

Pedagogic strategies supporting the use of Synchronous Audiographic Conferencing: A review of the literature

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Abstract

Synchronous audiographic conferencing (SAC) refers to a combination of technologies for real-time communication and interaction using multiple media and modes. With an increasing institutional uptake of SAC, users require an understanding of the complex interrelations of multiple media in learning scenarios in order to support pedagogic-driven planning and effective use of the tool. This paper provides a review of recent literature that explores the pedagogic strategies used to underpin practical uses of SAC for the benefit of learners especially in non-standard contexts such as distance education. The paper reports on approaches from practitioner-oriented perspectives as well as approaches based on educational theory, notably the community of inquiry model, task design and multimodal models of cognition, meaning and interaction. The main features of these models were extracted to provide both a synthesis for future work on dedicated pedagogic models for SAC and a resource for practitioners wanting to link SAC with educational theory.

Introduction

Distance education and remote learners need particular kinds of tutorial and peer support, both to ensure motivation to remain on the course and to provide support to achieve well in the process of learning (eg, Threlkeld & Brzoska, 1994). Without the regular face-to-face contact of tutors and other students, it is easy for learners not to give the maximum effort required or, worse still, to abandon learning altogether. General trends towards tools that integrate a range of functionalities are emerging with the wider access to broadband and web-based services, and these offer scope for providing the necessary additional support required by these learners. One of these tools is synchronous audiographic conferencing—or SAC—which refers to a combination of

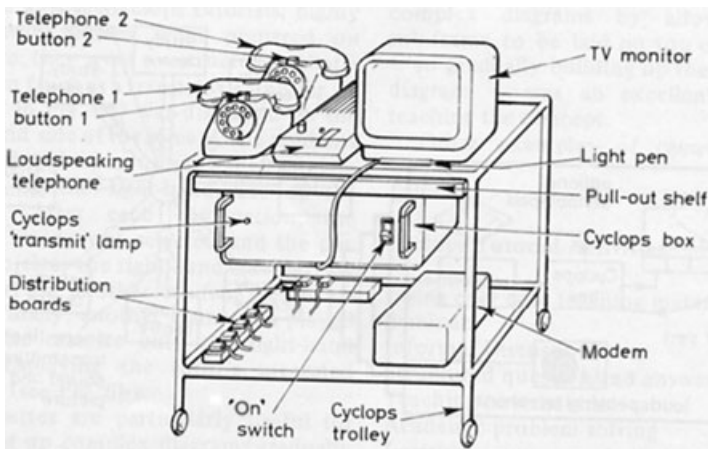


Figure 1: Cyclops study centre trolley. Source: McConnell (1983)

several technologies that provide synchronous communication and interaction using multiple media and modes at the same time. SAC systems are typically based on one- or multiway live audio transmission, a shared display of visual information—most often in the form of a virtual whiteboard, which allows participants to annotate slides or produce simple drawings collaboratively in real time—and text chat similar to instant messaging systems. SAC offers a means to provide extra tutorial support needed, has relatively low associated costs and can also work in low bandwidth contexts (eg, developing world), which is typically still difficult for other media-rich technologies such as video conferencing (Coghlan, 2005).

Examples of early SAC systems include the Cyclops application (McConnell, 1983) that was developed at the Open University (Figure 1). Cyclops was a response to the limits of tuition over the phone; in particular, the system offered the opportunity to integrate audio with visual and graphical data, notably allowing for the adoption of ‘shared screen’ technology as a new tutorial tool. Current systems usually are based on the web and do not require specialised equipment beyond a computer, a headset and an optional webcam.

The three SAC core functions, live audio, shared visuals and text chat already represent three different communication modes. In addition, SAC systems often also integrate presence indicators, visual cues (eg, the use of emoticons) and instant feedback or voting functions to elicit quick responses and to monitor and coordinate participant involvement. Screen or application sharing provides a more complex tool for interactions by operating any software application from any connected computer by any of the other participants. Session leaders usually have numerous options to ‘coordinate’ the group by instantly creating breakout rooms for smaller groups of participants, by pushing website uniform resource locators, videos or other media to the participants’



