# Human Centred Technology Workshop 2005

## Advancing the Potential for Communication, Learning and Interaction

PROCEEDINGS

8th Human Centred Technology Group Postgraduate Workshop

Department of Informatics, University of Sussex, Falmer, Brighton

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Organizers:
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# FOREWORD

This is the eighth in an annual series of workshops held in Brighton in the summer or autumn. They bring together PhD students from around the UK and the rest of Europe with a common interest in Human Centred Computing Technology. The diverse and interdisciplinary nature of this area can restrict opportunities available to students, at their own universities, for peer review, feedback and discussion of their work or the process of completing a thesis. These workshops give such students a chance to discuss their work and also hear presentations from leading

# Contents

## Day 1

## DAY 2

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Technologies in homework have been positioned as an aid to both learning, and linking home and school effectively [1, 2]. This paper holds that an understanding of current homework practices, and the home context, is vital to designing technologies that can achieve these lofty goals. Data from a series of ethnography-inspired video diaries are used to illustrate how this might be achieved, outlining issues of sharing of tasks, routine and reminders, with the implications of these for design.

While homework is at the centre of many children's lives, it is still poorly understood. Dedicated work [3] suggests that the impact of homework on education is difficult to make concrete. However, the role of technologies in supporting home study and home-school links has been the focus of much research.

Socially-driven research tends to focus on the role of the computer in the home – one technology being used for multiple tasks, rather than the single task and multiple technologies that make up the activity of homework. Sutherland et al [2] found that that children's use of home computers tends to be defined by their normal activities, of which homework is just one. Kerawalla and Crook [4] note that homework is a potentially important part of family computing – a site where children are receptive to parental involvement. While these studies, and others, comment briefly on homework, none focus exclusively on homework usage.

Technology-driven research has looked at the design and evaluation of new technologies [1, 5]. While parents are often involved in such studies, evaluation of technology's impact on home life, rather than home-school links, is rare.

Lacking in research is a focus on the place of homework within home life – the specific context in which 'homework technologies' reside. Venkatesh [6] has talked about the importance of considering the fit between the social and technological contexts in the home. Research shows how changes in the technological space can affect the social, illustrating how changing from paper technologies to computer-based ones [7, 8], or placing the computer in a certain location [4], can have important social consequences, or reflect important family issues. Homework makes demands that relate to both home and school, making it a unique social context, and what is more, a poorly understood one [3]. A starting point for studying this social context is by looking at the use and appropriation of current and traditional technologies – paper, computer, textbooks – within it.

This work attempts to follow through on this hypothesis. Ultimate goals are to assess the impact of current technologies, and guide the design of new ones. Studying current home practices should indicate how they can be supported, or altered, through technological design. As an inroad to understanding how homework technologies are used in the home, ethnography-inspired [7] video diaries were used to capture these

Figure 1 shows a boy doing his homework on the kitchen table while his mother cooks her meal – visible at the top right of the picture. The mother moves first from the homework task, back to stirring her food, then to the homework task. Her movements around the room take her either towards the food preparation or towards her son, physically moving between parallel and collaborative tasks, but with conversation constantly collaborative with the son's homework task. The paper used by the child supports this co-located activity quite well. Most screen displays would face issues with the variety of angles and interactions needed to coordinate the sharing. This suggests that the tendency to design new technologies primarily to support either individual tasks or collaborative tasks is flawed. ICTs designed for education tend to support normal school classwork, which is either strictly individual or collaborative, but such technologies are out of place within the home context. Here, minimal collaboration through co-location seems far more common.

**Figure 2: Television programme finishes**

*L: (switches TV off as programme finishes) See if you can get on a bit faster with that, that*
W: I'm done, I've only got to write one more word
*L: Oh well done*

In Figure 2, William is doing his homework in front of the television, with his mother to one side. The primary homework technology here is a paper one. He has been working on a piece of writing for quite some time, switching attention between the television and his work. Eventually, the television programme finishes, and his mother immediately switches off the television, and comments on the progress of his homework. The end of the programme alerts his mother to the passage of time. It is arguable whether the television is acting as a homework technology here – it does not support William's work, but certainly acts to shape it. Contrasting footage of the less time-critical computer shows another mother overlooking the passage of time while caught up in a website. Technologies can either create or subvert routine in this way – affecting everyday events, such as mealtimes, or more unusual events such as family visits. Whether technology should bow to home routine, or more actively aim to create reliable homework patterns is an important issue for designers to consider.

