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HCT Workshop '98

Proceedings

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Brighton

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University of Sussex, School of Cognitive and Computing Sciences
COTCOS (Co-operative Technology for Complex Work Settings)

Organisers
Ann Light
Rose Luckin
Fabrice Retkowsky
Pablo Romero

Preface

The Workshop

Human Centred Technology covers a wide range of interests within which common research questions are considered from differing perspectives. The aim of this workshop is to bring together people with this common interest, and to provide students who are researching into related issues with an opportunity to present and discuss their work with other students and members of the HCT group.

The Sussex HCT group

The Sussex Human-Centred Technology group comprises faculty, research fellows and graduate students from COGS and other schools, interested in research on the design, implementation, and use of human-centred technologies. In particular, its main objectives are:

- to develop frameworks for understanding how people interact with and communicate through technology,
- to apply this understanding to develop and support innovation.

The group carries out research in a number of areas including:

- interactive learning environments and educational software
- intelligent tutoring systems
- collaborative and networked technologies
- intelligent agents
- visualization and medical information systems
- interactivity, external representations, multimedia and virtual reality
- telematics and virtual collaborative environments
- software design and reuse.

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Programme

Friday - Day One

Session One: Does the "system" need to "know" about a particular or group of users? If so what?

9.45 Welcome to participants - Yvonne Rogers
10.00 Fabrice Retkowsky: An experiment workbench to study software reuse from a cognitive perspective
10.20 John Bradwell and Mary Ulicsak : The Laughing PC: How a computer based instruction programme uses riddles to help children's reading comprehension
10.40 Zahra Al-Rawahi: Virtual Hospital Round
11.00 Marta C. Rosatelli: Supporting Group Activity in Distance Learning from Case Studies
11.20 Patricia Tedesco: Mediating Meta-Cognitive Conflicts in a Collaborative Problem-Solving Situation

Tea break

11.50 Anthony Basiel: Web Constructivism Using Javascript
12.10 Richard Butterworth: User Models for Predicting Usability: real world vs. mathematical abstraction
12.30 Sara Jones: Understanding the Cognitive Basis for Using Multimedia in Education

Discussion

Lunch

Session Two: What does or should the user need to know about the system?

2.10 Guest Speaker - Lydia Plowman
3.00 Pablo Romero: Focal structures in Prolog programs
3.20 Dominic Stanyer: Redefining the hyperlink
3.40 Nuno Otero: 3D Virtual Environments and Learning

Tea break

4.10 Paul Parry: The Application of Visualisation of Requirements
4.30 Maria Wimmer: Experiences from Applying HCD in a Complex Process Control Environment: the FS Case Study
4.50 Julie Waplington: A Human-Centred Recycling Support Tool

Discussion

5:40 Paul Ardern: The impact of technology on education

Saturday - Day Two

Session One: Should the design of communication technology reflect culture?

10.00 Guest Speaker - Charles Crook
10.30 Clodagh Miskelly: Community Storytelling using Hypermedia
10.50 John Halloran: An Activity-theoretic analysis of the failure of a requirements capture protocol for a peer-to-peer student support system
11.10 Joyce Lamerich: Seniors on the Internet

Tea break

11.40 Jenny Fry: Computer Mediated Communication across Divergent Research Networks
12.00 Heather Matthews: The Development of Electronic Academic Communities: Using Computer Mediated Communication to support Undergraduate Studies
12.20 Jon Rimmer: The Community and Technology

Discussion

Lunch

Session Two: Does technology design dictate communication patterns?

2.00 Guest Speaker - Colin Millar
2.30 Ann Light: Interactivity and the Web
2.50 Lars Birch Andreasen: Learning Processes in Distance Education
3.10 Frode Guribye: Computer Supported Collaborative Learning

Tea break

3.40 Marco Palmonari: How the Properties of the Communication Medium affect cooperation: pilot-controller mutual awareness
4.00 Gordon Rae: The Colleague in the Machine: Electronic Commerce and Organisational Learning in the Insurance Industry

Discussion

People

Day 1 speaker : Lydia Plowman

Narrative is fundamental to the ways we make sense of texts of all kinds because it provides structure and coherence, but it is difficult to see how this works in the context of multimedia interactive learning environments (MILEs). We tested our hypotheses about the form and function of narrative in MILEs by developing three versions of material on CD-ROM with different narrative structures. I shall describe using it with groups of students, the impact of the different versions on learner behaviour, and how the concepts of narrative guidance and narrative construction apply to the design of MILEs.

Day 2 Session 1 speaker : Charles Crook

I started as an experimental psychologist (as PhD student in Cambridge), then turned to developmental matters (at Brown and Strathclude universities) and then towards my current basic interest in how cognitive development is mediated by social processes (Durham and Loughborough). This has developed into a specialised interest in how computers enter into that interpersonal arena. That has developed in turn into a more general interest in technology and "designs for social living/learning".

Day 2 Session 2 speaker : Colin Millar

Colin Millar leads a small research group at BT Labs investigating the impact of Community Networks on BT's business and network operations. A chartered engineer and chartered physicist, he has developed his interests from basic optical components and communication networks into the social and business implications of the widespread adoption of new technologies in communities.

Discussant : Josie Taylor

I have been studying people learning how to use complex systems (computers, video-tape recorders, television sets, calculators etc) since 1984. My DPhil thesis examined learners of Prolog, and since working at the Open University, I have been involved in examining how to use such systems for teaching and learning, and how systems can be developed to enable learners to use them on their own in their sitting rooms. This in turn raises the interesting question of how best to provide support for these learners, and hence my interest in the topics of the workshop.

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Virtual Hospital Round: A Cognitive Tool for Clinical Teaching

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This paper will investigate the use of an intelligent tutoring system to overcome problems with clinical teaching. Although, there are a number of medical diagnosis expert systems which have been designed to help medical students and medical practitioners in deciding about diagnosis, little of these systems studied students difficulties with clinical diagnosis . This research investigated some of these problems such as: the anchoring problem, forcing the diagnosis and endless enquiry.

Whilst a number of systems have been developed based on a cognitive apprenticeship approach, and a significant body of research has been carried about learning with multiple representations, nothing is known about the effectiveness of multiple intelligences (MI) on students' learning. To address this, a prototype was built and some experiments will be performed to study the effectiveness of MI in comparison with multiple representations. Gardner's theory of Multiple Intelligences and cognitive apprenticeship approach were implemented in the designing of the Virtual Hospital Round (VHR). The VHR is a practice based learning tool in Cardiovascular diseases.

The VHR prototype allowed for a unique blend of intelligences (learning styles) in each student, and assessed their development. It enabled students to explore a topic according to their learning styles preferences but simultaneously encouraged them to conduct their interaction on a more systematic basis. Also as both approaches used in VHR are based on the belief that learning generally take place in the context of social interaction, we are going to study students' ability to transfer their learning through sharing their experience by being a reviewer or a critic of each other's learning.

The student model in VHR consists of a domain learner model (DLM) and a preferences learner model (PLM). The aims of DLM were to record the medical student's clinical diagnosis skill and difficulties. The DLM concentrates on procedural skills but also takes into account symbolic and conceptual knowledge. On the other hand, the objectives of PLM were to record students'learning preferences and cognitive style in order to provide an appropriate help strategy for each student.

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Learning Processes in Distance Education

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The main problem of my Ph.D. research project is to investigate in what ways the use of information technology in distance education affects the learning processes that takes place. What are the new possibilities and how can these be used? I will focus especially on changes in the processes of interaction, communication and collaboration, as well among the students as between the teacher and the students. In the empirical study of this, I have planned two steps:

- The first step is seen from an ethnographer's point of view. I am participating in a postgraduate course about IT and education, which is delivered this fall online from a Californian university. In this field study I will participate and observe, reflect and discuss with my co-students, and through the experiences and frustrations I sure will get, I will come closer to what shall be the key concepts of my research project.
- After this field study the main empirical investigation in the project will be an intensive case study of one particular course and its participants and the learning processes that takes place among them. The methods will be observation of the communication and the work through the course, qualitative interviews with selected participants before, during and after the course, and interviews with teachers, designers and planners.

