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REVIEW ARTICLE

Interaction and critical inquiry in asynchronous computer-mediated conferencing: a research agenda

Joseph Hopkins^b, Will Gibson^a, Cristina Ros i Solé^c, Nicola Savvides^a and Hugh Starkey^{a*}

^aUniversity of London, Institute of Education, UK; ^bUniversitat Oberta de Catalunya, Spain; ^cUniversity College, London, UK

Abstract

This paper reviews research on learner and tutor interaction in asynchronous computer-mediated (ACM) conferences used in distance learning. The authors note claims made for the potential of ACM conferences to promote higher order critical inquiry and the social construction of knowledge and argue that there is a general lack of evidence regarding the actual achievement of these aims in such conferences. We present and discuss the relevant research literature currently available on the effects of social presence, the tutor's teaching and moderating strategies, and task type. The paper concludes with recommendations for future research in each of these areas.

Keywords: asynchronous computer-mediated conferencing; interaction; research; tutor; task design

*Corresponding author. Centre for Distance Education, Institute of Education, 20 Bedford Way, London WC1H 0AL, UK.

Email: h.starkey@ioe.ac.uk

Introduction: asynchronous computer-mediated conferencing and distance education

In 1990, Harasim predicted that online technologies would lead to an unprecedented increase in interactivity in education, and since that time the introduction of information and communications technologies (ICTs) has indeed brought about a profound change, especially in distance education programmes. Courses delivered at a distance are no longer limited to a pedagogical model based chiefly on self-study materials and periodic feedback on assignments from a tutor, relying on correspondence through the post (Moore, 1993), but rather they can now incorporate student-to-student and student-tutor interaction as an integral part of course design.

Although in recent years some distance courses have adopted more advanced Web technologies, such as Voice over IP (VoIP) or audio-graphic virtual learning environments (see, for example, Hampel & Hauck, 2004.), the preponderant model is still asynchronous computer-mediated (ACM) conferencing. Unlike synchronous forms of online communication, which require real-time online participation, ACM provides the flexibility required by many distance learners in that they can log on to the system to participate in a conference at any time. It is for this reason that ACM conferencing is unlikely to be completely replaced by synchronous forms of online communication in the foreseeable future.

The removal of time and space restrictions and the interactive nature of ACM conferencing provide numerous additional advantages. Of particular importance to open and distance learning (ODL) practitioners is the claim that this type of communication model potentially provides opportunities for greater learner reflection and processing of information leading to a deeper understanding of subject matter than were previously possible in traditional forms of distance education (Laurillard, 2002; Hara *et al.*, 2000; Wallace, 2003). Similarly, various authors maintain that online technologies can facilitate the achievement of social constructivist learning goals in distance-learning courses (e.g., Bates, 2005; Jonassen, 1995; Salmon, 2003).

In light of this background, the purpose of this paper is to provide an overview of research that sheds light on the extent to which student-student and student-tutor interaction in asynchronous discussion environments leads to the social construction of knowledge. More specifically, the paper explores the empirical evidence that examines the quality of information sharing and creation in ACM online discussions drawing on the concept of ‘higher order critical inquiry’ (Ennis, 1987). Various researchers have defined “higher order” critical inquiry in ACM conferencing as interaction which goes beyond the mere sharing of information and which involves negotiation of meaning, co-construction of knowledge, and integration of that knowledge (Anderson *et al.*, 2001; Bullen, 1998; Gunawardena & Zittle, 1997; Thomas, 2002). This is the definition adopted in this paper.

The review considers in particular the effect of social presence, the role of the tutor, and the impact of task type on the quality of learner interaction within ACM conferencing. We focus on these particular factors given claims that they affect the depth of students’ cognitive engagement during online interaction and could therefore lead to enhanced learning outcomes. We explore the evidence for these claims and identify possible lessons, approaches and pedagogical models that may promote reflective practice and higher order critical inquiry.