Figure 2: Components of the SAC environment Elluminate. Adapted from Neumann and Carrington (2007)

displays, by handing over or retracting control over certain functions, or sometimes even by looking at a participant's local screen display remotely. Finally, specialised tools may include online questionnaire facilities with an instant-shared graphical analysis of the questionnaire data, live video transmission (although this can exclude some participants because of bandwidth requirements) or live file transfer to share further information during a session. (Figure 2)

The market for SAC systems is broad, diverse and dynamic. Far more than 100 products are currently available commercially for a range of platforms, with flexible licensing plans based on effective usage time or number of users (Thinkofit, 2007). Promising open-source developments are currently in alpha or early beta stage, and are increasingly supported by larger funding bodies, for example, the Agora project at Lancaster University (Fish & Gonzalez Losa, 2007, <http://agora.lancs.ac.uk>), funded by the Joint Information Services Committee and the Economic and Social Research Council in the UK. The main difference with earlier tools such as the Mbone (multicast backbone) tools—partly developed by the University College London's Network and Multimedia Research Group (<http://mediatools.cs.ucl.ac.uk>)—is an enhanced usability that does not require special technical knowledge for administration and use. The term 'synchronous audiographic conferencing' itself is still under discussion; the same technology is referred to elsewhere by terms such as webinar, web meeting, desktop or teleconference, virtual class or webcast (Hyder, Kwinn, Miazga & Murray, 2007). SAC describes the technology rather than the purpose or context and is therefore more neutral. Thus, the term can be used for learning, e-administration, marketing, technical support and leisure activities, across disciplines and across sectors.

In this way, SAC can address a range of uses and has many application scenarios. Some of these may be achieved with traditional video conferencing, such as small team meetings or video streaming, such as live lecture broadcasts. SAC, however, goes beyond that; for example, it can be used for rapidly recording voice-overs alongside a set of slides or screen interactions. In remote supervision sessions, tutors can leave annotations and edits directly in electronic student documents via application sharing, which is also useful in help-desk scenarios for remote computing support. Groups, both on- and off-campus, can collaboratively produce diagrams and run formative questionnaires with instant visual analyses. SAC has particular strengths where rich interactions need to be run at-a-distance and where visual interaction focuses on data, graphical objects, visual artefacts and text alongside the audio conversation, rather than where there is an emphasis upon body language and visually-based communications.

One problem of SAC though, is that the combined use of media presents a challenge for education practitioners. While existing practitioner guides are helpful for operating the multimedia environment that SAC represents, they do not provide high level support for understanding the interrelations of multiple media used synchronously for learning purposes, nor a consideration of the current models being used to support practice (de Freitas & Neumann, 2007). In earlier works, it was found that little, if any, literature has identified how practitioners could use existing pedagogic strategies and models to support using mixed media. This study regards the importance of identifying current pedagogic strategies and models to support practitioners' use of SAC as central to more effective use of this technology. Therefore, this article aims to review and summarise current models being used with SAC and consider some of the practical challenges with using SAC, in order to point out existing resources that address conceptual issues and support pedagogic-driven planning and use of SAC. The authors are taking this study as a basis for development and testing of a more integrated and SAC-specific model.

Methodology

This review comes out of a study being undertaken as part of the Models for Synchronous Audiographic Interactive Conferencing project funded by the Centre for Distance Education, University of London. The Centre was set up by the External Programme of the University of London to support distance education delivered by the colleges of the University of London as well as informing developments within the External Programme.

The scope of this review includes the use and application of SAC. We have purposefully omitted related technologies, such as web streaming and webcasting (and mobile casting), or pure audio or video conferencing in particular as SAC has a more interactive dimension, providing the potential to engage learners more effectively—a necessary aspect of maintaining the interest of distance learners. Also, we did not focus upon components of SAC systems in isolation, such as application sharing or text chat, as it is the combination of all of these media and technologies that establishes additional potential and challenges.