In my theoretical studies, I have found a growing amount of literature on experiences with distance education. Especially the writings of Andrew Feenberg, Starr Roxanne Hiltz, Murray Turoff and Linda Harasim have guided my orientation to the field of distance education. Regarding the study of learning processes and the field of learning and communication theory, I will explore the field from a constructivistic viewpoint. I'm currently reading Howard Gardner ('multiple intelligences') and Jean Lave & Etienne Wenger ('situated learning' & 'communities of practice'), and I'm working on how to use these theoretical perspectives to inform my actual study.

I think that my presentation will be most suitable for session 3 on the question: "Should the design of communication technology reflect culture?" with Charles Crook. I'm interested in how the computer-supported learning environments can "bridge the gap between users", and I will draw on my initial experiences from my field study mentioned above.

Note: I'm not investigating the kind of distance education that could be labelled "correspondence school" where each student individually works on his or her assignments and sends them to the teacher without knowing of any other of the students. Rather I'm studying distance education that gives space

for processes of computer-supported collaborative learning. At this early stage of my project (which takes place from 1998 to 2001) I'm still using the term 'distance education' even though I'm not sure if it is the right label to indicate this kind of learning. Other labels such as 'online education' or 'flexible learning' could be more appropriate, and this is a question that I later in my project will address closer.

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The Learning Technology Project: Re-defining educational opportunity in the digital age

Paul Ardern and Rod Paley

Learning Technology, a joint project to be launched by the Institute of Economic Affairs and DEMOS, aims to kick-start a radical re-think of education policy. As the world becomes networked and the computer becomes an everyday tool in our lives, the idea of the empowered learner is becoming a reality. The implications are huge yet remain largely unexamined. This transformation in education, long delayed but inevitable, is challenging our fundamental assumptions about the way learning is organised and accessed.

Institutional boundaries are blurring. Constraints on the demand and supply of education are being loosened. Control is beginning to pass away from institutions and towards individual learners as life-long learning becomes the dominant paradigm.

In this kind of world, education is likely to be substantially different in many ways from what we have now. It will be diverse, increasingly driven by the needs of the learner, and the market it generates will be dynamic, global and massive in scale.

These changes pose an immense challenge to the existing system, bringing with them huge disruption as well as many new and exciting possibilities. What policies are needed to ensure that technology helps to deliver the prize of a modern education system providing high-quality learning opportunities more widely than ever before? How will our infrastructure have to adapt? What will be the role of the school? How might the relationship of parents, teachers and learners change? And what are the risks we should be focussing on? The project invites all to join our discussion group, to respond to the project briefing paper and the series of featured articles posted on this site, and to add new perspectives of their own.

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Web-Constructivism Using Javascript

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This talk illustrates how the Constructivist Learning Theory can be demonstrated through the use of Javascript in a web-based learning environment. The power of stand-alone multimedia applications can now be replicated on the web through many types of plug-ins. However, they are tedious and time consuming to download. Client-side Javascript is the answer this research proposes as a fast, reliable alternative. By embedding Javascript throughout a web-based tutorial system the principles of Constructivism guide the Learning Environment Designer (LED) in the development of a web-based tutorial system.

If a web-based learning environment is designed by the principles and protocols established in this research it takes on a 'template-design approach'. That is to say that the tutorial system is content independent. Any subject matter can be addressed using this problem-solving, collaborative approach. By applying Web-constructivism to the tutorial system the student's actions shape the content of the learning experience, thus making it a student centred design.

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The Laughing PC: How a computer based instruction programme uses riddles to help children's reading comprehension

John Bradwell and Mary Ulicsak

Overview Corny jokes used as a teaching aid can quickly improve a child's reading comprehension age by focussing the child on the double meanings within joke sentences (Yuill,1996). Based upon Yuill's research a computer based instruction (CBI) package has been developed. As much of the raising of awareness that a piece of text can have two meanings occurs not through practise, but by discussion of the possible ambiguities, the software is specifically designed for collaborative use. The software package also overcomes the apparent difficulty in providing individual feedback from group learning.

Introduction Children's ability to treat language as an object and reflect upon its meaning develops rapidly in the early school years (Gombert, 1991). In particular, learning to read can help children to reflect on alternative meanings of text. However, research by Yuill & Oakhill (1991) discovered that approximately 15 percent of 7-9 year-old children who are assessed as fluent readers, have been observed to have a poor comprehension of what they read. Yuill and Oakhill (1991) identified particular problems in inferential skills and linguistic awareness. In particular, poor comprehenders fail to develop an awareness of ambiguity and alternative meanings in a sentence.

One area of everyday life which relies upon ambiguity and alternative interpretation for its effect of meanings is verbal humour. Riddles create two internally consistent interpretations that conflict with each other. Young children laugh at jokes and often invent their own. Although children commonly display familiarity with the riddle format, they seem to be unaware that riddles rely for their effect on ambiguity. However, it is easy to show that children are in perceptual and productive control of two senses for a single word (e.g., the two meanings of bark). Jokes are able to address awareness of linguistic features without requiring explicit discussion of study skills (Hirsh-Pasek, Gleitman, & Gleitman 1978).

Yuill (1996) developed and tested a training programme for less skilled children, to enhance inferential skills by engaging children in discussion about the double meanings within jokes. This used riddles and verbal jokes to focus children's attention on ambiguity and alternative meanings. The results provided evidence that riddles and ambiguity are useful in advancing children's text comprehension. Improvements were not confined just to the less skilled group. This suggests that the training technique is useful for improving comprehension skills generally, rather than for poor comprehenders in particular. The training programme developed created considerable interest among teachers where the research was conducted. However, a major limitation with the training programme concerns its practical application. From the teachers perspective, it is labour intensive. Also, the children are unable to take advantage of the training without supervision.

To overcome these problems a computer based instruction (CBI) system, Joke City was developed. A point of distinction about Joke City is that it is one of the very few pieces of software that is specifically designed for collaborative use. For example in 1996 Cavalier (1996 cited by Cavalier & Klein 1998, p.5) observed that only 40 out of 5,984 CBI programs were designed for collaborative use. Joke City involves pairs of children being presented with jokes in which they have to identify "the word or words that have two meanings". Much of the raising of awareness that a piece of text can have two meanings occurs not through practise, but by discussion of the possible ambiguities. The results from the pilot study provide support that CBI incorporating collaborative working can improve reading comprehension (Bradwell 1998).

Whilst Joke City supports research advocating the benefits of peer working, it does raise further academic and pragmatic considerations. In schools there is now a strong focus on measuring the benefit that an individual child receives from any particular activity. Many CBI programmes, for example 'Successmaker' by RM Learning recognise this and produce performance reports (Woods, 1988). This emphasis on measuring the individual child's improvement in performance appears to be in conflict with the apparent benefit gained from CBI collaborative working. How can individual feedback be collated from group working? A feedback system has been developed that can be used to support the teacher by quantifying individual differences in pupil's performance from a CBI programme which is designed for collaborative use.

References

Bradwell, J. (1988), *An evaluation of a software riddle package designed to assist children's reading comprehension*, Psychology Project, COGS, University of Sussex

Cavalier, J.C. & Klein, J.D (1998), *Effects of Cooperative Versus Individual Learning and Orientating Activities During Computer-based Instruction.* ETR&D. Vol. 46, No.1

Gombert, J. E. (1992), *Metalinguistic development*. Harvester Wheatsheaf: New York.

Hirsh-Pasek, K., Gleitman, L. R., & Gleitman, H. (1978), *What did the brain say to the mind? A study of the detection and report of ambiguity by young children.* In A. Sinclair, R. J. Jarvella, & W. J. M. Levelt (Eds.), *Text and text processing*, (pp. 77-103). North Holland: Elsevier.