We note that there is substantial evidence suggesting that in practice students often fail to achieve the goals of promoting reflective practice or higher order critical inquiry and only rarely engage with each other to a significant extent (Gunawardena, Lowe, & Anderson, 1997; Kanuka & Anderson, 1998). This raises questions about the extent to which constructivist aims of co-creating knowledge and integrating it into work are

achieved. Given these insights, we conclude with recommendations for further research, suggesting a greater need to focus on the factors that facilitate specific forms of interaction amongst learners.

Learner interaction in ACM conferencing

Vygotsky's (1962; 1978) social-constructivist theory highlights the importance of social interaction for the construction of knowledge. Through discussion and collaboration with one another, students can co-construct meaning and learn effectively by articulating their ideas and receiving feedback that enables them to adjust and develop their understanding (Thorpe & Godwin, 2006).

A key feature of ACM conferencing is that it provides students with a unique virtual learning environment where they can share information and exchange ideas and opinions by participating in online discussion. Online interaction therefore gives students an opportunity to 'scaffold each other's learning' (Hara *et al.*, 2000), leading potentially to enhanced learning outcomes (Thomas, 2002).

A particular advantage of ACM conferencing is that it is seen to offer a more comfortable environment in which students can interact than traditional FtF classes (Larkin-Hein, 2001; Larkin-Hein & Irvine 2001). Zhu (1998) found that participation in an online conference was more evenly balanced in comparison with FtF classes, where a few students dominated the discussion. Likewise, Hillman (1999) noted that students in an ACM conference tended to express their opinions more frequently than their FtF counterparts. This author suggests that the asynchronous nature of the medium allows shyer or less assertive students, who might need more time to formulate their responses, to contribute to a discussion from which they might have otherwise abstained in a FtF setting.

In terms of learner perceptions, most of the literature reports that learners value highly the opportunity to interact with their tutors and their peers in ACM conferences (Fox & MacKeogh, 2003; Gunawardena & Zittle, 1997; Hara *et al.*, 2000; Rourke & Anderson, 2001). Swan *et al.* (2001) found a significant correlation between learners' perceived amount of interaction with their instructors and perceived learning and overall satisfaction with the courses. Although opportunities to interact with the tutor were the greatest source of satisfaction, the researchers found that students who claimed a high level of interaction with other learners also had higher overall satisfaction and sense of achievement in learning. Similarly, in Thomas' (2002) study, certain students stated that online discussions facilitated the development of critical thinking skills and enabled them to reflect on the ideas presented by other learners. Thorpe & Goodwin (2006) also found that students valued interaction because they believed it broadened their views and enabled them to learn from different perspectives.

Despite these encouraging findings, a recurring theme in the research literature is the lack of interactivity in learners' postings, i.e. the tendency of online conference participants to post contributions without referring to those of their peers. For example, in two separate studies, Henri (1992; 1995) observed that over two-thirds of conference participants posted "serial monologues". Similar findings were subsequently obtained by McKenzie & Murphy (2000) and Pawan *et al.* (2003). Likewise, Hillman (1999) found that students in a computer-mediated environment used "lecturing" more frequently than students in the FtF mode of the same course. Along these same lines, based on her observations of an online discussion in a university philosophy course, Dysthe (2002, p.349) noted:

Some students spent much more time presenting their own examples than engaging with the ideas of fellow students.... There is a danger in an asynchronous discussion that students use the extra time primarily to present new information and to "say their piece", instead of considering the thoughts of others.

Likewise, Bullen (1998) sums up the perception of several participants in an ACM conference as follows:

For these students there was no “virtual community.” The online activity was not an interactive discussion, but just a series of messages posted to an electronic bulletin board. They felt no connection with their fellow students and thus felt no compulsion to go beyond the minimum participation required.

In a similar vein, several students in Thomas’s study described the online discussion as more “disjointed, stilted, and less spontaneous” than FtF discussions (2002, p.361). The author argues that the threaded format used in most discussion forums does not lend itself to interactive knowledge building.

