ally and vehicle for expansion in the current push to deliver education online. From early conceptions of an agent as, "A character, enacted by the computer, who acts on behalf of the user in a virtual environment," useful in mobilising our well developed understandings of human social interactions in order to mediate "… a relationship between the labyrinthine precision of computers and the fuzzy complexity of man" (Laurel 1990, p. 355), these entities have been moving quietly but steadily from concept to realisation, to the extent that we now take for granted the ever increasing army of 'knowbots', 'spiders' and the like which scurry around the Internet in the service of increasingly sophisticated search engines, not to mention the proliferation of cheery little characters which pop up on our computer screens offering assistance with a wide range of tasks. In real time 'chat' environments it is not at all uncommon for users to interact at length with software 'personalities' without ever becoming aware of the fact.

Typical of more recent definitions of a software agent is that cited by Okamoto &Takaoka (1997, p. 356), namely that "An agent can be viewed as an object which

has a goal and autonomously solves problems through interaction, such as collaboration, competition, negotiation and so on". Other qualities frequently proposed, but not universally endorsed, include the ability to learn from experience, and consequently to respond in flexible and possibly unforeseen ways to particular situations, and the possession of a strongly realised and believable 'character', or personality.

Increasingly, designers of computer based courseware, particularly that intended for online use, are incorporating within their products such software entities, personified to differing degrees and fulfilling a range of functions within the learning environment. While some, such as that of tutor, personal assistant or fellow learner clearly relate to the overtly social aspects of learning, others perform a range of supportive roles including testing, scheduling, record keeping and information retrieval, and are closer to the concept of 'tools', than to our experiences of fellow participants in collaborative learning situations. Johnson proposes the following detailed definition of the role of pedagogical as distinct from other types of agents:

> Pedagogical agents are autonomous agents that support human learning, by interacting with students in the context of interactive learning environments. They extend and improve upon previous work on intelligent tutoring systems in a number of ways. They adapt their behaviour to the dynamic state of the learning environment, taking advantage of learning opportunities as they arise. They can support collaborative learning as well as individualized learning, because multiple students and agents can interact in a shared environment. Given a suitably rich user interface, pedagogical agents are capable of a wide spectrum of instructionally effective interactions with students, including multimodal dialog. Animated pedagogical agents can promote student motivation and engagement, and engender affective as well as cognitive responses.

(Johnson 1998: 13)

Such a conception represents a clear advance on the old style of 'instructional' software. Indeed, the realisation in practice of a software entity possessed of these qualities could pose a real threat to our assumptions concerning the efficacy and importance of 'human' and 'face to face' interactions within learning environments!

Developments in this area often incorporate extremely sophisticated understandings of pedagogical theory and practice. Of particular importance to a number of researchers are analyses of the component tasks and activities that are included in the larger scale pedagogical interactions of human beings. Where we as educators or as students may simultaneously undertake a range of roles within the educational environment, the electronic medium makes it possible to identify and separate out these diverse functions, which might then be enacted through different configurations of software agents working in relationships which could range from collaboration to competition. A significant component of the research agenda in this area is therefore concerned with the architecture necessary to manage the activities of multiple agents which might be required to interact with one another as well as with human users. A metaphor commonly employed in this context is that of a 'society' of agents (Costa & Perkusich 1997).

One of a range of models of socially interactive agents which have been created by Chan and colleagues over a number of years is the 'learning companion' (Chan 1996, 1998). This software entity, conceived as a peer or fellow learner with whom the student may collaborate, even disagree, possesses a limited knowledge of the domain in question, in some circumstances being somewhat better informed than the student,

and in others being less knowledgeable. In learning environments designed for younger students, an animal is a common choice of persona for such agents.

The common wisdom that we learn best by teaching is another aspect of the social dimensions of learning which is reflected in current research into the use of software agents within educational environments. A number of researchers are currently exploring the translation of this concept into networked electronic learning contexts where agents exist to be 'taught' by the student user.

An example is described by Ju (1998) who writes of a computer based peer tutoring system employing two categories of agent – an 'expert', and a 'learner':

> ... students become active learners who are guided to learn by teaching a computer. After the students watch how the computer expert solves a set of linear equations [the program] helps the human student act as a teacher in order to learn more about the subject matter. At this time, the computer plays the role of a student ...