Wood, C. (1998). *Educational Consultant for RM Learning Systems*. Personal communication. Blacklands Primary School. 24th March 1998.

Yuill, N., & Oakhill, J. (1991), *Children's problems in text comprehension: An experimental investigation.* Cambridge, England: Cambridge University Press.

Yuill, N. (1996), *A Funny Thing Happened on the Way to the Classroom: Jokes, Riddles, and Metalinguistic Awareness in Understanding and Improving Poor Comprehension in Children.* Reading and Riddling: The Role of Riddle Appreciation in Understanding and Improving Poor Comprehension in Children. In C. Cornoldi, & Oakhill, J. (Eds.), *Reading Comprehension Difficulties*. New Jersey, Lawrence Erlbaum Associates.

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User models for predicting usability: Real world validity versus mathematical abstraction

Richard Butterworth

User models hold assumptions about how real users will interact with computers. The PUMA (Programmable User Model Applications) $< http://www.mdx.ac.uk/puma/ >$ project is investigating ways in which user models can be employed to *predictively* evaluate the usability of a proposed interactive device.

Typically usability requirements are decided at the beginning of a design cycle, but the designed system cannot be tested for usability until after it is built. User models allow for questions of usability to be addressed of abstract specifications of interactive systems, rather than only of implementations.

We have encoded the planning mechanism implicit in the PUM (Programmable User Model) [Young et al 1989] tradition of user modelling as a mathematical model (a benefit of doing so is that we have been forced to disambiguate several issues that were not clear in PUM modelling). The question now is: given this abstract user model, to what purposes can it be usefully put?

We have found [Blandford et al, 1997] that importing this model wholesale into an interactive system model results in a model that is operational in nature and is limited to 'simulations'. ie an analyst can propose a behaviour trace and then argue whether or not that behaviour trace can be generated by the model. However more general questions such as 'can a certain behaviour *never* happen?' cannot be answered by simulation approaches.

In contrast [Butterworth et al, 1998] proposed a very abstract model of an interactive system about which such general questions can be answered by inducting on the structure of the model. However, to arrive at such an abstract model, many of the cognitive assumptions from the user model are lost to Occam's razor or at least become very implicit in the system model.

My talk will lay out and discuss these trade-offs that we have found to be necessary in interactive system modelling.

References

[Blandford et al. 1997]
A. Blandford, R. Butterworth and J. Good. (1997), *Users as rational interacting agents: formalising assumptions about cognition and interaction.* In Harrison and Torres (eds) 1997, *Design, specification and verification of interactive systems '97.* Springer.

[Butterworth et al, 1998]
R. Butterworth, A. Blandford and D. Duke. (1998), *The role of formal proof in modelling interactive systems.* Accepted for publication in the DSVIS'98 proceedings.

[Young et al, 1989]
R. Young, T. Green and T. Simon. *Programmable user models for predictive evaluation of interface design*. In Bice and Lewis (eds), *Proceedings of CHI'89*. Pages 15–19. ACM.

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Computer Mediated Communication across Divergent Research Networks

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Developments in electronic networks, such as the Internet, provide the potential to alter scholarly communication patterns and work organisation radically. The focus of this study is the mutual interaction between electronic networks and disciplinary culture and the consequences of cultural differences for the uptake and use of such networks.

Knowledge domains within academia are not homogeneous, each discipline has a distinctive social and epistemological structure which leads to variations in the communication system which underpins academic research. These domains can be categorised into four general types: pure science; applied science; arts and humanities; and social science. A number of authors have devised typologies that outline the social and epistemological processes which shape the disciplines within each group. The relationship between these differential cultures and electronic networks will be explored using in-depth interviews with networks of researchers from several divergent specialisms. Analysis of pilot interviews has revealed domain differences in the purpose, frequency and perception of electronic network use.

Communication is essential for the production, dissemination and growth of knowledge. Knowledge domains have distinct cultural identities which are shaped by the social (establishment of reputation) and epistemological (promotion of knowledge) elements of scholarly activity (Becher, 1989). Consequently, each has a unique communication system according to particular need (Garvey, 1979). Walsh and Bayma (1996) studied the uptake and use of electronic networks across four science domains. The findings indicate that the particular work organisation of each field of science determines the use to which these new technologies are put.

References

Becher, T. (1989). *Academic tribes and territories: Intellectual enquiry and the culture of disciplines*. Buckingham: SRHE & Open University Press.

Garvey, W. D. Lin, N. & Nelson, C. E. (1979). *Communication in the physical and social sciences*, in *Communication: The essence of science*. W. Garvey, D. Oxford, Pergamon Press.

Walsh, J. P. & Bayma, T. (1996). *Computer networks and scientific work.* Social Studies of Science. 26, 661 703.

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Design and use Of Collaborative Telelearning Artifacts

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I am currently working on a masters thesis (hovedfagsoppgave) within the area of Computer Supported Collaborative Learning (CSCL). My thesis is part of a project (DoCTA - Design and use Of Collaborative Telelearning Artifacts) that focuses on the use of information technology in education. In particular we focus on the design and use of artifacts in collaborative telelearning scenarios aimed at teacher training.

The project is still in its initial phase, but we are presently designing various scenarios utilising the Internet that will be used to engage the students in collaborative learning activities. An exploratory study will analyse our three different scenarios. Two of the scenarios involve European inter-cultural simulations where the goal is to design a textual artifact (such as a treaty or policy statement). A third scenario, which will be designed, developed and deployed for use between three Norwegian Educational Institutions, has the goal of designing a visual artifact to be used in teaching a subject of choice.

In the DoCTA project the research questions are centered around how the students, teachers and facilitators organise their work, and how the patterns of collaboration vary. This is considered with respect to actor characteristics, the type of learning activity, the kinds of artifacts they have access to, and the kind of artifacts they are supposed to design. I will restrict my study to how the patterns of collaboration vary with different configurations of tools, tasks and interaction types. To analyse and evaluate the scenarios I will use an Activity Theory and distributed cognition framework, and different methods including external observations, self-reporting and unstructured interviews.

My research design is still on "the drawing board", so one of the reasons for participating in this workshop is to get some ideas about how to evaluate and collect data from these scenarios.

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An activity-theoretic analysis of the failure of a requirements capture protocol for a peer-to-peer student support system

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The talk reports on an attempt to produce an Internet-mediated peer-to-peer support system for use by a cohort of DPhil students on CASE studentships with BT, a new form of activity designed to reduce isolation and dropout. A requirements capture protocol was used to elicit student needs, but the major tool, an online questionnaire, elicited only one reply.

The requirements capture paradigm would suggest that the tasks and needs involved were ill-specified to the extent that there was no interest in the proposed system. I will attempt to theorize the failure of the requirements protocol in an alternative way, using activity theory (AT). A major tenet of this is that an activity, here student communication over the Internet, is situated within a network of interlocking activities. We can call this an 'activity space'. There needs to be matching or congruence between all the activities in an activity space in order for any single activity to make sense. Thus we can see the failure of the requirements capture protocol not simply as the failure to generate adequate needs and task analyses but as an anomalous attempt to place an activity into an activity space.

I will argue that 'bridging the gap' between theory and practice for open-ended 'virtual community'-like systems of this type involves matching a new activity - the computer system - to the activity space. AT can help us conceptualise and model this process.

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Understanding the cognitive basis for using multimedia in education

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The advent of multimedia has enabled novel ways of presenting information through different media formats, such as, text, audio, graphics, and animation, and provides the opportunity for innovative ways of interacting with information not available with traditional media formats.