In terms of the depth of cognitive engagement in ACM conferencing, very little research reports evidence of higher order critical inquiry. In a highly influential and often cited study, Gunawardena, Lowe, & Anderson (1997) developed a five-phase model for analysing social construction of knowledge in ACM discussions (see Table 1). The researchers found that the conferences under scrutiny rarely went beyond phases I and II. In other words, participants tended to share and compare information, as well as identify areas of dissonance, but there was little evidence of socially constructed meaning requiring the use of higher order critical thinking skills. In line with this model, Althaus & Matuga (1998) observed that statements of disagreement were infrequent amongst students participating in online conferences. Similar findings were reported by Kanuka & Anderson (1998), who also found that, although the conference participants’ knowledge base widened, their views on issues rarely changed as a result of interaction with their peers.

More recently, Larkin-Hein (2001) commented that through online discussions, students are better able to connect the topics being learnt to their everyday lives thereby facilitating the development of higher-order thinking skills. Nevertheless, the study did not use any tools to measure the extent to which higher-order thinking *is* developed, and therefore it remains more of a speculative conclusion. Similarly, Fox & MacKeogh (2003) claim that students engaged in the use of “higher-order cognitive skills” in the online conferences examined. However, a close analysis of their findings shows that the interaction in these discussions rarely moved beyond phases I and II in the Gunawardena *et al.* model. If we accept that socially constructed knowledge involves negotiation of meaning, co-construction of knowledge, and integration of that knowledge then Fox & MacKeogh’s claim appears not to be supported.

INSERT TABLE 1 HERE

Summary of the research on learner interaction

The research to date suggests that opportunities to participate in ACM conferences enable less vociferous students to participate more than they would in some FtF class settings. There is evidence that some learners value highly the opportunity to interact with their instructors and fellow peers. However, numerous studies have called into question the non-interactive character of asynchronous discussion environments, pointing to the tendency of participants to post serial monologues in which they do not refer to the contributions of their peers. In addition, there are few accounts of critical inquiry or of the social construction of knowledge in ACM environments. These findings lead us to further interrogate the research to determine whether the reported absence of socially constructed knowledge in ACM conferences is a product of the medium or due to other factors. In the following sections we will concentrate our analysis on three issues, namely: online sociability; the role of the tutor; and the effect of task design.

The effect of online sociability on interaction

Much of the research on social factors in ACM conferencing focuses on the importance of ‘social presence’ (e.g., Gunawardena & Zittle, 1997; Rourke *et al.*, 2001), a concept which has evolved over the past three decades. In their original formulation of social presence theory, Short *et al.* (1976) defined the construct as a property of telecommunications media. This theory predicted that the fewer nonverbal cues conveyed by a medium, the lower the level of social presence. Walther *et al.*, (1994, p.426) describe the principal claim of social presence theory as follows:

Social presence, or the salience of another person in an interaction, is said to depend on the number of channels or codes available within the medium; the fewer the channels, the less attention paid by the user to the presence of other social participants. As CMC [computer-mediated communication] filters out nonverbal channels—channels that are generally rich in interpersonal information—social presence should be lower, and messages presumably are more impersonal.

This theory, therefore, suggests that ACM conferencing is likely to be a relatively impersonal medium given the lack of nonverbal cues. However, in his social information processing (SIP) theory, Walther (1992) refutes the “cues-filtered-out” perspective, arguing that actors engaged in ACM environments will eventually overcome the limitations of this restricted form of communication and exhibit socially revealing, relational behaviour. An early prediction was that: ‘Given sufficient time for multiple message exchange and development...relational patterns in CMC and FtF settings should become similar’ (Walther *et al.*, 1994, p.466). In other words, students will recognise that they are engaging in the kinds of interaction familiar to them from experience of classrooms. Subsequently much of the research on ACM conferencing has substantiated this claim, reporting that participants generally find online environments reasonably convivial (see, for example, Gunawardena & Zittle, 1997; Wegerif, 1998; Hara *et al.*, 2000; Rourke & Anderson, 2002).