Table 1: Keyword search results table

<i>Term used (2000–2007)</i>	<i>Search returns (no.)</i>
Audiographic conferencing	31
Conferencing	30 600
Video conferencing	16 400
Teleconferencing	7 930
Web conferencing	673
Synchronous conferencing	314
Synchronous audiographic conferencing	0

Key texts have been identified primarily through the use of a keyword search in Google Scholar and a search of electronic databases, according to the systematic review methodology employed in the Evidence for Policy and Practice Information and Co-ordinating Centre, part of the Social Science Research Unit at the Institute of Education (<http://eppi.ioe.ac.uk/>). A hand search of key educational technology journals has been used to supplement the main texts found. We excluded anecdotal reports and selected only papers that provided a clear link between SAC practice and pedagogic theory. Two coders were used to identify the key texts selected in this review according to their relevance to SAC and pedagogic modelling, strategies and practices for assisting tutors with using SAC.

The literature review was conducted using a Google Scholar advanced keyword search (undertaken on January 11, 2007). See Table 1 for summary of numbers of articles found through a basic Google Scholar search. Because of the fast moving nature of the field, the search has focused upon identifying key texts from the year 2000, texts previous to this date have been excluded, unless identified as a key by another reviewer or recommended by an expert, or recommended in other identified reviews in the field.

To reduce the high number of results, generic and not directly related keywords, such as ‘conferencing’ and ‘video conferencing’, were ignored. To supplement the literature review, a small number of experts in the field have been interviewed to identify key texts, to validate the review undertaken and to help identify key issues, themes or factors for inclusion in this summary report. These key themes were used to further reduce the number of resources in combined keyword searches, and after further exclusion, based on a review of 258 abstracts, we reviewed 59 resources in more detail. The synthesis of the review is included within this article.

Review of literature

Despite the increasing use of SAC, often to support distance education and language learning (Modern Languages Review Group, 2005), the use of audiographic technology as noted in the literature has remained an ‘under-researched and under-theorised’ area (Erben, 1999; see also: Hampel, 2003). In addition, there has been a dearth of work pertaining to the pedagogic strategies taken with using SAC technologies (Schullo

et al., 2005). In this way, the theoretical basis for using SAC technology has often been neglected in favour of more technical approaches, and recently, with more practical guides for users (Hofmann, 2004a). The focus on technology and the explanation of features, however, left many tutors unclear about application scenarios and therefore the usefulness of SAC, potentially leading to reduced uptake. The recent practical guides have started to address this gap, but their focus on the use of features often leaves out pedagogical issues or does not address them explicitly. They thus lack guidance on how to link SAC with learning aims and integration into larger teaching scenarios, so the learners' needs are not always served most effectively.

Much of the literature associated with the area has placed greater emphasis upon technical problems and how to overcome them. We acknowledge that there are still significant non-pedagogic challenges for practitioners wishing to engage with SAC, including technical issues, restricted numbers of users, licensing issues, availability of good practice guides, and frameworks and institutional issues. However, as users move from experimental phases into wider usage and uptake of SAC, pedagogic issues become ever more important. We thus deem the findings, although limited in number, valuable for practitioners and theorists alike as a reflection of the current state of pedagogic development in the field.

Pedagogic strategies supporting the use of SAC

While the body of peer-reviewed academic literature in the area is relatively small, our searches uncovered a more substantial area of literature concerning practical manuals and guidelines. These are aimed at practitioners intending to use SAC in their learning and teaching practice (eg, Brandon, 2005; Finkelstein, 2006; Hofmann, 2004a, b; Hyder *et al.*, 2007). While these guides provide helpful guidance for practitioners, it is notable that few offer pedagogic models, theories or frameworks.

Finkelstein (2006) does, however, touch upon these issues in his discussion of skills that can be developed and assessed in live online conferences, and in his review of good practice, which identifies collaborative engagement and active learning as important principles in SAC. His review is based on Chickering and Gamson's (1987) 'Seven Principles for Good Practice in Undergraduate Education', which Finkelstein maps as a pedagogic model to real-time online learning. Based upon 50 years of research into learning and teaching, the seven principles outline good practice in undergraduate education as:

- encouraging contact between students and faculty;
- developing reciprocity and cooperation among students;
- encouraging active learning;
- giving prompt feedback;
- emphasising time on task;
- communicating high expectations; and
- respecting diverse talents and ways of learning.

Notably, these principles still provide a valuable strategic checklist for practitioners using SAC.

