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The evolution of a cooperative work framework for e-Learning

Deryn Graham
Unitec New Zealand
New Zealand

Abstract

This paper details the evolution of a Framework for e-Learning, to a Cooperative Work Framework for e-Learning, as presented at the IASK conference (Graham 2008a) and annotated accordingly. It begins by discussing the development of the original Framework for e-Learning, and how this study resulted in a further study investigating whether the use of Blended Learning could fulfill or at least accommodate some of the human requirements presently neglected by current e-Learning systems as identified by the original Framework. This second study evaluated an in-house system: Teachmat, and discussed how the use of Blended Learning had become increasingly prevalent as a result of the enhancement and expansion of Teachmat. It looked at the employment of Blended Learning and Teachmat's relationship to human and pedagogical issues, as well as both the positive and negative implications of this reality. PESTE factors from Sociology were then applied to appraise the adoption of e-Learning, leading to the proposal of PESTE factors for educational software and e-Learning in particular. Finally, the study evolved to reconsider e-Learning in relation to a Cooperative Work Framework, revealing critical weakness in the fundamental nature of e-Learning and its consequent propensity for failure.

Keywords: cooperative work framework, e-learning, e-tutoring/e-moderation, PESTE factors

1. Introduction

In March 2005, it was reported that the main reason for the failure of the United Kingdom "e" University (UKeU) was attributable to the lack of research into potential customers' needs and a "supply-driven approach" (Samuels 2005). This was one of

many recent examples of problems with the development and employment of e-Learning. Mason (2004) states that:

"There is absolutely no evidence that learners are able or willing to do without teachers, no matter how well designed the materials, how extensive the resources or how 'just in time' the learning. The fundamental role of the teacher or tutor has not changed but the mode of operation has".

This view was further supported by experiential data from current students on Information Systems, Multimedia, and Computer Science programmes within the University of interest (Jones 2004) insisting on no more than thirty percent of their courses in total (their management, content and delivery, etc) be "e". A preliminary study in 2005 (Graham 2005) on which this work is founded, viewed e-Learning from a Human-Computer Interaction (HCI) perspective, motivated by reports such as those above. It looked at the skills and knowledge required for both traditional and e-Tutoring in an attempt to discover the reasons behind the apparent lack of success of present e-Learning systems. It attempted to establish whether this lack of success was: an issue of requirements gathering and analysis; a tutoring problem; or simply a communications problem and an issue of HCI (now more commonly referred to as Interaction Design). These endeavours led to the development of a Framework for e-Learning (Graham 2005), as described below.

2. The Original Framework for e-Learning

2.1 Tutoring: Activities and Requirements

In order to identify typical tutoring activities, a representative week in the calendar of several university lecturers was elicited, resulting in a synthesis of common interaction examples that constitute teaching and tutoring. Highly noticeable was the significant amount of time spent dealing with e-mail. The activities and tutoring skills required were identified from this diary synthesis. A third column was added which suggested the new skills required if for e-Tutoring (Figure 1). The inference was that e-Tutoring requires all the same skills as traditional face to face (f2f) tutoring, plus some additional skills. These additional skills were considered to be firstly technological and secondly, skills which dealt with managing mostly remote and often asynchronous communication. Such skills relate directly to perceived problems with Computer-Mediated Communication (CMC), and are equally inherent in Computer-Supported Cooperative Work (CSCW) and HCI. CSCW is about groups of users and designing systems to support their group work, understanding the effect of technology (products often called groupware) on group work patterns (Preece et al. 2002, pp. 105-137; Dix et al. 2004, pp. 463-464). Interaction problems such as the lack of visual and audible cues, gestures, intonation, turn-taking, context, collaboration, group dynamics etc have long been recognized by HCI and CSCW practitioners (Maier and Warren 2000). A further related area is Information Visualisation. Information Visualisation (Shneiderman and Plaisant 2005) can be defined as "the use of interactive visual representations of *abstract* data to amplify cognition". Learning is arguably a social activity, and communication is widely accepted as being central to any successful teaching and learning strategy (Sutherland 1992). A system will fail even if it fulfils all its functional requirements, if it does not address the requirements of the user.