A significant development from Short *et al.*’s (1976) original formulation of social presence is that SIP focuses on the individual, and takes the medium for granted. According to Walther (1992, p.68):

...the term social information processing is used to describe the (individual) cognitive processing of socially revelatory information (a subsequent communication based on that information), rather than the social (conjoint) processing of information (about a medium).

Illustrative of this evolution of the construct is Rourke *et al.*’s (2001, p.51) definition of social presence, which they define as ‘the ability of learners to project themselves socially and affectively into a community of inquiry’. Similarly, Garrison *et al.* (2001, p.4) define social presence as the extent to which participants are able ‘to project their personal characteristics into the community, thereby presenting themselves to the other participants as “real people”’.

Various studies have explored the effect of social presence in ACM conferencing. Gunawardena & Zittle, for instance, found that social presence, as perceived by participants in various online conferences, was a strong predictor of satisfaction. The researchers also observed that individual learners who felt there was a high level of social presence frequently ‘enhanced their socio-emotional experience by using emoticons to express missing nonverbal cues in written form’ (1997, p.8). Along similar lines, Richardson & Swan (2003) found a correlation between the level of social presence perceived by students and their perceived learning gains and satisfaction with their instructors. Rourke & Anderson (2002) observed that overall satisfaction with the online social environment correlated with the following aspects of social presence: participants addressing each other by name, complimenting one another, expressing appreciation, using the reply feature to post messages, expressing emotions, using humour, and greeting one another.

In their framework for assessing social presence, Rourke *et al.* (2001) identified three main categories: affective, interactive, and cohesive (See Table 2.). Using this categorization scheme, along with a measure of “social presence density”¹, the researchers compared two ACM conferences and found that students posted twice as many messages and wrote four times as many words in the conference where there were significantly more instances of social presence. Similarly, Tu & McIsaac (2002) found that the level of participation was higher in online conferences with high levels of social presence.

INSERT TABLE 2 HERE

Numerous authors have highlighted the importance of a sense of community in ACM conferencing (e.g., Garrison *et al.*, 2001; Salmon, 2003; Garrison & Cleveland-Innes, 2005). Wegerif found that students who were not successful in an online course had failed to ‘cross a threshold from feeling like outsiders to feeling like insiders’ (1998, p.34). He concluded that:

Forming a sense of community, where people feel they will be treated sympathetically by their fellows, seems to be a necessary first step for collaborative learning. Without a feeling of community people are on their own, likely to be anxious, defensive and unwilling to take the risks involved in learning (1998, p.48).

In an attempt to evaluate learners’ perceptions of community in ACM conferences more objectively, Rovai (2002) developed the Classroom Community Scale. Using this measure, it was found that there was significantly more discussion and a greater sense of community when students were assessed on their participation in ACM conferences. With the exception of the studies cited above, however, very few empirical studies have been undertaken to investigate to what extent a general sense of community in ACM conferences translates into greater learner satisfaction or enhanced learning outcomes. According to Wallace (2003, p. 269):

...the literature specifically about online community is more anecdotal and case-based, more likely to illustrate the existence of community than to probe its origins or outcomes.

Finally, although the research indicates that a certain level of social presence and sense of online community is crucial for the success of ACM conferencing, Rourke *et al.* (2001) caution that an excessive amount of purely social activity might be counterproductive. In support of this view, Lamy & Goodfellow (1999) observed that the marked social presence of one of the tutors in their study appeared to sidetrack learners from the main aim of an ACM conference, which was to encourage them to reflect on their learning. Likewise, Garrison & Cleveland-Innes stress that, although it may be a necessary condition, online socialization on its own is not sufficient for pedagogical goals such as reflection to be realized:

...interaction is not a guarantee that students are cognitively engaged in an educationally meaningful manner. High levels of interaction may be reflective of group cohesion, but it does not directly create cognitive development or facilitate meaningful learning and understanding. Interaction directed to cognitive outcomes is characterized more by the qualitative nature of the interaction and less by quantitative measures. There must be a qualitative dimension characterized by interaction that takes the form of purposeful and systematic discourse (2005, p.135).