A multimedia system can be thought of as a particular form of external representation, such as diagrams, which support external cognition (Zhang and Norman 1994), the latter being a part of human cognition that happens outside the brain and is supported by external tools, such as, diagrams, text, animation, simulation, computer-interfaces. The pervading assumption is that the more complex and varied the technology the better the interaction and the better the learning. "It is frequently claimed by... producers (and emphasised by reviewers) that multimedia capabilities enhance educational value" (Large et. al. 1994, p. 528). However, where multimedia systems are complex, with a lot of information presented simultaneously, learning could become more difficult than with a traditional one-media system. Technological advantage allows more ways of presenting information, but are such advances cognitively beneficial? Thus, it is essential to investigate the effects of multimedia and interactivity on cognition.

To do this we aim to look at learning with multimedia (external) representations using the 'Cognitive Interactivity' framework developed by Scaife and Rogers (1996). This emphasises the interplay between internal and external representations on cognition; (i) how new information is integrated with existing knowledge and then re-represented and (ii) the identification of the cognitive benefits and costs of particular forms of representations identifying the properties of external representations in terms of their computational offloading - the ways in which different forms constrain the amount of cognitive effort required to solve informationally equivalent problems. An example here is graphical constraining - the way that different graphical forms of representations of the same information will limit the kind of inferences that are likely to be made, thus guiding thinking towards the concept to be acquired.

A user centred design methodology will also be incorporated. This focuses on the users' activity in order to develop artefacts that achieve usability, effectiveness, efficiency, learnability and satisfaction during user interaction. The process consists of the repetition on many design cycles, prototyping-evaluation-implementation, until a suitable artefact is designed, and considers three key-points (people, work and technology) as relevant to developing a system. As the methodology suggests, the role of the user is central in design, and the iterative design in user-centred methodology guarantees that developed systems match the users' needs and requirements.

The project will focus on the effects of animation and interactivity on cognitive processing, investigating learners using diagrams expressing dynamic processes, such as cardiac circulation. To do this the system needs to know about the users in several ways to enable appropriate design of interactive educational software, for example; internal representations (mental models) so that the system can be designed to allow for these as a basis from which to work; the effects on cognition of varying external representations on the alteration, addition or modification of internal representations, to promote appropriate learning to take place; the effects on cognition of varying levels of interactivity with the diagram, to investigate influences on learning outcomes. We also need understand the nurses' learning context and their requirements, their learning tasks, goals and aims.

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Seniors on the Internet

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The aim of this study is to explain the mutual interaction between electronic networks and disciplinary culture and the consequences of cultural differences for the uptake and use of such networks.

Seniors on the Internet In my workshop presentation I want to talk about communicating and learning trough technology, specifically aimed at bridging the gap between users through computers. As a case study for my PhD research I will introduce two senior citizens communities on the Internet, one in the United States and one in the Netherlands. It would be interesting to focus on the ways these groups of people both communicate and learn through participating in these Internet communities.

SeniorNet In the United States, SeniorNet is a very well known site on the Internet, were a lot of Seniors frequently meet, discuss, share information and experiences and engage in activities that also have an offline counter-part, for instance their involvement in so called Learning Centers. In these Learning Centers, people learn to use to new information technologies, specifically the Internet, and for instance learn to build home-pages on the Internet and install their own computer and Internet software. Besides this process of learning, people are also involved with learning on another way, via the SeniorNet Roundtables, a series of discussion-lists. This learning process is aimed at learning about ways of communicating via the Internet.

Recently, a group of researchers from the Institute for Research on Learning, have conducted a survey via e-mail and face to face interviews in which they have asked the participants in SeniorNet in what way they feel they have learned from their involvement in SeniorNet. The specifically focus on learning when being part of a discussion group, but also learning related to learning about the (technical) aspects of the technology. The questions on the Roundtables Discussionlist were the following:

- What are the processes through which you learned how to use computers and online resources?
- How are people inducted into the conventions and practices of the online community?
- How are people welcomed into the community?
- How are people informed if they are doing something inappropriate?
- What are the avenues for soliciting technical help?
- Is there a category, implicit or explicit, of a "new member"? If so, what does it mean to be in that category versus other social categories in SN?

SeniorWeb In the Netherlands, the SeniorWeb community has just started, compared to their American counterpart. However, also in the Netherlands initiatives are taken to get the SeniorWeb participants involved in learning to use computers and the Internet. Besides that there are also discussion lists that can be visited by the participants, and there is also very often a general discussion about a specific item. A couple of months ago, that discussion was about the national elections, since they were held in the Netherlands at that time.

From looking at the questions that are being asked by the Xerox Parc Research Group, it becomes clear that aspects that have to do with learning can both be asked on a technical level (their involvement with technology, the Internet) and also regarding the ways people behave in online communities. Both aspects will hold a central position in my research of both communities.

In my presentation I will talk some more about these various ways of learning by showing some examples and preliminary survey results. I will also introduce one of the research methodologies I will be using in this case-study, that is discourse analysis. Using this perspective provides me with a empirically based tool to address the conversations people have when they are online and enables me to take a better look at their actual communication by looking at the way they themselves refer to for example the things they value most about the technology and certain aspects of the computer mediated communication process.

Interactivity and the Web

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The Web differs from mass media such as television and newspapers in that it is a potentially symmetrical medium: messages can travel in either direction using the same technology. However, there are constraints of many kinds - social, financial and perceptual, to mention some - which will limit people's use of this innate potential for interactivity. A dominant factor is that commercialisation of the Web is bringing in more users, but, at the same time, drawing a greater distinction between producers and consumers. Producers are making efforts to harness the interactivity of the medium to provide various kinds of functionality - how do users respond to the opportunities provided?

As soon as behaviour on the Web is examined, it becomes apparent that there is more than one kind of interactive experience to be had. A distinction can be made between behaviour which involves the summoning of information or services for an individual and that which involves communicating with others. Within the latter category, a continuum exists from communication which involves private exchange to communication which constitutes a form of publishing, in that contributions are, or are intended to be, available publicly. People's behaviour appears to be affected by their perception of these differences. By understanding more about these different perceptions and the conditions which encourage certain behaviours, it will be possible better to design interactions through the design of sites.

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The Development of Electronic Academic Communities: Using Computer Mediated Communication to Support Undergraduate Studies

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This research examines how electronic conferencing might bridge the gap between academics and undergraduates by facilitating dialogues within an academic community.

Many undergraduates experience few opportunities for intellectual discussion and debate with their tutors, and many also fail to exercise their critical faculties in argument with their peers. Such dialogues were traditionally an important part of academic life, a demonstration of critical spirit, of what "being" academic involved. Academic discourse provides opportunities for "legitimate peripheral participation", leading to an understanding of the "culture of practice" (Lave and Wenger ,1991)

Practical reasons for reductions in academic discourse include, staff having less flexibility within their timetables, fewer physical spaces available for unscheduled meetings, students having family or paid work commitments. Computer mediated communication (CMC) offers a potential solution to overcome these practical barriers to communication. Access to an electronic conferencing system removes time and space constraints. In theory dialogues can be maintained asynchronously and all the students can be involved in every discussion.

In practice electronic discourse has not universally flourished. Many students are reluctant to enter into any discussion unless it is designed as a mandatory unit, integrated into their course work, and for which they will receive a credit. Where a formal requirement for CMC use has been incorporated into course work it has not necessarily led to any ongoing change in communication habits.

Research has indicated that informal communication is important but undervalued (Isaacs, Whittaker, Frohlich,and O'Conaill, 1997). Informal communication could overcome some of the difficulties and linguistic misunderstandings in the ways that academics and students communicate (Bourdieu, Passeron and Martin, 1965). This research has been designed to present first year psychology undergraduates with a Lotus Notes Conferencing system to use for "informal communication". To encourage interaction and overcome natural anxiety that can be aroused when writing for an unknown audience short video introductions by the academic community are made available to students.