As a complement to routine, physical cues acted as major mechanisms for reminding family members of tasks. An example can be seen in Figure 3, where items to be taken upstairs or downstairs were left on an appropriate step, or landing in one home.

**Figure 3: Items left on stairs**

J: And up here is some cups that maybe someone's been drinking from in the night, and they're ready to go down. And some cream that I have to use, and things that are ready to be used. And washing that's ready to be hang up, and sewing box.

The daughter here explicitly refers to the role of these items as the start of a task: 'they're ready to go down'. Similar roles were seen for homework books and bags across families. The transparency and portability of these items are potential qualities to be mimicked by new technologies; the loss of these qualities by the introduction of less transparent technologies may have consequences for family coordination.

The three examples above outline issues that may face designers of technologies for children's homework, and illustrate the importance of these issues for design.

Involving parents in homework may require more flexibility in viewing and input than many have considered. The ability to share tasks with parents when only co-located should either be built explicitly into designs, to encourage maximum interaction, or built explicitly out, to encourage only involved help – should homework be viewed as an ideally completely collaborative task.

Implications for supporting homework routine are also clear. Physical items seem to function very effectively as memory aids – suggesting that the media on which work takes place should either be transparent in purpose, as in the case of paper, or accompanied by supplementary memory cues. Family routine could also be considered by building in time-critical events – crafting routine by demanding engagement from children at a key time – or allowing the flexibility to use technologies whenever and wherever necessary.

By highlighting current practices within the home, and their implications for design, ideas for new technologies can be guided, and it is hoped this paper illustrates both the importance and the practicality of understanding these issues.


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# Tangibles in the balance: a comparison of physical and screen versions of the balance beam task

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## 1 Introduction

Physical objects are increasingly being used within interaction design to give form to, access, or interact with digital information. This has lead to an explosion of prototype systems and frameworks described in this paper by the catch-all term t*angibles* [e.g. 3, 4]. What distinguishes a tangible from a more generic physical object linked to a computer, like a mouse, is that both the physical and digital components represent something [13]. Dourish [2] has argued that tangibles might better suit the embodied skills we have developed for interacting with the physical world than the more abstract representations of graphical or textual interfaces: an approach related to a more general trend within the cognitive sciences of seeking explanations for mental phenomena in terms of our bodily engagement with the world [1, 6, 14].

In a previous paper [7] we suggested that tangibles might down, or remaining in balance) of a balance scale with different weights placed at either one or multiple positions on each side of the fulcrum. Siegler [11] developed a more standardised task to categorise children's knowledge about balance, as expressed by their performance on different types of problems. From Inhelder 12 119.28 658.68 Tm(l)Tj12 12 119.28 658.658.68 Tm(F)T8.68 Tm(l)Tj12 12 119.2858 658 test, comprising twenty-seven balance beam questions of different types. Then in pairs, they we the different conditions to determine whether there are learning differences related to use of physical or virtual materials.

Participants' verbal protocols and interaction will be analysed using a coding scheme adapted from Okada and Simons' [9] study of collaborative discovery learning. This analysis will focus on the relationship between hypothesis generation and evaluation and search of the space of possible experiments. It is designed to uncover more subtle differences in participants' problem solving strategies.

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# How can we advance the potential for learning via technology? It's all in the CREATIVE design

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**Abstract:** A question gaining wide spread interest in the design of educational technologies, is 'how' can learning tasks be structured so that creativity can be facilitated in educational settings? In the domain of music education, contemporary research focuses upon how technology can be utilised to assist students with *learning to create* music. However, this raises the question 'how can we encourage students to think creatively when interacting with learning technologies?' We suggest that theories advocating learning as a socially constructive process may shed light upon creative phenomena. Extending upon this, an integrative framework of learning and creativity is presented. This framework exists as a design support tool to aid the design of educational systems. This paper also provides an example of a music composition program (SoundScape) designed in accordance with this framework.

## 1. Introduction

Traditional pedagogy isolates the learner from social interaction and concerns pre-packaged lesson materials being delivered from the teacher and/or learning program to the student. Such an approach concerns itself with the passive absorption of knowledge, which is later tested via exam based scenarios. Although this may equip students to pass exams, they may face difficulty when applying concepts into authentic practice (Brown *et al,* 1989). We therefore emphasise the importance of designing educational technologies in a way to facilitate the natural learning process.