MacDonald (1998) makes a clearer link to pedagogic models. In his book on audio and audiographic learning, he does not only report on practice in a series of short case descriptions, but presents a detailed SAC strategy based on a discussion of experiential learning and the experiential learning cycle (Kolb, 1984). The cycle suggests successive activities addressing experience, reflection, generalisation and application, preceded by orientation and clarification sessions and followed up with an evaluation activity. MacDonald (1998) concludes that the principles of this model 'are consistent with good teleconference practice' (pp. 121–122), and he translates the model into a thorough practitioner guideline for instructional design based on learning activity/methods and resource charts, including an evaluation strategy that addresses a comprehensive range of issues related to SAC, from interaction and media quality to site facility and economic factors.

A survey undertaken in 2004 for the Observatory on Borderless Higher Education (Bonk, 2004) polled experts about their views on instructional strategies likely to be widely used by 2009. The responses in Figure 3 show high scores for group problem solving and collaborative tasks, problem-based learning and discussion, case-based strategies and simulations, and role-play. Interestingly, the practitioner guides identify similar strategies as particularly suitable for SAC; other work with learners addresses these strategies in more detail such as a suite of surveys done by the Open University (Kirkwood & Price, 2005).

One recent paper (Schullo *et al.*, 2005) has explored pedagogic strategies in SAC in a more detailed and methodical way. Focused upon distance education, the paper argues that there are two main challenges: ensuring the maximum interaction with groups

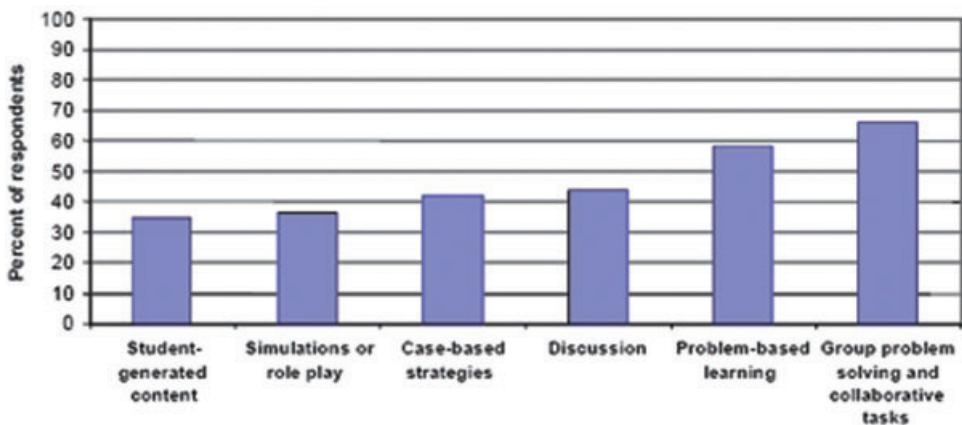


Figure 3: Instructional approaches most likely to become more widely used. Source: Bonk (2004)

and a 'lack of confirmed pedagogic strategy for supporting work in synchronous environments' (Schullo *et al.*, p. 3). Their review found that learners who became isolated were not helped greatly by the use of asynchronous methods (eg, email correspondence and bulletin boards) as 'lack of immediacy still makes it difficult for students to connect quickly with each other or their instructor' (Schullo *et al.*, p. 3). Also, passive modes of delivering content and a lack of active student participation or effective interaction cause more extreme problems in distance education groups, such as high drop out rates, because of limited or no face-to-face contact between students and tutors (eg, de Freitas & Roberts, 2004).

The study undertaken examined pedagogic strategies used with SAC at a large metropolitan university in the USA. The pedagogic strategies used included a mix of lecture, interaction, questioning and discussion, and problem-solving group activities were implemented through scenarios. Instructors appeared to use the SAC environment effectively, and learners perceived that the learning objectives were clear and well aligned to SAC activities. Overall, the study found that SAC was effective, particularly for distance learners, and that the role of the tutor is still important even where learner autonomy strategies are in use; however, there is a need for guidelines to support tutors.

While the above literature approaches pedagogic strategies for SAC from a practitioner-oriented perspective, we identified literature engaging more deeply with educational theory. We grouped these findings broadly into the three areas of Community of Inquiry (CoI) model, task design and multimodal models.