References

Lave, J and Wenger, E (1991), *Situated Learning: legitimate peripheral participation*, Cambridge University Press, Cambridge, UK

Bourdieu, P, Passeron, J, and de Saint Martin, M (1965), *Academic Discourse: linguistic misunderstandings and professorial power*, Polity Press, Cambridge, UK

Isaacs, E, Whittaker, S, Frohlich, D and O'Conaill, B (1997), *Informal Communications Re-examined: New functions for video in supporting opportunistic encounters*, in K.E. Finn, A.J. Sellen, S.B. Wilbur (Eds), *Video Mediated Communication*, Lawrence Erlbaum Associates, New Jersey, USA

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Developing Sustainable Community Networks: A personal, social, economic, and political challenge

Colin Millar

Community Networks represent the geographical localisation of Internet technologies allied with existing telecommunications services. The aim is to expand the benefits of computer-mediated communications and information systems to the majority of the population by making the content and the transactions relevant to meeting ordinary daily needs.

Despite globalisation, the expansion of virtual worlds and increased travel, we will remain rooted - living and working in a defined geographical location typically of 10 - 20km radius. It is estimated that by 2005, 60 % of UK households will be on-line. Why? What will they use the technological capabilities for? The challenge is to encourage participative design with current and future users such that local social and economic benefits are achieved. Such changes to the means of doing business and delivering life-support services in a place-based community will have a profound influence over local governance and local trade. The social aspects of technical, individual or economic exclusion are crucial. In this presentation I will indicate what BT is doing in this field, and provide examples in the UK and Europe of exciting examples of Community Networks in action.

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Community storytelling using hypermedia

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The True Stories Project is exploring how communities might make use of hypermedia technology to represent themselves. We are interested in how groups engage with the technology for their own purposes as well as what kinds of "stories" emerge. Our understanding of what the user needs to know about the system is closely related to how we work with community groups. We are facilitating projects with groups who constitute a community in that they define themselves as such, who have a story they wish to tell and who are willing to use unfamiliar technology to tell it. We have just come to the end of an eight month project with St Paul's Carnival Association.

We are using a multimedia PC, with in built scanner, designed for "creative families". For the Carnival Project we used Adobe Photoshop and Macromedia Director which are aimed at a professional market but which are more flexible than many of the cheaper packages designed for the domestic market. With greater flexibility also comes greater choice and complexity which can be daunting for less confident participants.

In order for the process to be of use to the community group in relating their story and in order that we might observe how they make use of the technology, the participants should have as much control over the process as possible. Although the technology was alien to the carnival group, their story is their area of expertise. By focusing on some aspect of the story, participants could come to the technology with a sense of purpose. They could tackle the technology by getting to grips with the aspects needed to put together that part of the story as they intended it to be.

Thus the users get to know as much of the system as enables them to tell their part of the story. As the story is added to and changed and parts are linked together, they get to know more of the system and this also feeds back into ideas for the story. As the process continued the participants designed a carnival island which was to serve as the basis for their own system for navigating the story.

Of course it doesn't always work quite that smoothly in practice. Working with a voluntary sector group which relies heavily on placements, volunteers most of whom have little or no experience of computers presents a number of challenges both for the facilitator/researcher and the participants, for example in the carnival project:

- Continuity is difficult to sustain in such an organisation and the facilitator tended to fill the void.
- A lack of experience and confidence meant that participants who were getting to grips with the basics of window felt that these procedures acted as a barrier to creativity

- Group work is impractical on one PC. Most group work was mapped out on flipcharts and posted on the walls. The maps were integral to the process and guided the creation of the materials developed on PC. This part of the system was owned and controlled confidently by the participants.
- Software metaphors were often problematic but the group developed their own metaphors (around a carnival island) which served as a basis for the system they created for their hypermedia story.

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3D Virtual Environment and Learning

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The research that I intend to pursue concerns the assessment of 3D virtual environments usefulness for learning. In particular, I am focusing on the different forms of visualising and manipulating representations that this graphical technology allows, and its relations with conceptual learning. There has been much hype in education about these technologies but the validation of the benefits is still not established, and typically, the research only takes the form of comparative studies. Little structured cognitive analysis has been carried out to explain the real advantages of applying VEs to learning. Moreover, it seems that there is a big gap between the investigations about interactivity properties/design principles of virtual environments and its use to support learning.

My aim is to contribute to the clarification of this problem through the use of external representation framework. In particular, focusing on the dynamics between internal and external representations. This research will contribute towards an understanding not only of how to design virtual environments for learning, but also when to design virtual environments for learning and how to use 3D interactive representations in conjunction with other types of representations for an effective learning process.

To carry out this kind of research, however, is not easy. Even the apparently simple task of choosing the domain seems complex. In fact, it is difficult to clearly establish how a certain concept or problem must be represented in a 3D format and whether this same concept would be better represented in another format. A possible domain candidate for the investigation that I am considering is geology because: it has spatial properties, most of the times the problems involve the display of different variables working at the same time, many phenomena are invisible, and the time scale can also be manipulated.

Considering the question proposed by session 2 in the workshop, it is often considered that the interaction techniques of three-dimensional virtual environments are more intuitive and transparent than common interfaces, allowing a greater focus on content. This should be due to the fact that virtual environments can use natural body schemes in a virtual space and that the user can interact through a certain analogy with real space and objects. So, if the claims are right, the user should just need to transpose the knowledge about how to interact with the real world to the 3D virtual environment. In this context, some important questions are:

- How to design the representations to take full advantage of the resemblances of virtual and real world?
- How to deal with the cases where the virtual representation is clearly different from real world objects or spaces?
- How to avoid misinterpretations when the virtual representation and real world show some kind of mismatch?

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How the properties of the communication medium affect cooperation: Pilot-controller mutual awareness

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Intelligent actions in real work settings cannot be investigated by analyzing individual's cognitive performance in isolation, without taking into account the material and the social individual. Human cognition is always "cognition in the wild" in that it is naturally situated within a human constructed environment; for that reason, the study of the human activity in actual work settings implies the development of methodologies for investigating the role played by the material and the social context.

The Distributed Cognition approach (Hutchins, 1995) provides an interesting framework to analyze and model the relationship between activity and context in real work settings. Its central thesis develops around two main assumptions:

- to understand the role and the properties of every representation or communication medium we have to take into account the whole socio-technical system composed by people, roles, artifacts, rules etc;
- such a socio-technical system can be analyzed in terms of a cognitive system, a system which makes computations through the transformation and the propagation of different representational states, whether these representational states are internal (within the individual mind) or external (in the environment). It is the distribution across different media and the use of these informational resources that shape the activity of the system. In particular, the distribution of the information within the system strongly affects the level of cooperation among the different individuals involved in the process.

In the Long Term Research project "Mefisto", we analyze the Air Traffic Control team in terms of a "cognitive system" composed of groups of individuals (pilots and controllers) interacting with each other through a set of artifacts (radar screen, strips, elbow communication, radio communication) over a period of time. According to the Distributed Cognition approach, one of the first steps toward the understanding of the Air Traffic Control system is the analysis of the representational properties of the communication and representational media. Indeed, the representational properties of a medium (i.e, the broadcast radio channel) determine the degree of accessibility to different individuals (i.e, pilots) of the information concerning the air traffic, that is the degree of redundancy of this information within the system.

The aim of my presentation is to provide a real scenario describing how the access to the communication among controllers and pilots taking place through the radio channel allows every pilots to:

- build-up a model of the current air traffic and of the controller's workload (mutual awareness);
- use this information to cooperate with the controller in assuring an effective and safe traffic management.

In general, the scenario shows how the properties of the communication media, by supporting cooperation, that is the local redefinition of the roles and the mutual help, can enhance the effectiveness and the safety of the whole system.

References

Hutchins, E., 1995, *How a Cockpit Remembers its Speeds*. In Cognitive Science, 19, 265-288.

Hutchins, E., 1995, *Cognition in the wild*, MIT Press.