## 2. Theoretical background: learning and creativity

With growing advancements in technology, learning programs are an ever present element of education today. However, technology is often misconstrued as a medium for disseminating knowledge to students as opposed to providing a virtual space in which the student is an active participant, exploring a domain for themselves. It is therefore emphasised that the focus of educational media should not reside with what technology will improve education, rather the way in which such technology is designed should be considered. This emphasises the importance of design considerations of e-learning systems. In this paper we extend upon constructivist and constructionist perspectives on learning. These perspectives suggest artefact produced. A number of scholars have continued to apply the four stage model as a basis for understanding creativity (Osche, 1990; Goswami, 1996), while others have extended upon it (Amabile, 1996; Runco & Dow, 1999) offering models consisting of several stages. Others have proposed different approaches which show no correlation with the traditional model (Eindhovern & Vinake, 1952).

## 3. An Integrative framework of learning and creativity

Drawing on the above, we have developed a framework which represents a distillation of creativity theory focusing upon education. This framework is presented the form of an integrative framework, which exists as a design support tool to assist the design of creative educational experiences for the classroom (see figure 1). Wallas's four-stage model has been adapted as the fundamental basis for this framework, with the processes of preparation, generation and evaluation represented laterally across the framework. The vertical dimensions reflect individual (denoted here as personal) and social components of creativity. The 'social' level refers to others, peers and society. Whereas, 'personal' levels reflect explicit and tacit levels of thinking.

**Figure 1 – An integrative framework of learning and creativity**

The processes of preparation, generation and evaluation are three integral concepts of the creative process. Every creative act involves the preparation of ideas. At a personal level, an individual will develop a curiosity or a desire to create. Once this desire has been established, information is consciously accumulated from the external environment and thoughts may be discussed with others on a 'social' level which the individual can reflect upon. If working in a

collaborative setting, group willghts maesses of pr 630.004 .00skop a cal 0 -saok -1.l, 0 Tw 50 envias, 01 e instances processes within the framework may overlap. The framework can be used as a

The interface relays to the student the selected theme which is set as the background and the selected objects are presented in coloured boxes at the bottom of the screen. The lines running from top to the bottom of the composition screen represent bar lines, so it is easy to depict images which are associated with a longer sound duration than others (see figure 3). With regard to figure 3, students simply drag the objects from the coloured boxes onto the theme and structure them on the composition background as they wish. In terms of the framework, it is expected that students will collaboratively discuss and personally construct ideas. It is also expected that pair wise discussions may also trigger further realisation of ideas._In terms of evaluation, it is expected that on an individual level, a student will form their own judgements concerning the composed work. On a collaborative level, it is expected that pair-wise reflection and judgements concerning the composition will take place. Arising from this, students may move between generation and evaluation phases as refinements are made to the composition. Students might then seek wider evaluation of their composition from their peers and /or teacher. For example, students can listen to each others compositions or can print out the pictorial representations which can be exhibited in the classroom to encourage peer-wide evaluation.

## 5. Conclusions

This paper has discussed an approach towards advancing learning through technology by considering the creative process. In particular, this paper has focused upon an integrative framework of learning and creativity, which exists as a design support tool to facilitate creative learning in the classroom. The music composition program 'SoundScape' has also been presented as a vehicle to demonstrate how this framework can be applied in practice. This is part of a wide programme of research for which studies are currently being conducted.

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a set of desires, likes and dislikes when interacting with others. In virtual reality research, collaborative virtual environments (CVE) such as MASSIVE[1] and DIVE[2], have lend themselves to research embodiments, avatars, clones and agents for multi-user by using very basic block-shaped forms. Here researchers have noted that users are still viewed as people on the outside looking in and that those environments make no provisions for visualizing them inside the system (Steve Benford et al., 1997). In looking at the key issues of user embodiment in CVE's researchers concluded that virtual body-building will involve identifying the important issues in each case and supporting them within the available computing resource (Steve Benford et al., 1997). Besides a 3D exploration of user representation for virtual worlds and CVE's, StarCursor (P. R. Rankin et al., 1998) used an anthropomorphic cursor symbolically displaying the body with a heart, limbs, eye, and aura. In the virtual context the cursor represented multimedia channels for personal disclosures, communicative signals and actions (Spence, 2001). On a more rudimentary level, instant messaging e.g. ICQ.com and Window's messenger, utilize 2D generic, iconic user representations to communicated online availability with various qualifiers and customization possibilities.