Community of inquiry model

The CoI model is relevant for this review as it is based on the notion that interaction is central to the effectiveness of education. As noted above, Schullo *et al.* (2005) regard SAC as an effective means to enhance interaction in the distance education context. The CoI model considers the pedagogic strategies employed with computer conferencing, and although Garrison, Anderson and Archer (2000) focused upon textually based asynchronous computer-mediated conferencing (CMC), their study provides a model and consideration of the key pedagogic issues, which can also be applied to the more live and synchronous experience of SAC. They argue that three aspects of CMC are needed for any educational transaction: cognitive presence, social presence and teaching presence (see Figure 4).

The model apportions importance to the community of practice (or inquiry) that has formed in support of the educational experience. Cognitive presence is the 'extent to which the participants in any particular configuration of a community of inquiry are able to construct meaning through sustained communication' (Garrison *et al.*, 2000, p. 89). Social presence is defined as 'the ability of participants in the community of inquiry to project their personal characteristics into the community, thereby presenting themselves to the participants as "real people" ' (Garrison *et al.*, p. 89). Teaching presence includes two main elements; these elements are normally undertaken by the tutor.



Figure 4: Community of inquiry model. Source: Garrison et al (2000)

The first is the design of the educational experience, including the selection, organisation and presentation of the course content. The second element involves facilitation.

From the study, Garrison and colleagues (2000; Garrison & Anderson, 2003) argue that there is a connection between text-based communication and higher-order cognitive learning, allowing as it does time for reflection (Garrison *et al*, 2000: p. 90). They argue that:

... the use of writing may be crucial when the objective is to facilitate thinking about complex issues and deep, meaningful learning (Garrison *et al*, 2000, pp. 90–91).

This may be difficult to address with SAC; its synchronous nature may not leave sufficient time for reflection, especially in a tutor-paced scenario that puts restraints on student control. Laurillard (2002) highlights the danger that academics ‘can all too easily make use of [SAC] for delivering new material, rather than allowing a student-led discussion to develop’ (p. 155). However, it can be argued that other oral-based synchronous teaching methods, including face-to-face classroom teaching, are facing similar challenges. Consequentially and similar to face-to-face contexts, in SAC, a variety of media can be used separately or together (eg, text, video, audio, other visuals) and thus generate a richer variety of representations, adding a wider range of opportunities to the pedagogic portfolio.

Garrison *et al* (2000) follow the view that the educational experience is 'a collaborative communication process for the purpose of constructing meaningful and worthwhile knowledge' (Garrison *et al*, p. 92), as cognition cannot be viewed as separate from the social context. In their terms, collaboration is an essential element of cognitive development, affecting the nature of learning outcomes and activities (Resnick, 1991).

Related to the social context is the notion of social presence, which is a basic parameter in communication studies when effects and perceptions of communication technology are assessed. Short and colleagues (1976) define social presence as the ability of a medium to allow people to feel the actual presence of a communicator, and Gunawardena and Zittle (1997)—as well as Anderson and Garrison (1995)—extend this by referring to the need for a necessary degree of comfort and safety to express ideas in a collaborative context. Wenger and his communities of practice concept picks up on social aspects and recognises the legitimacy of 'peripheral participation', that is, moving from novice to expert through participation within defined or even undefined groups of practice (Wenger, 1998). Little, Fowle and Quintas (2003, p. 5) include SAC as part of an infrastructure that supports communities of practice 'to emerge and be maintained'. Bradner and Mark (2001) examined the social presence concept in relation to SAC-related media and established the importance of social presence for learning, while highlighting that the use of application sharing alone, an integral tool of SAC systems, already established a high level of social presence that could not be surpassed by the addition of video. For distance education, SAC is therefore one of the tools with the highest potential to establish social presence, provided that the toolset for fostering interactions is exploited.

Anderson and Garrison (1995) also stress that it is the instructional design, alongside how the technology is used to create the learning environment, which is most important for achieving high-quality learning outcomes. Consequently, an instructional model dedicated to SAC should enhance the quality of learning with this technology more than the application and required adjustment of non-specific models. To emphasise this point, Garrison and colleagues (2000) acknowledge that different media may have 'different potentials to address cognitive, social and teaching presence' (p. 92). They conclude that in particular, computer conferencing requires teaching presence in order to foster more active discourse and knowledge construction (see also: Gunawardena, 1991; Hiltz & Turoff, 1993).