Norman, D. A., 1991, *Cognitive artifact*. In J. M. Carroll (Ed.), *Designing interaction*, Cambridge University Press, Cambridge, MA.

Zhang, J., and Norman, D. A., 1994, *Representations in Distributed Cognitive Tasks*. In Cognitive Science, 18, 87-122 .

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The Application of Visualisation to Requirements Engineering

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It is now widely regarded that there is a direct correlation between the successful conclusion of a software development project and the attention paid to the project's requirements engineering stage. During the requirements stage, the developer and user are brought together with the aim of producing an accurate description of the user's own needs, i.e. a software requirements specification.

Communication between the developer and the user during this stage is critical. Differences in domain knowledge, terminology, and culture, result in a separation or a 'gap' being formed between the two parties. This gap must be bridged, if an accurate requirements specification is to be produced.

To this end, requirements prototyping has been widely advocated as a technique to provide this necessary bridge. This involves the development of a dynamic model of the requirements which can be used as a common reference point, to which the developed and the user can relate their own perceptions and evaluate the requirements as they evolve.

Although there are many prototype development approaches, one particularly noteworthy and increasingly popular approach involves the use of formal methods. Here, a requirements specification is expressed using an abstract mathematical notation. This specification is subsequently executed, resulting in the production of a dynamic and interactive prototype. The abstract mathematics allows low-level implementation details to be hidden, increasing developer productivity.

Whilst this approach offers many benefits, these benefits are primarily for the developer. Unfortunately users are often unable to comprehend the mathematically based specifications or the resulting prototypes. Consequently, if they cannot understand the requirements as presented to them, their successful evaluation cannot be guaranteed. This situation could lead to errors arising in the requirements specification, and ultimately to the failure of the project.

The crux of the problem lies in the accessibility of formal representations. This research project addressed this problem. The objective is to enable developers to retain the benefits of formal specifications, and at the same time enable customers to comprehend them. To this end, we advocate that the discipline of graphical visualisation can be used effectively in this domain.

Visualisation is essentially a transformation process. It is concerned with transforming representations of information for the purpose of communicating a more adequate appearance of that information to a viewer. We believe that visualisation can be used to transform the formal representations of the requirements into more familiar forms using graphics and animation.

The research has two main objectives. The first is concerned with the development of a software toolset that supports the visualisation of execution of formal specifications. It achieves this by intercepting execution results and then transforming these into representations that are more appropriate for the

user. The second objective is the development of a suitable method to provide guidance to a developer in devising and applying suitable graphical representations.

It is hoped that the combination of both the toolset and the method will provide a suitable bridge by which the developer and user can communicate more effectively, and hopefully bring about more confidence into software development.

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The Colleague in the Machine: Electronic Commerce and Organisational Learning in the Insurance Industry

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Electronic Commerce is a marriage between a rapidly evolving technical environment and an increasingly pervasive set of ideas as to how markets should function. It is expected to transform or refine business processes helping purchasers to make better decisions by allowing them to amass, analyse, and control large quantities of specialised data. This paper argues against this dominant paradigm from a perspective that draws upon evolutionary economics and "connectivist" research in cognitive science. Organisational learning is cumulative, highly influenced by cognitive frames, and is embedded in organisational forms. In the case of electronic commerce, learning is complicated by the attempt to re-engineer processes across organisational boundaries. This view neglects the known difficulties of business process re-engineering and the observation that markets and firms are intrinsically different as co-ordinating mechanisms.

The predominant view has been disturbed by recent research into the phenomenon of "presence" in mediated environments. Studies of "presence" have their origins in virtual reality, telemedicine and teleoperation research where the idea is used to measure the user's experience of a computer-mediated environment and to compare it to a natural environment previously experienced by the subject. Presence includes cultural and social perceptions and involves a process whereby users seek and find social meanings, whether or not they are intended by the designers.

The "connectivist" cognitive science tradition offers a complementary perspective where the mind is understood as a controller of embodied and situated activity. Accumulated institutionalised learning and pattern recognition play important roles in the formation of perceptions in physical and electronic commerce environments. The extent to which actors are able to accept computers as invisible intermediaries and as social agents capable of competent performance, and the degree to which they succeed in constructing the institutional forms to accommodate this transformation are shown to be major influencing factors for the diffusion of electronic commerce.

I believe I can put an appropriate "spin" on my topic to fit in to any of the four sessions, if so desired.

1. *Does the "system" need to "know" about a particular user / group of users - if so what?*

   My research argues that the criteria users employ when judging a computer's fitness for a task are the same sort of criteria they use for deciding whether a colleague is competent and trustworthy. Therefore a computer need to know how to perform as a socially well-adjusted members of the community.

2. *What does or should the user need to know about the system?*

   The user needs to know that s/he is participating in a socially constructed activity with other selves. S/he needs to know his/her own role, and what others can be relied upon to do. Drawing on elements of Vygotsky, Social Identity Theory, and Socially Distributed Cognition, I can discuss the differences and similarities between activities that are mediated by a social setting and activities that are mediated by technology.

3. *Should the design of communication technology reflect culture?*

   Yes, it should. I can, if you like, talk about the evidence that communications technologies are not cold, cueless neutral environments, and that users will detect social cues and apply meanings to them which will affect task performance and satisfaction with outcomes.

4. *Does technology design dictate communication patterns?*

   Yes; more specifically, it dictates where communication will break down and how easy users will find recovering a breakdown.

I can illustrate each of these questions with cases drawn from the literature and my own consultancy work and also offer some methodological pointers to how problems can be overcome.

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People that aren't going to talk

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My research is in the area of Learning Companion Systems(LCS). An LCS is a variation of an Intelligent Tutoring System (ITS) where besides the tutor and the student a third agent is added: a Learning Companion (LC). The role of the LC is to be a peer for the human student and help her as another student would do. For example, the companion could be a role model, both students could collaborate and compete as equals, the companion could be an student of the human student, the companion could be a source of advice, etc. LCSs are relatively new systems so there are many questions to be answered. In particular, the expertise and behaviour of the companion must be carefully chosen so it can help a human student in her learning activities.

Research has shown that students learn more and better when they have the opportunity to teach other students. A student who teaches another student will have to revise, clarify, organize, and reflect on her own knowledge in order to be able to teach it, i.e. the student will need to master the knowledge. Based on this, I want the explore the hypothesis that a LC with less knowledge than the human student will help the student to learn by encouraging her to teach the LC.

At present I am developing a LCS in the domain of Binary Boolean Algebra. The tutor will teach the students the rules and laws of boolean algebra and how to use them to simplify boolean expressions. Two types of LC will be implemented: one with low expertise (weak) and one with high expertise (strong). One problem to solve is how to motivate the student to put effort into teaching a weak LC. There will be two modes of interaction between the companion and the student: motivated and free. In 'motivated interaction' there will be pressure on the student to interact with the LC. In 'free interaction' there will be no such pressure; the student will only be told that it is beneficial for her to interact with the companion. In either case, either the student or the companion will solve problems and seek/propose justifications for each move from the other agent. So the student will be able to give the LC suggestions, ask it for justifications and, most importantly, to teach it.

Experiments using a 2x2 design (weak and strong companions vs. motivated and free interactions) will be conducted. It is expected that motivated interaction between a weak LC and a human student will be the most beneficial of the interactions by encouraging the student to teach the LC and therefore learn more efficiently.

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An experiment workbench to study software reuse from a cognitive perspective

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Software reuse is a promising programming technique that is supported by many technological developments, and different theories compete as to how code reuse should be assisted by a computer tool.

The most important stage of software reuse consists of searching in a database for a software component that can be reused in a new program. This brings two interesting issues.

- First, a programmer must tell the computer system what requirements this component should meet. This can be done in many different ways.
- Second, the computer system must give back some information on the components found, so that the programmer can:
  - evaluate if a component is really suitable, and
  - understand how this component works, so that he can adapt it to his own precise needs. Various methods of software visualization exist to assist this understanding.