### **1.2.** What has been done to go beyond

Affective computing and Presencia[3] are branches in research that are looking at how the user can be interpreted in virtual space. Affective computing focuses on exploring new ways to sense and interpret the affective state of users (Barbara Hayes-Roth et al., 1998) by giving computers the ability to help communicate emotion, that is, receiving and sending emotional cues (Picard, 2000). Rather than representing the user in virtual space, affective computing establishes an empathetic relationship by introducing an affective agent to the user (Winslow Burleson et al.). Presencia or Presence research is concerned with the sensation of "being there" in a mediated environment (Wijnand Ijsselsteijn et al.), as a matter of suspended disbelief or "out of body" experience when we react in virtual space as if in physical space. Mel Slater, one of the presence pioneers, was able to measure a sense of presence by observing users in immersive virtual environments. But both, affective computing and Presence-research are confined to specific platforms and specific applications. Having the need to capture multiple bodily cues, for example from facial muscles (affective computing) or creating believable virtual environments by displaying them on head-mounted displays (Presence-research) does not make for large user participation.

### **1.3.** Why is there a need to go beyond the current state of representation

With increasingly personal data collected by societal, cultural, and enterprising establishments, the idea of ubiquitous computing has proven problematic. Ubiquitous computing in its purest form advocates that all computation is contained in the environment rather than on the person (Bradley Rhodes, 1999). Privacy issues and difficulty with maintaining personalization of ubiquitous computing systems have given good reason to move sensors from the environment to the person. Wearables offer a

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[1] MASSIVE [Model, Architecture and System for Spatial Interaction in Virtual Environments]
[2] DIVE [Distributed Interactive Virtual Environment]
[3] Presencia stands for Research Encompassing Sensory Enhancement, Neuroscience and Cognition with Interactive Applications. More at presence-research.org

solution to these problems (Bradley Rhodes, 1999). Of course they are not without problems and by now a combination of wearable and ubiquitous computing seems to deliver the best results. But as Bradley Rhodes wrote, wearable computers have the potential to "see" as the user sees, "hear" as the user hears, and experience the life of the user in a "first-person" sense; this makes them excellent platforms for applications where the computer is working even when we aren't giving explicit commands. However, the information that is being collected by wearables in so-called context-aware applications needs to be rendered visible, and when it comes to sensing the body, that information has to be displayed in some shape or form. One of the advantages that wearables give to the user is the freedom to do something else while the role of the wearable computer is in support. Along these lines, the displayed interface needs to follow the support role of the wearable by allowing for minimal cognitive demands but a maximum of information displayed. That "first person" sense described earlier moves us away from user representation as it was understood in desktop computing, allowing for more authentic, individualized, and concrete "in the moment" information. By sensing the body, thereby obtaining physiological, psychophysical and emotional states of the body, we are also moving closer to what could be termed the self. We are no longer representing ourselves but rather transcribing ourselves remotely. That there is a gap for remote transcribing of the self can be pointed out in two very different applications. In last years' UBICOMP paper "The CareNet Display" (Sunny Consolvo et al., 2004) under section 5.2 "Providing Sufficient Information without Complicating the Display" the ambient display interface of iconic nature did not communicate effectively the body state of the elderly person to the distant participants. In contrast, Thecla Schiphorst and Kristina Andersen pursuing a more artistic deployment of wearables while focusing on remote transcribing, note that the next step in (their) future work means exploring mapping and "meaning" in data patterns across participants' body state (Thecla Schiphorst et al., 2004). And from the point of developing hardware as it is the case in "LiveNet: Health and Lifestyle Networking through Distributed Mobile Devices" (Michael Sung et al., 2004) an appropriate interface that could be displayed on the LifeNet PDA would make the application complete.