Summary of the research on online sociability

Contrary to early predictions that ACM conferencing would be a relatively impersonal medium, current research indicates that most students find the online environment welcoming and congenial. Indeed, social

¹ The social presence density of each conference was calculated by tallying all instances of social presence and dividing this number by the total number of words of all participants’ contributions. As these numbers were extremely small (i.e., in the 10⁻³ or 10⁻⁴ range), the results were then multiplied by 1000 to facilitate comparison.

presence has been linked to overall student satisfaction and perceived learning. In addition, levels of social presence and a general sense of community have been found to have a positive effect on the quantity and frequency of participation.

It is not clear from the research, however, what effect these social aspects have specifically on overall learning outcomes and the extent to which participants engage in higher order critical inquiry in ACM conferences. On the one hand, some research suggests that social presence and group cohesion seem to be a necessary condition for successful online conferencing. On the other, an excessive amount of socializing may hinder achievement of pedagogical goals. This is not unlike FtF situations, and is therefore perhaps not surprising. There would appear to be an optimal level of online socialization for knowledge to be constructed successfully amongst participants. This issue, however, has yet to be addressed by the research.

The establishing of the social atmosphere is no doubt influenced highly by the action of tutors. We will now turn to the research literature focusing on their role in ACM conferencing.

The effect of the tutor on interaction

The role of the tutor in helping students to achieve skills of higher order critical enquiry in online conferencing is summarized in a five-stage model proposed by Salmon (2003). The stages, which are necessarily interdependent are:

1. access and motivation;
2. online socialization;
3. information exchange;
4. knowledge construction; and
5. development.

According to this analysis, the role of the tutors, or ‘e-moderators’, is especially critical in stages 4 and 5. As she puts it, tutors:

...pull together the participants’ contributions by, for example, collecting up statements and relating them to concepts and theories from the course. They enable development of ideas through discussion and collaboration. They summarize from time to time, span wide-ranging views and provide new topics when discussions go off track. They stimulate fresh strands of thought, introduce new themes, and suggest alternative approaches. (2003, p.42)

In this view, the tutor is a facilitator whose main role is to moderate and ensure a sense of coherence in the online discussion. The degree of intervention required by the tutor will vary depending on the purpose and aims of the conference, and the extent to which students are participating. The tutor’s main goal is to engage the participants ‘to enable ‘meaning making’ rather than content transmission’ (Salmon, 2003 p.52). Therefore, according to Salmon, subject expertise is not an overriding requirement. Nevertheless, in order to moderate effectively and to recognize when a discussion goes off track, tutors should ‘know something of the subject matter’ (2003, p.51).

Another model regarding tutor role has been proposed by Anderson *et al.* (2001). These authors introduce the concept of ‘teaching presence’², which they define as:

the design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes (2001, p.5)

² Anderson *et al.* (2001) purposely use the term “teaching presence”, rather than “teacher presence”, in recognition of the fact that learners may also assume the role of teacher.

Three main teaching roles are identified as:

- 1) design and organization,
- 2) facilitating discourse, and
- 3) direct instruction (see Table 3).

Unlike Salmon (2003), Anderson *et al.* argue that subject knowledge and the ability to convey that knowledge, without dominating the discussion, is an important function of the online tutor in higher education. They conclude:

...we believe that there are many fields of knowledge, as well as attitudes and skills, that are best learned in forms of higher education that require the active participation of a subject matter expert in the critical discourse. This subject matter expert is expected to provide direct instruction by interjecting comments, referring students to information resources, and organizing activities that allow the students to construct the content in their own minds and personal contexts (2001, p.9).

INSERT TABLE 3 HERE

In terms of the tutor's role in promoting higher order critical inquiry, Anderson *et al.* assert:

A widely documented problem in computer conferencing is the difficulty of focusing and refining discussions so that the conversation progresses beyond information sharing to knowledge construction and especially application and integration. We believe that this stalling of the discussion at the lower levels of the critical inquiry process occurs when there is not adequate teaching presence in the computer conference. The teachers' summary is also normally not merely a "weaving" of the previous postings. It often serves to develop and explicitly delineate the context in which knowledge growth has taken place (2001, p.9).