We are developing a reuse workbench which will simplify the evaluation of these various theories.

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The Community and Technology

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This paper discusses some of the most important technologies that have been introduced to and used by the community over the last few centuries (from the printing press to computer networks). This interaction between the community and technology shapes its subsequent evolution; however, predicting the consequential impact of a new technology is an extremely complex problem.

Technology usually has two types of effect, the first level is the economic implications or efficiency gains, and the second is the social effects once the technology is in use. Forecasting the direct costs can be hard enough, but understanding how the technology will interact with on going routine practices and policies is even more difficult. It is the social human element that makes prediction so problematic. By paying attention to this complex element, it is hoped that a better technology can be designed and appropriately introduced.

A recent technology that has, and continues to have, an impact on the community is the increasing use of computer networks. Networked applications are increasingly permeating our lives, and yet applications are rarely designed to take account for being networked. When the network breaks down the user is not helped in selecting the appropriate recovery action, which often leads to frustration and inefficient use of network resources.

The current research project at the University of Sussex looking at these issues is EMMANATE (Exploring Mental Models for Application in Networking Applications, Telephony and Environments). Users' mental models and representations of networks and related technology are being investigated in order to build a taxonomy of key concepts used in formulating such models. These results can be used to inform better design of interfaces and to ensure that the gulf between the models used by network service providers and end users (customers) is bridged.

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Focal structures in Prolog programs

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There are several instructional systems for Prolog, however, these systems have been built mainly based on the designers intuitions about what is the nature of the Prolog programming skill. A knowledge of the way programmers represent the code they work with, specially about the way this representation develops from novices to experts, seems to be of central importance when designing such instructional systems. However, this knowledge is absent from them simply because it has not been elicited.

There have been several studies that have suggested that programmers of procedural languages base the mental structures of the programs they understand in the idea of Programming Plans. Experienced programmers are said to posses a more advanced knowledge about these structures. There is also evidence that there are parts of these plans that are focal to the programmers' structural knowledge. It is not clear that this is the case for Logic Programming, though. Prolog has some important differences when compared to procedural languages. It does not have obvious syntactic cues to mark blocks of code (begin/end, repeat/until, etc). Also, its powerful primitives (unification and backtracking) and the extensive use of recursion might influence the way programmers comprehend Prolog code in a significant way.

One way of studying the structural knowledge that Prolog programmers posses is through finding out which parts of the program text are important to them. A comparison between what is important for novice and experienced programmers might give clues about the way the representation of programs develop as the level of skill increases. My research project is focused on a set of experiments that intend to find out about the segments of code that Prolog programmers consider as focal and their relevance to the construction of the mental models they build when trying to comprehend programming code. The findings of this study might provide useful information for the design of instructional systems for Prolog programming.

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Supporting Group Activity in Distance Learning from Case Studies

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Burt (1997) defines distance education as education that occurs at a distance, and emphasises the importance of characteristics such as two-way communication and interaction. In this sense, the World Wide Web constitutes an unrivalled environment for distance education. The development of uncountable Web-based educational applications and Web-based courses for distance learning over the last few years is a demonstration of this reality. On the other hand, in the design of an Web-based educational system, there is a need to take into account the constraints presented by the Web as well as the pedagogic issues that arise from its use (Benyon et al., 1997).

The Learning from Case Studies method (Christensen & Hansen, 1987) is well established as an educational method and has been widely used in diverse fields, for many years now. Shulman (1992) says it represents a valuable procedure to complement the traditional instruction, characterised as a prescription of theoretical principles, where usually the learners are not subject to face the complexity of real problems. The case method enriches the limitations of traditional teaching, creating opportunities for the learner to deal with day-to-day ambiguities of professional life.

Distance Learning from Case Studies involves enabling collaboration between two or more learners at a distance on a case study activity, which is carried out over the WWW with the support of intelligent technology. In this project the design of a system to support group activity in distance learning from case studies is proposed. The system's design aims to guide, promote and monitor the case discussion. It is based both on the Seven Steps Approach (Easton, 1982) and on the role of the case instructor in the traditional classroom (Christensen & Hansen, 1987). The former provides a framework to develop the case solution through seven steps. In each step the learners are requested to collaborate (Dillenbourg et al., 1994) to accomplish an activity. The latter refers to determining in which opportunities, and what for, the system should intervene during the case discussion.

The design basics mentioned above define the kind of support to the method the system provides and model the interactions between the learners and the system. In this context, the main issue is the discussion management. Concerning the interventions made by the system during the case discussion they intend to:

1. identify when the group have not completed a certain step;
2. identify a learner's misunderstanding about the case study or about the way the group is conducting their case study solution;

3. identify when a learner is not participating in the group activity during the case study solution process;

4. identify when the group exceeds the time limits of on-line collaborative work in each step.

References

Benyon, D., Stone, D. & Woodroffe, M. (1997). *Experience with Developing Multimedia Courseware for the World Wide Web: the Need for Better Tools and Clear Pedagogy*. International Journal of Human-Computer Studies, 47, 197-218.

Burt, G. (1997). *Face to Face with Distance Education*. Milton Kynes, UK: Open and Distance Education Statistics.

Christensen, C. R. & Hansen, A. J. (1987). *Teaching with cases at the Harvard Business School*. In C. R. Christensen with A. J. Hansen, *Teaching and the Case Method: Text, Cases, and Readings*, pp. 16-49. Boston, Mass.: Harvard Business School.

Dillenbourg, P., Baker, M., Blaye, A. & O'Malley, C. (1994). *The Evolution of Research on Collaborative Learning*. In E. Spada & P. Reiman (Eds.), *Learning in Humans and Machine: Towards an Interdisciplinary Learning Science*. Oxford: Elsevier.

Easton, G. (1982). *Learning from Case Studies*. London: Prentice Hall.

Shulman, J. H.(1992). (Ed.). *Case Methods in Teacher Education*. New York, NY: Teachers College Press, Columbia University.

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Redefining the hyperlink

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I am a PhD student in the Department of Computer Science at the University of Edinburgh and my research revolves around the idea of redefining the hyperlink to give users information concerned with:

1. the referenced information object
2. the quality of service of the data transfer and
3. the social recommendation of an information object.

The question that this work most clearly addresses is key question two; what does or should the user need to know about the system?

The system communicates with the user solely through the presentation of a visual image. Users construct mental models of systems largely by interpreting the visual image, which should present the system's responses to their actions. The World-Wide Web provides an image of the system which is too abstract and this coerces users into relying on tenuous implications and predetermined system knowledge (often erroneous) to construct their mental models. This results in inconsistent and incomplete mental models that lead to frustration and error.

Changing the system image of the World-Wide Web is not a trivial operation. The World-Wide Web is a distributed information space and the communication between an information store and a user's browser is a major contributing factor to the observable behaviour of the system. The reasons for an observable action, such as a delay in transferring an information object, must be explained to the user if they are to construct practical mental models. Presently, the underlying communications protocols are unable to provide the user with the necessary dynamic properties of the communication when information is being transferred, or any pre-transfer predictions as to the 'quality of service? which the user can expect. It is the goal of this work to redesign these protocols from a user-centred perspective and hence produce a more desirable system image.

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Mediating Meta-Cognitive Conflicts in a Collaborative Problem-Solving Situation

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The technological advances seen in the last two decades have brought a change of paradigm in Computer Science, which has also been reflected in AI-ED systems. From an emphasis on the individual, as a way of providing better usability systems, we have now passed on to focus on building Collaborative Environments (Paiva 1997). This has raised the issue of communication among the peers - fundamental to make collaboration possible. According to (Easterbrook et al. 1992) an immediate consequence of this is the potential for conflicts. When considering a group-problem solving situation, we cannot ignore this possibility. In such cases, articulating the conflicts can be a way of refining solutions, avoiding group-thinking, etc. There is evidence that, in groups solving a problem, the incompatibilities that arise are either of goals (conflicts of interests or ends) or of beliefs (which can be further divided into the categories described in (Self 1995)). In (Dillenbourg et al. 1994) we can find another division of conflict types: social conflicts (not connected with the problem being solved) and cognitive conflicts (relating to the task).