Tutoring Activities	Tutoring Skills	New (e)Tutor Skills required
Tutorials. **Lecturing.** **Assessment.** **Research supervision.** **Preparing teaching materials.** **Mentoring.** **Queries.** **Scheduling.** **Updating skills.** **Industrial training visits.** **External exam moderation.** **Administration and meetings.** **Taught project supervision (UG and PG).** **EU project management.**	**Personal and academic.** **Communication, enthusing.** **Feedback, plagiarism.** **Knowledge, support, enabling.** **Presentation, authoring.** **Mentoring.** **Communication via e-mail and telephone.** **Time management, organisational skills.** **Learnability.** **People skills, assessment skills.** **Subject knowledge, assessment regulations, etc.** **Academic judgement.** **Knowledge, support.** **More of all the above!**	Technology. Coping with the lack of f2f contact, visual and audible cues. Dealing regularly with asynchronous and remote communication. Remote, asynchronous enthusing! e-Motivation. Committed time management. Extending the application of traditional tutoring skills, such as authoring and the scheduling of activities. Adding to repertoire of teaching methods through the media. Information Visualisation! Adopting a more student centred approach? e-Socialising. Culture/attitude shift.

Fig. 1. Activities and skills required for Tutoring and e-Tutoring

SALMON STAGES	SKILLS TO BE ACQUIRED	KNOWLEDGE TO BE ACQUIRED	ACTION TO BE TAKEN
STAGE 1: Access & Motivation	There is now an abundance of tools available, which may be W3C compliant (and SENDA compliant to some degree). These tools have much of what is required for all of the five stages, so what must be acquired are the skills and knowledge necessary for their use. It is the non technical aspects which are therefore the focus.	See "Skills to be acquired" column. Tools are easier to adopt (and have often been adopted) for stages four and five, with forums etc available, to cater for stages two and three in particular.	Computer Science, Multimedia, and Information Systems students should be capable of attaining access! Motivation is the main problem which could be assisted by improvements to the course site Welcome? F2f meetings to be arranged prior to e-Tutoring?
STAGE 2: Online socialisation			Use of tool's news and course forums to be adopted for conferencing etc. Regular checking of forums is very important.
STAGE 3: Information exchange			Ditto stage 2 above.
STAGE 4: Knowledge construction			Stage 4 is often fully implemented and operational. Further improvements to the presentation and compliance could be made.
STAGE 5: Development			Achieved in most cases, but could be further improved upon, e.g. the links to past papers and other resources.

Fig. 2. A Framework for Supporting e-Tutoring

2.2 Salmon's 5 stages of e-Tutoring

The mapping of the relationship between the skills identified and those given or suggested by Salmon's (2004) five stage model of e-Tutoring, was next explored. Salmon's model for e-Moderating gives more weight to the social aspects of e-Tutoring; adapting to the e-Learning environment and the group dynamics (three of the five stages). The last two stages are those concerned with the actual knowledge construction and development. From direct experience, this emphasis is probably correct and this is the main implication for practice. In the Framework proposed (Figure 2), the human factors associated with stage 1 of Salmon's model appeared to be paramount to the success or failure of a system. This refers to human factors such as; the current learning situation, communication, cultural and social aspects, all of which are well known to other aforementioned disciplines and have much in common with the user requirements. Learning is achieved by providing appropriate scaffolding, whether for traditional tutoring or e-Tutoring. Instead of motivation there is e-Motivation, socialising becomes e-Socialising. Fundamentally, the nature of human interaction and the lack of visual and social cues etc. provided by the technology is likely to be a major reason for Salmon's e-Tutoring stages 1 to 3 being more difficult in non f2f situations.

2.3 Blended Learning and Teachmat

One possible solution implied by the "Action to be taken" column above and often proposed to resolve the inadequacies of e-learning, especially the human requirements of "motivation" and the lack of "online socialisation" in Salmon's (2004) early stages, is the application of Blended Learning. There is currently a movement towards Blended Learning, with in-house course management tools invoking a creeping change in teaching practice from traditional tutoring to e-Tutoring. Blended Learning (Teach-nology 2006) has been defined as:

"An educational formation that integrates elearning techniques including online delivery of materials through web pages, discussion boards and/or email with traditional teaching methods including lectures, in-person discussions, seminars, or tutorials".

In developing a Framework for e-Learning it was apparent that many of the technological requirements necessary to enable e-Learning were provided by an in-house tool; Teachmat (Graham 2006). On reflection, it led also to the realization that many aspects of this Framework in relation to Salmon's 5 Stages had been attained for many courses, effectively these courses were using technology led Blended Learning. Teachmat and the School's intranet are treated as synonymous, although strictly speaking Teachmat is part of the intranet. Teachmat was originally developed primarily for course content management support, a pseudo Content Management System. It has been extended considerably and indeed since the framework was suggested (for example, printed handouts are no longer given, and links to past papers and other resources now exist). Teachmat has developed from a mere repository for course materials to a comprehensive on-line intranet system. Teachmat now resembles more an in-house Virtual Learning Environment (VLE) for Computer Supported Collaborative Learning (CSCL), employing web 2.0 technologies, wikis, blogs, video conferencing (optional) and attempts to incorporate social networking, i.e. Second Life (2008). It now handles everything from; learning material, assignment uploads, assessment and examinations management, forums, student advice, registration and