To date, however, little empirical research has been carried out on the tutor moderating strategies in ACM conferencing. One exception is a study conducted by Garrison & Cleveland-Innes in which the researchers found that the tutors in four different graduate-level courses were instrumental 'in triggering discussion and facilitating high levels of thinking and knowledge construction' (2005, p.137). In a study focusing specifically on tutor interventions, Mazzolini & Maddison (2003) found no correlation between average number of postings per tutor and student participation, although students rated instructors who posted more frequently as more enthusiastic and expert in their subject areas. In conferences where teachers posted more frequently, however, the average length of student messages was significantly shorter, suggesting that an excessive amount of teaching presence may lead to lower levels of student participation.

In one of the few studies focusing on specific online teaching strategies, Yang *et al.* (2005) report on the use of Socratic questioning to enhance students' critical thinking skills. This study observed that tutors' use of this questioning technique increased students' level of critical inquiry as measured by the California Critical Thinking Test. Along similar lines, Gilbert & Dabbagh (2005), in a longitudinal study of an online course over four terms, found that the addition of facilitator guidelines, student posting guidelines, and assessment rubrics increased the level of 'meaningful discourse' in the ACM conferences.

One recurring theme in the research literature is the great time commitment required of tutors in order to moderate ACM conferences effectively (Browne, 2003; Fox & MacKeogh, 2003). In part to lessen this burden, but also to shift the focus of discussions from the tutor to the learner, peer moderating schemes have been used widely. In research in this area, Rourke & Anderson (2001) found that learners preferred online discussions moderated by their peers, although many participants felt that the peer-led discussions lacked depth. Similarly, other studies have noted a general absence of challenging of ideas in peer-led conferences (Althaus & Matuga, 1998; Hara *et al.*, 2000; Kear, 2004; Zhu, 1998). These findings suggest that, although

conference moderating can be delegated to students to a certain extent, tutor intervention is still necessary to instil a critical element into the discussions.

Summary of the role of the tutor

There is no doubt that tutors play a key role in ACM conferences. The various models that have been proposed regarding their role are open to critique and are, we suggest, inadequate summaries of a complex interactive reality. However, as yet too little empirical research has been conducted to substantiate theoretical claims. Thomas recommended that:

The facilitation of discussion must be a focus of further research and the mechanisms by which instructors are able to assist groups of students in creating vibrant online discussion made explicit (2002, p.363).

Subsequently, Gilbert & Dabbagh noted:

Although asynchronous communication tools have the potential to support knowledge construction, there are few research-supported models to assist instructors in the design of effective online discourse (2005, p.7).

Thus, few conclusions can be drawn with regard to the question of how much and what types of tutor intervention are most effective in promoting the social construction of knowledge.

In addition to their role in leading online discussions, tutors are often involved in the design of the online tasks in which students are asked to participate. In the following section, we consider the role of task type on the outcome of ACM conferences.

The effect of task type on interaction

The literature suggests a relationship between task type and learning outcomes (Jones & Asenio, 2001). It is likely that certain types of task will promote learner interaction and cognitive engagement more than others. Therefore, the question of interest to course designers is what types of tasks encourage collaborative dialogue for the social construction of knowledge and the development of higher order thinking.