## 2. How representation of the self could be approached

### **2.1.** What does it mean remote transcribing of the "self"?

If it was said earlier that we are not only moving closer to what could be termed a sense of self and that that can be no longer called representing ourselves in virtual space, then we need to look at the consequences of this observation. Transcribing here would mean that we transfer "ourselves" from the physical state to a virtual state using a transformational process, such as sensing and digitizing the data. But what should come out on the other end, in digital form, should be as close as possible to the original input that constitutes this "self," and is not just a singular aspect in physical manifestation. Meaning it should embody holistically what was captured from the original source when recomposing it in digital form. Holistic embodiment would go beyond mere visualizing data; it would draw from various cultural sources that are focusing on understanding this notion of "self." Although it has become clear that the approach to this research would be interdisciplinary, it should be said that these sources have to be chosen selectively to keep within the scope of the research project. It would be a viable aim to build up the remote transcribing of the self so that it could evolve, eventually having full-fledged interactions with others in virtual space. An open-ended research approach would also allow for subsequent adaptations that are application specific. Further, focusing on the body state in daily life as a stage for the self, then the idea of daily life with all its unpredictability should figure into the design of the user studies.

## **2.2.** Mind-body integration

So sensing the body would mean capturing a collection of emotional body states which in turn are the result of thoughts (mental images) that have activated a specific brain system. Given that the essential condition for a mind is the ability to display images internally and to order those images in a process called thought (Damasio, 1995). These images are not solely visual; there are also “sound images,” “olfactory images,” and so on (Damasio, 1995). More over, factual knowledge required for reasoning and decision making comes to the mind in forms of images through varied sensory modalities. And the essence of a feeling here is the process of continuous monitoring that experience of what the body is doing while thoughts about specific content roll by (Damasio, 1995).This illustrates just how intertwined, mutually and reciprocally connected and influenced the mind-body connection is. But it further shows how important these elements are for perception and cognition. For this research it

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# Communication and Interaction using Touch - Examine the User Before You Reproduce his Hand!

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## Abstract

My research interest is haptic and tactile channels in communication - interacting via our sense of touch. This includes interacting with digital information on the computer and interacting with each other via remote communication.

While continually innovating technology, the main research focuses of the Haptics community concerning the user are his psychophysical and neurological processes. My contribution is to introduce an investigation of the cultural context of touch. I am interested in the meanings we ascribe to different types of touch. I explore this field with the help of low-tech prototypes and social sciences and art and design methodologies.

The human being is not merely a subject made up of dissectible layers of information processing. He should be appreciated as a whole being and in context. This may help to avoid creating technology that sometimes becomes awkward and seems inhuman - quite the opposite, it could help to create poetic and metaphoric devices and services that intrigue and stimulate the user. With more available and more accessible technology, a multidisciplinary approach can be encouraged and a broadened range of ideas can be tested early on with simple prototypes. This should ultimately create a more engaging experience for the user.

## Communication via Touch: Technological Developments

Establishing contact in a physical sense also means creating and confirming a mental and emotional connection. Touch, as well as having a physical-sensory modality, has a psychological dimension in which we can literally reach out and communicate. In nonverbal language, body contact and gestures are an important part of the information exchange. It has also been established that human beings can learn new languages based on touch. *Tadoma*, a language used by people with dual sensory impairments (deaf-blind), works by placing the hand on lips, neck and cheek to feel vibrations, airflow and facial movements made during verbal expression. Alphanumeric languages like *Braille*vibcEiKemodadw 0-16tions, 8can learn new laanicatio create their own coding system with vibratory signals delivered to the hand. All participating subjects managed to establish communication successfully, even with the audio channel restricted. MacLean is developing *Haptic Icons* [8] - an attempt to design computer-generated force or tactile and associations was filled out afterwards, to gain insight into the subject's touch awareness.

**Association to Physical Nature:** A lot of overlap on the collated scales was probably often due to the physical nature of the object, and the fact that some of the word pairs can be taken very literally - e.g., almost everyone associated *rugged* rather than *delicate* with the Tree Fungus.

very early on in the process (user-centred / user-involved approach). Mock-ups can be used to help users envision the kind of systems they need - and in turn inform the designers of exactly what will be required [4].

## Conclusion

Tangible interfaces are part of the new design space, which promises the user rich, holistic, multi-sensory and intuitive interactive experiences. We are exploring a new dimension of HCI and telecommunication that could give room for information of affect, atmosphere and presence – something which is often considered redundant and therefore neglected in interface design.