attendance, curriculum and institutional policies management, lecturer and student handbooks, etc, etc. The result is that the Teachmat environment has changed the learning and teaching style from traditional to Blended. The level of Blended Learning being individual to courses, with some courses employing multimedia course delivery, such as video. The facilities used for courses are presently a matter of choice, however, virtually all coursework is uploaded on-line and there is a growing pressure for on-line assessment. Submissions generate automatic electronic receipts and staff e-mail notifications, in the case of final year projects for instance. Electronic registers record both weekly attendance and uploads for each week linked to the files themselves. Forums are available to students and staff at course level. The level of electronic communication with students and other staff has exploded as a by-product. Fundamentally, more and more elements of the teaching and learning are now electronic. F2f (co-located and synchronous) teaching is still the predominant method employed in the institution for local (co-located) students, but much of the related activities are now remote and asynchronous. Lecturers still give lectures, tutorials and workshops in person but via personal computers, stored on data sticks or directly linked to Teachmat. Teachmat is being further exploited for external institutions, where both teaching and supporting activities are being carried out remotely and asynchronously, using video for example. Here learning is moving from Blended to fully "e".

The pros of this situation, the deployment of Blended Learning, appear to be mostly managerial: For example, a reduction in the amount of printing and photocopying costs, and paper; Moderated work is immediately available electronically, indeed almost everything is now available at the click of a mouse. All learning material for each course (schedules, coursework, room bookings, etc) is on the system so staff absence can be more easily accommodated. Staff absence is also recorded on the system and news bulletins provided on Teachmat inform students of the absence of staff; Extenuating circumstances and coursework extensions are also dealt with on-line; Everything is on Teachmat.

Teachmat, whilst having provided for many of the mostly technical requirements of Blended Learning or the Framework for e-Learning support, has yet to completely resolve the human issues: Tutors are expected to be on-line 24/7; Traditional tutoring is still superior in terms of flexibility and the accommodation of unforeseen circumstances; It is still much easier to flick through paper coursework submissions than electronic ones; A Course Attendance and Uploads Register for a student on a continually assessed course, only actually shows that a file has been uploaded for a course in a given week by the student, it does not indicate the file contents. There are restrictions on the file size of uploads; Any printing of uploaded coursework is restricted to black and white, which is a weakness for assessing HCI criteria in particular, adding further pressure for tutors to mark on-line; Students and especially staff feel that are being dictated to by the system; There are issues associated with the ownership of teaching materials which are obviously more accessible in electronic form; Teachmat has furthered the vast increase in "e" administration, requiring the continuous monitoring of forums, plus propagating electronic communication and documents required to be completed for tasks; The management system is becoming unmanageable; Anxiety and resentment within staff and students is being created by this "wandering into" Blended Learning; There are still health and safety,

pedagogical, as well as social issues regarding e-Tutoring which have yet to be addressed; Finally, everything is on Teachmat!

2.4 PESTE Factors

Inspired by work with Sociologists on a completely separate research project, the next phase of this work was to consider the drivers for e-Learning by applying PESTE (Political, Economic, Social, Technical, and Environmental) factors from Sociology. Wannermacher (2006) identified the following categories for incentives for increasing Faculty acceptance of e-teaching at German universities: "a) Financial Incentives; b) Infrastructural and Technical Incentives; c) Accounting and Reducing Workload; d) Distinctions Incentive; e) Competitive Advantage for Universities; f) Creating a Climate Conductive to E-teaching". Sociology uses a classification system of PESTE factors: Political (P); Economic (Ec); Social (S); Technical (T), and; Environmental (En). Reclassifying Wannermacher's incentives in terms of PESTE factors, it can be seen that for the normal interpretation of Environmental issues, these issues are not pertinent to e-Learning. However, a looser interpretation could classify incentive f) as Environmental (educationally environmental).

a) Financial Incentives (Ec)
b) Infrastructural and Technical Incentives (T)
c) Accounting and Reducing Workload (Ec)
d) Distinctions Incentive (S/Ec)
e) Competitive Advantage for Universities (Ec)
f) Creating a Climate Conductive to E-teaching (P)

The major concern with the incentives identified by Wannermacher was that pedagogical motives were not evident. This significant absence is true of the evaluation of the application of Blended and e-Learning through in-house tools such as Teachmat (Graham and Valsamidis 2006). The findings of Wannermacher (2006) and Graham (2005) indicate that e-Learning was management driven, the pros given above were mostly managerial and, as they originated from the higher echelons of the institution were likely to be externally politically driven. Hayden (2006) suggested that the e-Learning trend in the UK at the time was highly political, but again it was the lack of the employment of e-Learning to improve pedagogy as the primary motivation that raised considerable unease.