Paulus (2005) points out that putting students in groups to work on set tasks does not necessarily lead to collaborative interactions. Hathorn & Ingram (2002) found that the level of student collaboration in ACM conferencing is affected by the type of instructions given for completing the task. In their study, two groups of students were told to collaborate on a solution, and the other two groups were told to select a role and discuss the problem from that point of view. The findings revealed that those groups that were instructed to collaborate were in fact more collaborative. However, they also found that these groups produced a solution of a lower quality than the other groups, suggesting that collaboration is not enough for the development of higher order thinking. In their study on the depth of online learning through interaction, Garrison & Cleveland-Innes (2005 p.145) similarly concluded that simple interaction, absent of structure (i.e. design) and leadership (i.e. facilitation and direction), is not enough. Design, facilitation, and direction are also the three categories of 'teaching presence' put forward by Garrison & Anderson (2003). Together, these three categories are seen to offer important guidelines for creating and maintaining cognitive presence in virtual learning environments and for promoting a deeper approach to learning.

In terms of design, Garrison & Cleveland-Innes (2005) stress the importance of defining clear expectations. Fundamentally, a clear formulation of the purpose of the task appears to be particularly helpful to learners. In an analysis of ACM conferences where foreign language learners were encouraged to reflect on their learning, Lamy & Hassan (2003) found that making learning aims explicit to participants was more important to

achieving the intended outcomes, than detailed structuring of a task. Garrison & Cleveland-Innes (2005 p.145) also suggest ‘selecting manageable content, structuring appropriate activities (collaborative and individual), and conducting assessment congruent with intended goals’.

Assessment is in fact a powerful extrinsic tool that affects learning. A study by Macdonald *et al.* (1999) on students’ perspectives of assessment revealed that assessment can encourage students to adopt new patterns of learning and get them to cover course content in order to achieve the desired outcomes. It is important, therefore, that each task is carefully constructed to be in line with the determined assessment criteria. The task should also be structured in a balanced way in order to enable sufficient freedom of manoeuvre for participants. This can be quite challenging as course designers will need to make many decisions such as how often to use deadlines, how detailed instructions should be, and how far participation should be encouraged or enforced (Jones & Asensio, 2001). Strijbos *et al.* articulate this dilemma:

An unresolved issue is when, how, and what kind of pre-structuring is used to support interaction. Too much structure may result in “forced” artificial interaction, but no structure may result in fragmented interaction or a situation where interaction could be seen as an optional activity instead of an essential process (2004, p.412).

Nevertheless, despite careful task design and clear assessment aims, the literature suggests that there can still be problems of interpretation in terms of how students understand what is expected of them. For example, Jones & Asensio’s (2001) found that students’ interpretations of their common set tasks varied within the group. This issue is therefore likely to have implications for the way in which students plan to co-ordinate their work and collaborate with one another in order to complete the tasks.

A useful six-step model for the development of online tasks has been designed by Strijbos *et al.* (2004), who have drawn from the research literature on face-to-face collaborative learning (see Table 4 below). Although the model is presented as linear, course designers are likely to consider these elements in random ways. They might well, for example, start by identifying group size, think about use of computer support, select a task type and then work on the objectives.

INSERT TABLE 4 HERE

Summary of research on task type

The research indicates that careful structuring of tasks is important to the success of ACM conferences. In particular, the literature highlights the importance of making explicit the purpose, learning aims, and assessment criteria, which are major influences on learner engagement and may therefore affect the extent to which higher order critical enquiry is developed. However, there is currently little research that explores in detail the impact of different levels and types of activity structuring. Likewise, whilst there are descriptions of the tasks students were engaged in, few of these have been written in peer reviewed journals and are consequently not always accessible through the usual academic and library research tools. As such, it is difficult to draw any conclusions with regard to task type. Furthermore, few empirical studies have been conducted comparing the effectiveness of different task types (e.g., convergent vs. divergent tasks) or groupings (e.g., whole class, small groups, or dyads). The model proposed by Strijbos *et al.* (2004) for the development of online tasks may provide a possible starting point for course designers. We may also be able to use the six elements as a framework for analysing task design.

New research agendas

As we have seen, much of the research has reported that learner interaction in which information is shared and compared is common in ACM conferences. However, it appears that interaction which goes beyond this level is rare. As yet, there seem to be few examples of published research which describe in detail and evaluate tasks that involve negotiation of meaning, synthesis, or assimilation of socially constructed knowledge. We have considered the quality of interaction in ACM conferencing from the three perspectives that have received some attention in the literature: social aspects, the role of the tutor, and the role of task type. We now present some suggestions for further research.