(Ju 1998: 559)

The notion of computer programs substituting for human participants in the social interactions that mediate learning raises a number of issues. While in practical terms we need to consider their pedagogical effectiveness within these contexts, there are other broader questions to be addressed, including a range of potential ethical dilemmas too complex for inclusion in this paper.

The issue of personification has been a constant presence in the area of computer interface design, but its importance has obviously become far more explicit in regard to the development of software agents. While there are theorists and researchers who eschew the notion of the deliberate personification of computer programs being helpful to the human user, in the context of this discussion it is clearly a very important element in the creation of an electronic learning environment characterised by interactions which can reasonably be described as 'social'.

The appearance of a screen based entity is obviously an important aspect of personification, and in this regard the extent to which a high degree of visual realism in the animation of agents is useful in promoting interaction and stimulating learning has proved somewhat contentious. While the area of computer games and entertainment seems to reinforce the idea that a 'lifelike' representation is more likely to engender the "affective" response associated by Johnson (1998: 13) with increased engagement and motivation, other experiences suggest that the match between realism in appearance and the apparent knowledge level of the agent can be a complicating factor. Agents that 'look' smart but 'act' or 'talk' dumb are poorly received by many computer users. In educational environments this is particularly important, as is well recognised, for instance, in the work of Masterton, who writes in relation to the anthropomorphism of software: "A common problem with AI programs that interact with humans is that they must present themselves in a way that reflects their ability. Where there is a conflict between the ability of the system and the users' perception of that ability a breakdown occurs and users may either fail to exploit its full potential or become frustrated with its shortcomings" (Masterton 1998, p. 215). He goes on to describe the use of a degree of anthropomorphism intended to convey qualities such

as friendliness and usefulness, without implying the possession of full human capabilities (Masterton 1998, p. 211).

Related to the 'intelligence' of the software is the issue of autonomy, in particular the degree to which an agent should be furnished with pre-existing goals which might lead it to take particular action without instruction from the user, and even contrary to what the user might perceive as his or her interests and wishes. It is easy to slip from such considerations into the need for a contemporary version of Asimov's laws of robotics as conceived in fictional terms more than 30 years ago. There are also questions which can be raised in relation to who bears the 'responsibility' for the actions of such agents in relation to learners. Issues such as these are difficult to address without more exposure to these types of software, and indeed it is likely that such experience will cause community understandings in regard to appropriate relationships between the 'human' and the 'not human' in electronic contexts to develop and change over time.

But however 'intelligent', anthropomorphised and autonomous the software agent, can it ever be said to participate fully in the social construction of knowledge? In the past has been argued quite extensively that even the most heavily personified of computer programs suffer from an intrinsic lack of ability to participate in the metacognitive aspects of learning. Pufall(1988), for instance, contends that a computer program is unable at any level commensurate with human capacities to modify its own knowledge structures or cognitive processes, and can thus not be regarded as a co-constructor of knowledge in any meaningful sense. While this might well have been the case in relation to earlier computer based learning environments, can we continue to make the same claims with confidence? The capacity of software to 'learn' and adapt to experience through the incorporation of new information and the appropriate modification of its inference mechanisms is undoubtedly increasing.

Conclusion

The social interactions that mediate learning, even within face to face environments, are complex and incompletely understood. Research into computer mediated interactions suggests that our encounters with one another within electronic environments are likely to be characterised by differences which in themselves merit further investigation. The extent to which personified pedagogical software agents possessed of a high degree of 'intelligence' and flexibility can contribute to the social dimensions of online learning adds yet another dimension to the question of whether or not we can we can effectively replicate these aspects of face to face learning within electronic contexts.

But this is not the only question. As we are well aware from our experiences with both computing and other technologies, in the long run the best use of the new is rarely the attempted replication of previous practice. We need to bear in mind that both the new possibilities for human interaction which exist in online environments and the potential for engagement with electronic entities with qualities and capabilities we have not yet fully envisaged may well cause us to redefine the social mediation of learning in terms not previously available to us.

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