3. A Cooperative Work Framework for e-Learning

3.1 Time/space matrix and Functional Classification

The study then returned to its HCI roots by revisiting e-Learning (Groupware) in relation to CSCW and a Cooperative Work Framework, as e-Learning is just another form of CMC. Groupware (Graham 2008) can be classified in several ways, one of these is by where and when the participants are performing the cooperative work, as summarised in a time/space matrix. Another classification is by the function of the system. Groupware systems may be classified by the function they primarily support: CMC supporting the direct communication between participants; meeting and decision support systems capturing common understanding; shared applications and artefacts supporting the participant's interaction with shared work objects (the artefacts of work). CMC includes: Email and bulletin boards; Structured message systems; Text messaging (IM, SMS and MMS); Video conferences and communication; Collaborative Virtual Environments, and; Meeting and Decision Support Systems.

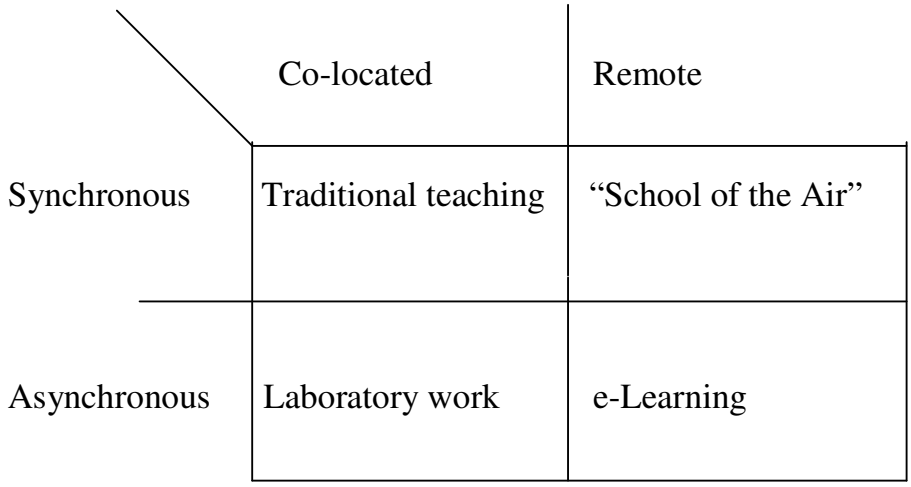

Fig. 3. Learning in a time/space matrix

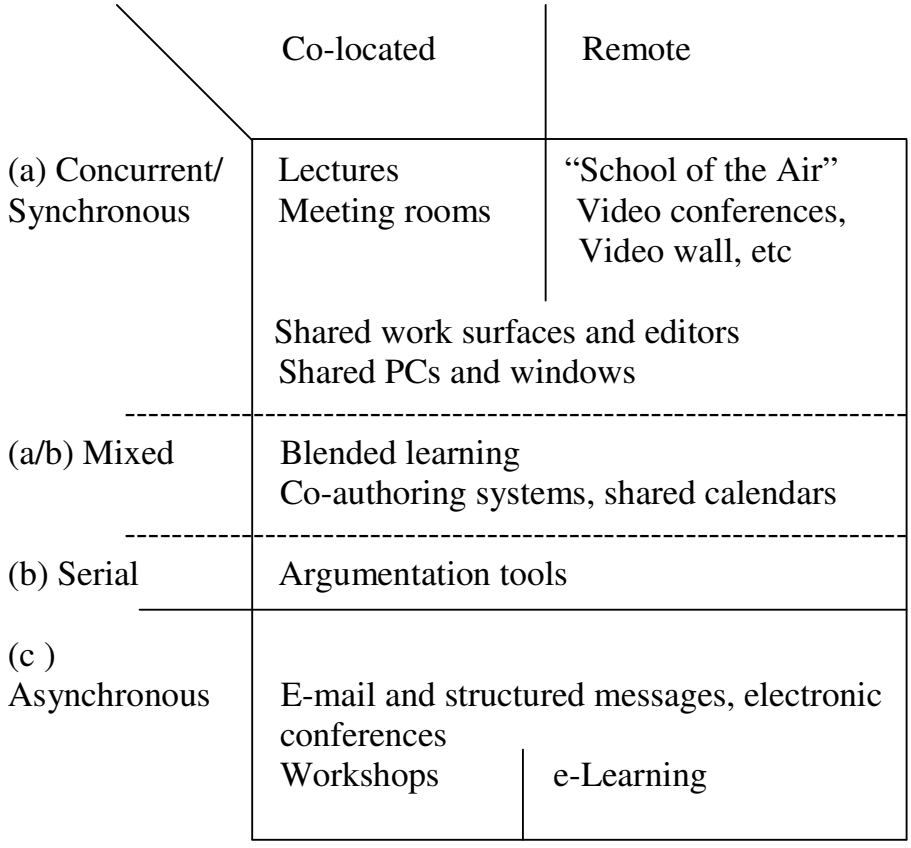

Fig. 4. Learning in a refined time/space matrix

Some CMC systems are asynchronous, including traditional e-mail and structured messaging systems. Various forms of video communication support synchronous

communication, such as video conferences, direct person-to-person video or social contact. Many systems such as those for e-Learning and CSCL may support more than one of these system functions, and this can be seen as a sign of good groupware. Furthermore, there can be some additional relationships between these functions.

Using a time/space matrix (Figure 3) e-Learning would be classified as mainly asynchronous and remote groupware, as it is these features that are purported to be the strengths of e-Learning. Australia's "School of the Air" is categorized as being remote but synchronous. The time/space matrix can be useful during design as one of the earliest decisions is what sort of interaction is planned. The design space for synchronous interaction is entirely different from the asynchronous. A useful distinction is to look at the data store and classify systems as synchronous when there is a real-time computer connection, or asynchronous when there is none. Laboratory work can be synchronous, but is usually asynchronous as in this case. Figure 4 places learning systems into a refined matrix.

3.2 A Cooperative work framework