Although the concepts of social presence and online community seem to be strongly linked to the success of online discussions, their effect on the quality of critical online discourse has not received sufficient attention in the research. The framework proposed by Rourke *et al.* (2001) (see Table 2) could be a useful point of departure for examining this area.

With regard to teaching and moderating strategies, tutors face the dilemma of when to intervene and when to step back and allow learners to assume control of the online discourse. This is problematic in any educational setting, but it is especially the case in ACM environments, where the tutor cannot observe nonverbal cues, such as learners' facial expressions, gestures, or tones of voice. Research is therefore sorely needed to shed light on what type and how much tutor intervention is most effective in promoting higher levels of critical inquiry. Theoretical models of the role of the online tutor, such as the one put forward by Anderson *et al.* (2001), could be used to guide research in this direction.

Task type and its role in promoting critical discourse is a third area that deserves attention. Most of the current peer-reviewed research lacks clear descriptions of the tasks learners were engaged in, and this is perhaps due to the fact that the vast majority of ACM conferences have been based on general discussions with no clear outcomes. It is crucial, therefore, that research be carried out with learners engaged in a variety of task types to evaluate their relative effectiveness. This will require researchers to provide clear accounts of these tasks.

Since much of the research on ACM conferencing focuses on isolated cases, it has been difficult to identify successful models and interventions. Future profitable areas for research are comparative and action research studies that may help to determine the effectiveness of specific practices. In addition, longitudinal research which compares different student bodies undertaking the same course is likely to be helpful, possibly following the study conducted by Gilbert & Dabbagh (2005), in which the evolution of the same course is followed over four terms.

Finally, future research should also focus on the role that individual learners have in promoting higher order critical inquiry and social construction of knowledge in ACM conferences. This is an aspect which has been all but ignored by empirical research and which, in light of increasingly favoured learner-centred approaches, should be an area of considerable interest.

Conclusion

Despite the limitations of the research findings to date with respect to higher order critical inquiry and socially constructed knowledge in ACM conferences, we remain optimistic that social constructivist goals can and will be achieved effectively in such environments. The key to attaining these, however, will depend not so much

on the intrinsic properties of the online medium, but rather on stimulating and encouraging appropriate interactions between students, tutors, and materials. We are pleased to propose a substantial agenda for future research. It is likely that interactions between teaching and research or rather research-led teaching will provide the guidance for course designers and developers on how best to utilize this still relatively new form of teaching and learning.

Authors' Biographies

Will Gibson is Lecturer and Course Leader for Master in Educational and Social Research, University of London, Institute of Education

Joseph E. Hopkins is Lecturer in English as a Foreign Language, Universitat Oberta de Catalunya, Barcelona

Cristina Ros i Solé is Principal Research Fellow in Language Pedagogy, University College, London

Nicola Savvides is Research Officer, University of London, Institute of Education

Hugh Starkey is Reader of Education and Fellow of the Centre for Distance Education, University of London, Institute of Education

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Table 1: Interaction Analysis Model for Examining Social Construction of Knowledge
(Gunawardena *et al.*, 1997)

Phase I:	Sharing/comparing of information
Phase II:	Discovery and exploration of dissonance or inconsistency among ideas, concepts, or statements
Phase III:	Negotiation of meaning/co-construction of knowledge
Phase IV:	Testing and modification of proposed synthesis or co-construction
Phase V:	Agreement statement(s)/applications of newly constructed meaning

Table 2: Categories of social presence in ACM conferences identified by
Rourke *et al.* (2001)

Affective:
Expressions of emotion
Use of humor
Self-disclosure
Interactive:
Continuing a thread
Quoting from others' messages
Referring explicitly to others' messages
Asking questions
Complimenting, expressing appreciation
Expressing agreement
Cohesive:
Vocatives
Addressing or referring to the group using inclusive pronouns
Phatics, salutations