The blended learning model (combining face-to-face with online interactions) was also noted as an effective approach.

When designing an educational experience supported by computer conferencing, consideration should be given to an initial face-to-face meeting where relationships and a comfort level can be established (Garrison *et al*, 2000, p. 97).

SAC, though, has more potential to create blends that go beyond start-up face-to-face meetings. Neumann and Carrington (2007) report on a Multiple Venue Production

setting, where face-to-face groups of people are linked to other remote groups and individuals with SAC technology, thus creating opportunities to interact online and face-to-face at the same time. The role of a team of mediating tutors becomes crucial in this process, which needs creative pedagogic solutions to develop into a meaningful learning experience.

Task design

Task-centred work on SAC emerged in the context of language learning. In this field, Hampel (2006, p. 105) notably emphasises the importance of educational theory and argues that:

... [a] theoretical approach based upon second language acquisition (SLA) principles, sociocultural and constructivist theories and concepts taken from research on multimodality and new literacies, can influence the design and implementation of tasks for computer-mediated communication (CMC).

For Hampel, the main role of the tutor is to design the tasks as appropriate to the medium. Klapper (2003, p. 35) defines tasks as:

... meaning-based activities closely related to learners' actual communicative needs and with some real-world relationship, in which learners have to achieve a genuine outcome ... and in which effective completion of the task is accorded priority.

Rosell-Aguilar (2005) regards task design as key criteria for effective use of audio-graphic conferencing. This approach has benefits for language learners, he argues, creating a 'collaborative learning environment within the principles of social constructivism' (Rosell-Aguilar, p. 418). His work has centred upon notions of CMC, defined as the 'communication that takes place between human beings via the instrumentality of computers' (Herring, 1996, p. 1). While CMC focused initially upon text-based interactions then text and audio interactions, this gradually evolved to include video conferencing allowing visual cues to be included in CMC.

Interestingly, Rosell-Aguilar does not see any evidence that video conferencing improves performance and argues that the use of video conferencing slows down the quality of audio, possibly impairing effectiveness of learning. Other studies have found no significant advantage in the use of a video channel (Gale, 1990; Heath & Luff, 1992; Isaacs & Tang, 1994; Smith, O'Shea, O'Malley & Taylor, 1991), although its potential was acknowledged for particular purposes. In relation to supplementing text with diagrams and multimedia, Ollerenshaw and Aidman (1997) and Sweller (1990) argued that visual or interactive supplements sometimes impede learning as they may be too distracting, contradictory to other modes or lacking informative value. Matarazzo and Sellen (2000) argue along similar lines in their findings that low-quality video was more effective for task collaboration than high-quality video, and that video may be detrimental if only used to show images of the participants.

This work has some resonances with a body of work focusing upon the effectiveness of simulations, and debates about levels of fidelity required for supporting improved performance (eg, Hays & Singer, 1989) have been broad. However, in simulations that use visuals purposefully and where technical loss of quality is not a factor, high degrees of verisimilitude have been found to aid learning (Delanghe, 2001) and create easier transfer between simulated and real learning contexts, a significant hurdle in experiential learning (Simons, van der Linden & Duffy, 2000). Task design can therefore not be completely separated from issues related to media and learning, which are discussed below.

Multimodal models for SAC

The concept of multimodality can provide a useful framework to improve understanding of SAC as a medium, also highlighted by Hampel (2006) in the context of task design. Interestingly, research on SAC seems to mirror the development of research on multimodality: early studies from the 1980s were largely technology-driven (Flanagan, 1996), while sociologists began exploring the field about 15 years later. Today, the field distinguishes multimodality from multimodality, multisemiotics and, particularly important for learning contexts, multiliteracies. Main strands of literature come from Jewitt (2006), Kress and van Leeuwen (2001) and Lankshear (1997) and the New London Group (1996), which attempts to design a pedagogy of multiliteracies.

The concept of multimodality goes far beyond a concept of multimodality, which Poletti (2006, p. 1590) simply defines as 'communication that uses various media' and as such, is more of a descriptor of the communication procedure. Cognitive science, though, tells us that this procedure should not be ignored; research on multichannel information processing makes pragmatic recommendations for working in and with multimodal environments. Bodemer, Ploetzner, Feuerlein and Spada (2004), for example, warn that an incorrect handling of a combination of media and modes may overwhelm the cognitive capabilities of a learner, even resulting in negative learning transfer. Such warnings are particularly apt in the SAC context as users do not just have to divide their attention between multiple information channels, but as Hofmann (2004a) notes, they often are performing other tasks outside the SAC environment, either at or beyond their personal workstation.