With reference to Figure 5, Dix et al. (2004, pp. 465-495) describe a Cooperative Work Framework thus: Implicit in the term cooperative work is that there are two or more participants, denoted by circles labelled 'P'. They are engaged in some common work, and to do so interact with various tools and products. Some of these are physically shared, but all contribute to the cooperative purpose. These tools and other objects are denoted by circles labelled 'A' – the artefacts of work. The participants communicate with one another as they work, denoted by the arrow between them. In real life this may be by speech, or any of the categories of the time/space matrix. Part of the purpose of communication is to establish a common understanding of the task the participants are engaged in. This understanding may be implicit in the conversation, or may be made explicit in diagrams or text. For some jobs, such as research and aspects of management, the development of understanding and ideas constitute the primary task. Where this is not the case, the participants will interact with the tools and work objects to perform their job. This is shown by the arrows between the participants and the artefacts of work. This arrow represents a two-way flow of information: of control from the participants to the artefacts, and feedback from the artefacts to the participants. In real-world tasks, these two hardly seem distinct. However, this will not necessarily be the case for computer systems. This framework also has:

1. The deixis. This arc shows that, in general, direct communication about a task will refer to the artefacts used as part of that task.
2. Feedthrough. This arc runs between the participants, but through the artefact. This reflects the feedthrough where one participant's manipulation of shared objects can be observed by the other participants. This communication through the artefact can be as important as direct communication between participants.

Although systems are classified by the arc which they most directly support, many support several of these aspects of cooperative work. In general, a test of a groupware product is how well it supports the whole of cooperative work. A groupware system need not automate every aspect of communication and shared work, but it should be open to supporting cooperative work as a whole.

An important issue in groupware and CSCW is awareness – generally having some feeling for what other people are doing or have been doing. Awareness is usually used to refer to systems that demand little conscious effort or attention. There are a number of different kinds of awareness: Who is there; What is happening to shared objects; How the changes to shared objects happened. Forms of awareness are achievable through architectures, such as client-server and shared-window architecture, etc. Groupware systems clearly involve more than one person. To some extent however, all systems influence and are influenced by the groups and social situations in which they are placed. CSCW encompasses both specific groupware systems and the effects of computers on cooperative working in general.