In our point of view (reinforced by the results of our preliminary experiment (Tedesco 1998)) in a group problem-solving situation, this division of conflicts can be further extended into the following:

- social conflicts, which relate to the social roles and positions of the members within the group;
- task-related conflicts, which can be further divided into:
  - belief conflicts, which comprise conflicts about the domain under discussion, and have been extensively investigated (for further details see, for example, (Gardenfors 1988));
  - meta-cognitive conflicts which comprise conflicts about strategies for solving the problem in question;
  - contextual conflicts, which relate to defining the model of the problem being solved.

(Ferguson et al. 1996) report that, in an informal analysis of a problem solving dialogue, they most of it was devoted to establishing the current state of the world. In this research, we propose the investigation of Meta-Cognitive Conflicts, and of how a model of the group may be useful to help mediating the conflict scenario. The aim of the project is to produce a computational system capable of mediating conflicts among students solving a task (e.g. designing software, planning activities, CSCW activities).

In order to achieve this goal, the following issues will be considered:

1. model of the negotiation process - here we have a computational model of Meta-Cognitive Conflicts;
2. model of the dialogue - using a dialogue game approach;
3. model of the group - which is based on the individual models of the learners, and consists of group beliefs, misconceptions, goals, differences and social roles; and
4. model of the task to enable the system to make useful interventions.

References

(Dillenbourg et al. 1994)
Dillenbourg P., Baker M., Blaye A. and O'Malley C., *Evolution of Research on Collaborative Learning*, in Spada and Reimann (Eds.), *Learning in Humans and Machines*, 1994

(Easterbrook et al. 1992)
Easterbrook, S.M., Beck, E.E., Goodlet, J.S., Plowman, L., Sharples, M. and Wood, C.C., *A Survey of Empirical Studies of Conflict*, in *CSCW Cooperation or Conflict*, Easterbrook, S. (ed.), Computer-Supported Cooperative Work series, Diaper, D. and Sanger, C. (eds.) Springer-Verlag, pp. 1-68, 1992

(Ferguson et al. 1996)
Ferguson,G., Allen, J., and Miller, B., *TRAINS-95: Towards a Mixed Initiative Planning Assistant*, in *Proceedings of the Third Conference of Artificial Intelligence Planning Systems (AIPS-96)*, Edinburgh, Scotland, pp. 70-77, 1996

(Gardenfors 1988)
Gardenfors, P., *Knowledge in Flux*, MIT Press, 1988

(Paiva 1997)
Paiva, A., *Learner Modelling for Collaborative Learning Environments*, in *Proceedings of the AI-ED 97 World Conference on Artificial Intelligence in Education.* B. du Boulay & R. Mizoguchi (eds.), 1997, pp. 215-222

(Self 1995)
Self, J.A., *Dormorbile: a Vehicle for Metacognition*, in T.W. Chan an J. A. Self (eds.), *Emerging Computer Technologies in Education*, Charlottesville, AACE, 1995

(Tedesco 1998)
Tedesco, P., *Mediating Meta-Cognitive Conflicts in a Collaborative Problem Solving Situation, First Year Report*, Computer Based Learning Unit, University of Leeds

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A Human-Centred Recycling Support Tool

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Traditional approaches to technology design have commonly produced systems which fail to adequately support the mental processes of the user or assist his work activities, resulting in user dissatisfaction and alienation from the technology.

The human-centred approach seeks to provide an arena in which the user and system can become connected and work in symbiosis, thus empowering the user and enabling him to utilise and develop his skills and creativity. Active user-participation in the design process improves the system's effectiveness within the work context and increases the user's knowledge and control of the system.

Many difficulties arise, however, in the practical application of the human-centred approach. Human- centredness itself is a highly subjective concept, necessitating an interpretation of relatively ill-defined concepts and their application to the system under development. Many human-centred aims are difficult to translate into practice and embody into the emerging system, for example the preservation and development of skills and tacit knowledge. In addition, the successful facilitation of active user involvement in the system design process presents a significant challenge.

A human-centred approach requires that the user's level of system understanding, in addition to being sufficient to allow him to carry out the required tasks in the workplace, must be at a level which facilitates the development of his skills, creativity and intelligence, and also enables him to be in control of the processes taking place. Any decision as to what the user needs to know about the system, therefore, has socio-political ramifications in terms of his role within the organisation and society.

The research involves the development of a support tool to aid in the day to day running and long term planning of an urban recycling system. This will provide a basis for an in-depth examination of the challenges of the practical application of the human-centred approach, particularly those associated with the process of user participation. The intention is to develop strategies which will facilitate the embodiment of human-centred principles into the emerging system, improving the translation of the human-centred approach into practice.

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Experiences from Applying HCD in a Complex Process Control Environment: The FS Case Study

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Applying a holistic approach for designing productive systems is becoming more and more important. Productive systems consist of the Software, Hardware, and Liveware (humans) components within a certain Environment (SHEL model see Edwards, 1988), which in their interplay try to fulfill the overall goals of the productive system. Thereby every component represents certain knowledge, where the Liveware normally is the only one capable of adaptive behaviour within a given SHEL space. Liveware is a fundamental component characterised by high flexibility, capacity of adequate reasoning in case of unpredictability, but also variable reliability.

Designing a new system means to modify the knowledge distribution within the given SHEL space. Hence when developing a new SHEL space one has to carefully analyse the existing knowledge distribution within the components. Designing a new SHEL space normally means introducing new SH components which embody knowledge kept in the Liveware.

Human Centred Design (HCD) claims to focus on the Liveware. The main objectives in my project was to define and apply a HCD framework based on the assumptions of the SHEL model. The Italian NationalRailways provided a case study, where the operator's work concerned the control and reactive management of the train movements. Some characteristics of that work are: economical and safety criticality, highdynamism and non predictability, unforeseen or unpredictable events that trigger and require quick decisionmaking, involvement of many objects, need of sufficient knowledge and skills, consideration of decisions inthe context.

Some kernel issues and experiences addressed in applying a HCD are:

1. focus on human's activities thereby starting analysis of simple activities, objects, and interactions to get insight into the basic processes; then enlarging the focus; continuous evaluation and feedback fromthe users thereby using different formal models, narratives, scenarios, mock-ups as communication tools.

2. analyse also the artefacts (SW or HW) being part of an activity (as mediation tool or object in use; see Bannon and Bodker, 1991) to find out, where the knowledge is actually spread within the SHEL.

3. how might the knowledge distribution change, when one of the components breaks down, and who compensates this missing knowledge.

The general target question of the first day raises my interest in respect to designing new systems. According to the SHEL model any productive system is formed by the users, and the SW and HW as-mediation tools or objects of use. It is the users who mediate their intentions through the support tools

to transfer an object of use from one state to another. So, they need to know about the capabilities, strengths,weaknesses and limitations of the support tools. And they need to know about the possibilities and restrictions of the objects they intend to act on during task performance. Yet, none of the SHELcomponents can be seen in isolation. It is the common interplay which make the whole system work smoothly. Hence, holistic design of a new SHEL space is of paramount importance, and it should guaranteea smooth and collaborative interplay of the components.

References

Bannon, L., Bodker, S. 1991. *Beyond the Interface: Encountering Artifacts in Use.* In *Designing Interaction: Psychology at the Human-Computer Interface.* J.M. Carroll (eds), New York: Cambridge University Press.

Edwards, E. 1988. *Introductory overview.* In Wiener, E.L. & Nagel, D.C. (Eds.), *Human Factors in Aviation.* San Diego: Academic Press.