This refers directly to cognitive load theory (Paas, Renkl & Sweller, 2003; Sweller, 2005) and derived or related principles (see Mayer, 2005), such as the split-attention or modality principles. These cognitive principles are now relatively well-understood, and from them, instructional guidelines have been developed for asynchronous multimedia. However, Clark (2005, p. 592) notes with direct reference to SAC that 'because these guidelines are anchored in human cognitive processes, we should be able to apply them to synchronous environments'. Most of these guidelines seem to suggest that in order to reduce cognitive load, redundancy within a single mode should be reduced in order not to divert the attention of the learner. In their summary of educational research on cognitive science, Moore, Burton and Myers (1996) list a range of cognitive concepts,

including cognitive load theory, in support of multimodal information processing for learning; some of which have been taken forward by Sankey and Nooriafshar (2005) to demonstrate their practicability in the design of pedagogic strategies and educational materials based on combinations of media and modes.

However, users in a multimodal environment need the ability to understand and work with the wide range of possible combinations of modes and media, which Kress, Jewitt, Osborne and Tsatsarelis (2001) aptly labelled an 'orchestration of meaning'. Modes can be combined in hierarchical, complementary or other formats (Kress & van Leeuwen, 2001), and according to Hauck and Youngs (2008), the competence in combining modes sensibly define the 'extent to which tele-collaborative partners can benefit from an exchange'. Here, cognitivist views may not be sufficient to fully understand the complex interactions, especially social interactions, in multimodal contexts. This is where the concept of multimodality becomes important: Kress and van Leeuwen (2001) describe multimodality as the use of 'several semiotic modes in the design of a semiotic product or event, together with the particular way in which these modes are combined' (p. 20). By referring to semiotics, they explicitly include the wider cultural domain and regard a social component as essential in the construction of a representation of meaning.

The inclusion of the cultural context is made very clear in the New London Group's (1996) suggestion of a theory of pedagogy in relation to multiliteracies. They identified four interrelated components that, as they stress, must 'always be integrated with the "practical knowledge" of master practitioners' (p. 82):

- *Situated Practice*: Immersion in experience and the utilisation of available discourses
- *Overt Instruction*: Systematic, analytic, and conscious understanding
- *Critical Framing*: Interpreting the social and cultural context of particular designs of meaning
- *Transformed Practice*: Transfer in meaning-making practice. (The New London Group, 1996, pp. 83–86)

The Overt Instruction component is noteworthy in that it suggests that students need to 'come to conscious awareness of the teacher's representation and interpretation' of a task, which is also an important aspect in Laurillard's Conversational Framework (2002), and is highlighted in the notion of 'transactional distance', that is, the distance between learners and tutors which is reduced through dialogue (Moore, 1993). The New London Group (1996), however, calls for an introduction of explicit metalanguages that can describe meaning in different modes and their combination. While such metalanguages have still not evolved, researchers such as Jewitt (2006) have started to explore the impact of new technology on learning pedagogy and are moving towards toolsets for analyses of multimodal representation and communication, though at this stage, primarily for research rather than teaching.

Nevertheless, the concept of multimodality, especially in combination with cognitivist views on multichannel information processing, seems to be promising in order to help

understand representations of meaning that are constructed while communicating in SAC environments. Considerations about multimodality should not revisit the great debate whether the delivery medium influences learning (Russell, 2001), but rather focus upon how to work with representations of tasks and meanings. This is what the concept of multiliteracies attempts to solve, although there does appear to be a gap between the theoretical understanding and practical application. It may be worth investigating the practice-oriented field of audiovisual media production to learn about media handling in practice and to find out whether practice matches theoretical assumptions from research on multimodality.