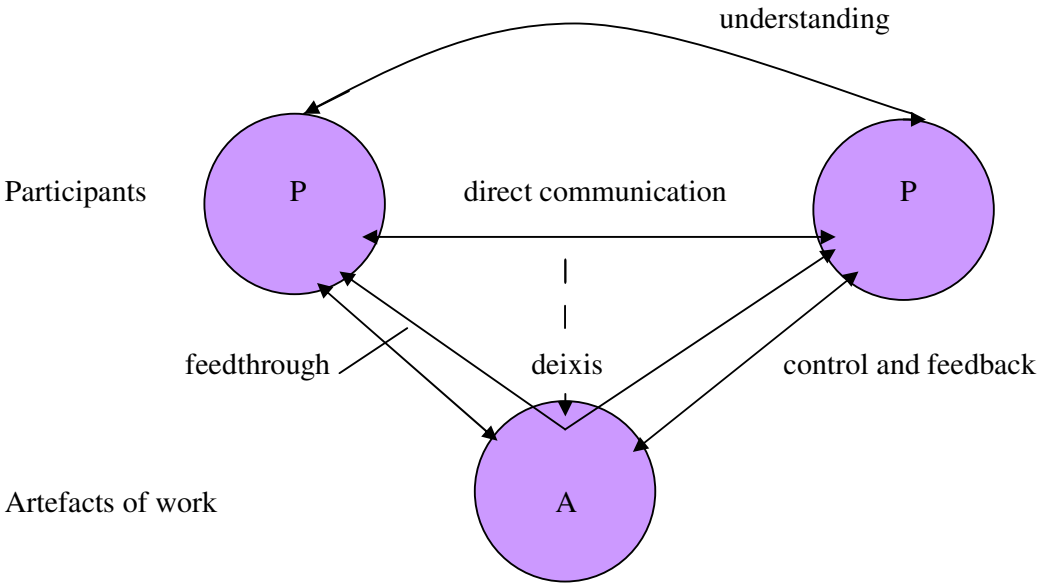

Fig. 5. Cooperative work framework

The cooperative work framework can be applied to e-Learning. The groupware is the e-Learning system, often an in-house Intranet or open-source based system. The artefacts of work are the assignments, tests, etc., those elements that are assessed formatively or summatively. The participants would be the students and the tutors, however, after the initial set-up the tutor may not be part or a full part (replaced by some sort of course administrator) of the framework. Direct communication is likely to be in the form of e-mail or forums, and may be supported by electronic conferences and video connections. Common understanding can be supported by argumentation tools, meeting rooms and shared work surfaces. Control and feedback from shared artefacts maybe supported by shared PCs and windows, shared editors, co-authoring systems and shared diaries. The problem relates to explicating common understanding. Feedback from the artefacts to the participants, would take the form of assessment for instance. However, control from the participant to the artefact is likely to be distinct from the feedback due to its asynchronous nature. The major issue for the cooperative work framework for e-Learning is where understanding actually occurs. In the classroom setting with f2f communication, understanding is more

achievable through the subtle cues and gestures exhibited by both students and tutors. Even in large classes there is a common awareness for both parties – "deadly silence" or smiles of acknowledgement resulting from a tutor's question to the class. Many of these cues are still present in remote, but synchronous learning; Australia has many years of experience with distance learning. Large distances and low population density led naturally to the "School of the Air". This retained the teacher pupil verbal interaction and much of the strict time frame with few of the problems that today's e-Learning environment faces (Howgate 2007). e-Learning not only lacks these important visual and audio cues, and synchronicity, but if the tutor is responsible for the initial setting-up of a system and then involved only via the artefacts of work, it is difficult to see where the common understanding so vital for any learning exists.

3.3 e-Learning and collaborative communication models

All computer systems, single user or multi user, interact with the work-groups and organisations in which they are used. F2f communication involves speech, hearing, body language and eye gaze. Conversation can be analysed to establish its detailed structure. In terms of technology, f2f contact is the most primitive form of communication. However, in terms of communication style, the interplay between different channels and productivity, f2f communication is the most sophisticated communication mechanism available. Using computer-mediated forms of communication leads people to carry forward all their expectations and social norms from f2f communication. Although people are very adaptable and can learn new norms to go with new media, their success is often dependent on whether the participants can use their existing norms. Furthermore, the rules of f2f conversation are not conscious, so when they are broken, the true problem is not always recognised. People just have a feeling of unease, or they may feel that a colleague has been rude (Dix et al. 2004, p. 511).

e-Learning essentially necessitates communication through collaborative models. For asynchronous groupware (and even some synchronous systems) used in e-Learning, the major form of direct communication is text-based. Exceptions to this are other media that may be used in addition to text such as graphics, voice animation or video clips. Despite these, text is still the dominant medium. Text-based communication in groupware systems and CSCL is acting as a speech substitute, thus, there are some problems adapting between the two media. Conversation analysis to establish its detailed structure has been applied to e-Learning and text-based conversation, which has reduced feedback for confirmation, less context to disambiguate utterances, slower pace of interaction, but is more easily reviewed. In addition, the communication may be connected to other shared computer artefacts. In the case where communication is an annotation, the annotation itself may be structured.