Discussion and conclusions

The review demonstrates that a pedagogic basis for the effective use of SAC is available from existing literature. In particular, the notion of social presence has particular resonances with SAC as a synchronous source of information delivery on one level but importantly, as a space for social interactions between learners and between learners and tutor. The use of social presence has important advantages for engaging and retaining the interest in particular of distance and remote learners, but may also have scope for supporting SAC used with face-to-face cohorts of learners, in particular larger groups of learners. In addition to the importance of using social presence effectively with different learner groups, distributed or local, the community of inquiry model may be valuable for supporting learning activity design. The reviewed models clearly show the importance of task design with respect to the particular medium, and all models indicate how the role of the tutor and how they design the activities needs to be sensitive to the context of use, the medium chosen and the particular learner group. With SAC, the additional aspect of live social interactions with peers needs special consideration, and can add valuable support for learners in terms of feedback to assignments and retention on the course, both of which may be problematic with distance learning groups.

One way that the learners' interactions can be better supported in SAC is through specified design of discussion and dialogue. In her description of the Conversational Framework (Laurillard, 2002), Laurillard directly refers to SAC and notes that pure online communications manage primarily the discursive level within the learning process. What makes SAC tools interesting is that they embody practice-based tasks, as reported in some of the literature. The graphic displays and opportunities for interaction provide a means for learners to practise tasks (which can also be done orally if the topic is verbal as it is in say, languages or in negotiating skills) and to discuss their reflection on those tasks, and therefore, can cover the whole Conversational Framework (Laurillard, 2002) if well designed. The section on audio conferencing in Laurillard's book (2002; p. 155) makes the point that this is 'potentially the most powerful medium so far in terms of coverage of the Conversational Framework'. Her framework is powerful for detecting and balancing aspects of the learning process when designing or evaluating pedagogic strategies, which is especially important when engaging in new immersive ways of blending online technology with face-to-face scenarios such as

Multiple Venue Productions (Balzer, 2004; Neumann & Carrington, 2007). This review has shown how SAC provides an opportunity for learning through interactions in real time across distances, and is thus an attractive option for distance and online education.

As evidenced in the review, whether adopting a community of inquiry or multimodal approach to the use of SAC, the dialogic role of a tutor as learning facilitator and a confirmed pedagogic strategy seems central to ensure a maximum benefit from such interchanges (Schullo *et al.*, 2005). Building upon this literature review, the authors are working towards a new model for SAC, which will give the greatest emphasis to the need for the tutor to manage a systematic and conscious understanding derived from multimodal representations of knowledge and meaning (The New London Group, 1996). This is a social task just as much as an individual multichannel cognition task. In our view, a combination of the main features of CoI, task design and multimodal models has the potential to enhance the robustness and practicality of pedagogical strategies, ultimately leading to more holistic and systematic approaches to achieving learning outcomes in SAC environments. However, while CoI and task design models are already pragmatic enough to be used in pedagogic planning, not all multimodal models have reached the stage at which they can be used as pedagogical frameworks or guides. We expect current work in this field to provide answers as to how a multimodal load can be handled effectively on individual and social levels, in order to derive activities that facilitate technology-enhanced learning.

Any model should also be sensitive to the multiple purposes of SAC. One of the key aspects highlighted by Finkelstein (2006) is the way using SAC can allow better access to expertise, but he also highlights how the tool can allow for concepts to be applied and critiqued in real time, with potential to overcome the problem of transferral of conceptual work into real contexts of use. One of the related aspects of SAC is its potential to inform and support not just direct and formal learning but also serendipitous, vicarious learning and professional interactions (Finkelstein, 2006; see also McKendree & Mayes, 1997). This aspect of SAC promotes opportunities for unplanned learning through impromptu conversations and exchanges, unplanned chats, serendipitous meetings and more emphasis upon learner-led activities. In this way, it may also allow for a greater blurring between formal and informal learning.

Overall, our findings seem to suggest that SAC represents a largely undiscovered opportunity for implementing and supporting effective pedagogic strategies for the benefit of learners, especially in non-standard contexts such as distance education. The pedagogic strategies that can be used with SAC are rich and diverse and can be based on a small but fundamental range of literature, as shown above. But as this literature is spread across multiple fields, practitioners wanting to link SAC with educational theory do not always easily identify the relevant work. We anticipate, therefore, that this study will contribute towards establishing a more visible and accessible body of research on the pedagogic use of real-time, media-rich and web-based conferencing.

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