One of the most profound differences between f2f and text-based communication is the lack of fine-grained channels (Dix et al. 2004, pp. 511-551). In addition to this loss of back channels, the speaker's tone of voice and body language are of course absent. These normally convey the affective state of the speaker (happy, sad, etc.) and the illocutionary force to the message (important, urgent, etc.). As a result, people tend to use stronger language in e-mail than in f2f conversation.

Grounding is the process by which conversants obtain common ground. This grounding process is linked strongly with the types of channels through which the conversants communicate. Clarke and Brennan (1991) describe the properties of these channels in

terms of grounding constraints: Contemporality; Simultaneity, and; Sequence. These are all constraints which are weaker in text-based compared with f2f interaction. It has also been found that e-mail and text-based meetings are less effective at resolving conflicts than a f2f meeting. For example, simultaneity in f2f conversation allows back channel responses. In a text-based system, different participants can compose simultaneously, but they lack contemporality. Linear transcripts obviously have some idea of sequence, but this is confused by the overlap and interleaving caused by the lack of contemporality and simultaneity.

Despite the occasional breakdown, in most instances of a two-party text-based interaction, an overall turn-taking protocol, which exhibits many of the structures of normal conversation including adjacency pairs is observed. However, when three or more participants are considered, turn-taking and adjacency pair structure begin to break down completely, again due to the lack of back channels. Some systems use more structured mechanisms to get round problems such as having a round-robin protocol (each participant 'speaks' in turn) or having a queue of turn-requests. Whether the structures of such mechanisms are worse than the problems of occasional breakdown depends very much on the context and is a matter of opinion.

Utterances are highly ambiguous and are only meaningful with respect to external context (the state of the world) and internal context (the state of the conversation). Both of these are problems in text-based communication. The very fact that the participants are not co-present makes it more difficult to use external context to disambiguate utterances. This is why many groupware systems strive so hard to make the participants' views the same; that is, to maintain What You See Is What I See (WYSIWIS). Whatever the means of direct communication, remote participants have difficulty in using deictic reference. If the displays are not WYSIWIS then they must also ensure that the other participant's display includes the object referred to, and that the description is unambiguous. Asynchronous participants have even more problems with deixis as there is no opportunity for the participants to clarify a reference (without extremely lengthy exchanges). Group pointers are also not an option, but one can use methods of linking the conversation to its context, either by embedding it within the objects as annotations or by having hypertext links between the conversation and the object. There are also problems with deictic reference to internal context. In speech the context is intimately connected to linear sequence and adjacency. Even in linear text transcripts, overlap breaks the strict sequentiality of the conversation, and thus causes problems with indexicals and with context in general. Most e-mail systems and some bulletin boards lack any implied sequentiality and thus any context to the messages. The users get round this by including copies of previous messages in their replies. Hypertext-based systems avoid the implied sequentiality of a linear transcript, by taking the form of parallel conversations, similarly the problems of pace may be partially solved using hypertext.

The term pace is used in a precise sense. In a spoken conversation, the turns are often only a few seconds long. Taking into account minor confirmations and back channels, the pace is still faster, perhaps a turn or back channel response every few seconds. Compared to this the pace of e-mail is very slow: messages can take a few minutes to several hours to deliver. Even synchronous text-based conversations are limited by the participants' typing speed and have a pace of at most one turn every minute or so. As the pace of a conversation reduces, there is a tendency for the granularity to increase. To get the same information across more information per message must be sent. The

importance of feedback from the listener to the speaker in clarifying meaning and negotiating common ground has already been evidenced. Even most monologues are interactive in the sense that the speaker is constantly looking for cues of comprehension in the listener. Reducing the pace of conversation reduces its interactivity.

Other e-Learning considerations are with respect to shared information: The granularity of sharing for groupware systems refers to both object chunk size (e.g. per sentence, per document) and frequency of update (immediately, within seconds, or after a chunk has been edited), and; Levels of sharing and types of object, how much is shared between participants in relation to both input and output. The kind of object or data being cooperated over obviously affects the way in which they are shared.

4. Discussion and Conclusions

The collective findings of the framework studies now follow. In developing the original framework it had been suggested that the problems of e-Learning were not new, and were as for other forms of interaction and their requirements. It was further suggested that e-Learning should heed the lessons learnt from other areas such as HCI and CSCW and that the problems of e-Learning and associated requirements were no longer fundamentally technological but human. It was concluded that it was these problems that needed to be addressed in any proposed framework, if progress was to be made. This might be enabled by greater improvements in communications technology becoming sufficiently sophisticated as to convey subtle cues etc, but subsequent progress may ultimately necessitate a cultural and social shift in the attitudes of tutors and tutees towards teaching and learning per se. It was yet to be seen whether or not the Department for Education and Skills' latest e-Strategy "Harnessing Technology: Transforming learning and children's services" (Dfse 2005) would prove successful in addressing the issues raised.

It was also concluded that the use of Blended Learning has been an indirect consequence of the in-house technologies now employed. Tools like Teachmat are directing teaching and learning practices towards Blended Learning. The development of such in-house tools has caused a technology led proliferation in the employment of Blended Learning. This sea-change was not a conscious decision by staff and students, who are highly unlikely to request e-Learning. This raised questions about the pedagogy behind the systems that were developed. HCI and communications issues remain, as do some technical problems. The major concern is that although many (but not all) of the technical requirements have been catered for by tools like Teachmat (as demonstrated by the list of pros, in the main associated with Salmon's Stages 3-5), many important issues, namely those referred to as "human" have not been addressed (reflected by the list of cons, mostly associated with Salmon's Stages 1 and 2). There has not necessarily been any cultural or social shift in attitudes however. It was concluded that the successful embodiment of human factors; pedagogical, social, etc, was still key and requires most effort for fully "e" or Blended Learning. Blended Learning is presently not providing a solution, it has yet to accommodate the attainment of Salmon's motivational or social stages identified by the original framework, and the constant focus on the technology was merely aggravating the situation.

It was therefore proposed (Graham 2007) that, after evaluating the application of e-Learning using PESTE factors from Sociology, e-Learning should adopt its own PESTE factors, where PESTE would stand for Pedagogical, Educational, Social, Technical and (Educationally) Environmental. The order of these PESTE factors for e-Learning is highly significant; Pedagogy should be the main concern. Obviously this overlaps with Education, but Social factors should also be high on the agenda in accordance with the findings that human issues are paramount, as learning is inherently a social activity, most fundamentally founded on the instinct to survive. Equally in relation to the findings, Technology and the Environment should carry less weight. A deliberate, conscious decision was made to exclude Political and Economic factors which are credited as the present drivers for much of the expansion of e-Learning. In practice, economic incentives are likely to prove to be a myth as serious attempts to realize e-Learning are experientially at least as expensive as f2f learning.

Human communication is very rich (Benyon et al. 2005, p. 699). Despite the development of ubiquitous communications systems distance still matters, however, the sheer richness is not merely verbal but is also reflected in the use of gesture, body posture and so on, all of which make up non-verbal communication. All this is highly relevant to e-Learning where the richness of f2f communication is replaced with impoverished CMC. Whilst humans cope with the inferiority of CMC there appear to be limits. The absence of one or two aspects e.g. co-located and use of gesture is manageable. However, e-Learning lacks non-verbal communication and social norms of behaviour, web-cam images are renowned for their distortions. It can be argued that Salmon's stages 1 and 2 (Access and Motivation, and On-line Socialisation) are where grounding (constructing a shared understanding) occurs. It is these two stages that are constantly being affirmed as difficult and fundamentally key to e-Learning. It appears to be the compounding of factors in an e-Learning environment, which make understanding and therefore e-Learning difficult or impossible. Lack of visual cues, or lack of audio cues, or lack of synchronicity alone are not insurmountable, but combined may prove to be so. This is why Blended Learning is so attractive. The crux of the problem is that understanding is a human attribute and can only take place between people (participants) and is not possible by current technologies. If the tutor is absent or remote from the framework in the sense that communication is only via the artefact (the system and/or the assessment) then understanding and therefore learning cannot take place. The continuous understanding, feedback and control, natural to humans are not present, or indeed possible for computer systems. Feedback and control would be restricted to that implemented. These are weaknesses fundamental to the nature of e-Learning. Factors key to understanding, learning and collaboration:

- grounding
- synchronicity
- feedback (back channels)
- control (breakdown and repair)
- visual cues
- audible cues
- technologies and architectures

Feedback and control are linked to cues and are obviously affected by synchronicity. As humans are adaptive they can accommodate the absence of one or some limited combination of these factors. The problem for e-Learning is that often the lack of

many or all of these factors is inherent. Blended Learning relieves some of the impediments, but does not solve them. Also of huge import is the reality that many current e-Learning systems and technologies, especially intranets are essentially glorified web-enabled databases (content management systems), rather than knowledge-bases. Unlike the structured "How" and "Why" answers derived from the semantic and cognitive-based architectures of knowledge-based systems, web-enabled databases simply retrieve answers to questions from their databases. Such information retrieval is not pedagogically sound and somewhat removed from human cognition.

The overall conclusion of the combined studies, is that communication enabling understanding must be unambiguous and explicit for any real learning to occur, whether "e" or otherwise.

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