I proposed the novel approach of using semiotic theory to research cultural aspects of touch communication. With the Haptic Box I have demonstrated how we can investigate cultural systems and integrate this knowledge. Following a recent presentation of this work to the Haptic community, there was positive feedback and interest by engineers and computer scientists. This work will be further developed with a special focus on vibration signals.

. With PinKom, I am investigating what kind of expressions are intuitively and spontaneously performed when confronted with the new medium of a tangible interface. This focus on the user will tell us which design parameters might be successful ones to choose.

Finally, to promote cross-fertilization as has been described here, I hope that with more accessible technology and the use of mock-ups, a multidisciplinary approach, a meeting of art and science, will be realised. This will help to build evocative interfaces that use metaphor, semiotics and suggestion. So far, as shown in the reviewed case studies, this has been most successful in creating a meaningful experience for the user.

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A user-centered approach to design has been described as involving four basic activities; identifying needs and establishing requirements, developing alternative designs, building interactive version of the designs and evaluating those designs (Preece, Rogers and Sharp, 2002). However, technology is developing rapidly and constantly opening up possibilities for novel forms of interaction. Therefore research in HCT must sometimes start from a more 'technology-led' or 'technology-inspired' (Rogers, Scaife et. al., 2002) position whilst still maintaining a human focus. Instead of starting with the problem situation, we start with the technology in order that we might explore and build up an understanding of the nature of the interactions they create, and the situations in which they may be used. In this paper I will outline how I plan to investigate the possibilities for a piece of technology called the SenseCam, presently being developed by Microsoft Research in Cambridge, to support reflection. I hope that a deeper understanding of this can lead to guidelines that will feed back and inform the design of future similar devices.

The SenseCam is a small wearable device that combines a digital camera with a number of sensors which are used to trigger pictures at 'good' times (presently when other people are around or when there are changes in the environment such as in light

camera. These sessions were videoed. I am planning initially to look at the collected data using an approach similar to grounded theory (Strauss & Corbin, 1998).

**Augmented Diaries:** An initial brief look at some of the data collected in the everyday situations suggests that the images collected may be good for raising awareness of habits that people have and are not fully aware of. There are a number of situations in which people are asked to keep a diary in order to become more aware of what they are doing. Two such examples are to improve time management skills and to help weight loss. I am presently considering how to investigate the use of the SenseCam to support this diary keeping process. A record in images might improve on retrospective written accounts in various ways.

## Conclusion

The SenseCam is an initial prototype of a device that can capture images passively. By trialing this camera in a number of situations in which it might support or provoke reflection and analyzing these, I hope to be able to experiment with different dimensions of both the capture device and the image replay in order to provide guidelines for the use of passive image capture to support reflection. This understanding will hopefully allow others who come from a more requirements based position to see how such devices and techniques could be incorporated into potential designs for evaluation.

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# A user-centred mobile television consumption paradigm

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***Abstract*** **: This paper describes the design considerations for a mobile television service from a user-centred perspective. Results from previous research on interface design,**

make more channel changes and may allow other demands and activities within the home to distract them relegating TV viewing to a background activity.

For the context of this work I consider the following to be the defining characteristics of standard television: Instant on – once a person turns on the TV he/she continuously receives content of a sequential channel. Easy switch - the cost of switching to a different channel is low, especially with a remote control. Seamless switch - the switch to a parallel channel is more or less instantaneous. Graceful transitions - due to the way TV is programmed, the transitions from a program that has just ended to the next program are smooth in an attempt by broadcast companies to keep their viewers. No spatial overlap - channel navigation does not spatially overlap with the content. No functional overlap - TV sets are dedicated to their purpose and can be used simultaneously with many other appliances.

In a study on digital television, Eronen and Vuorimaa found that users who were interested in watching television were not interested in interacting with an EPG or interactive television. The authors emphasized that digital television should maintain the familiar living room TV experience [5].

## 3. Mobile Phones and Mobile TV

Being mobile consists of spurts of activity that interwoven with periods of dead or unstructured time. The usage of mobile phones evolves around the three general user areas of home, work, and public [6]. People use them mainly is to stay in touch with friends and family and synchronize with them in and across space and time. The perceived main threats to this need are high cost, imperfect coverage, and short battery life [2].

How does the use of a mobile phone - the centre of communication representing activity and control - go together with the passive or “lean back” consumption of television content?

In terms of mobile consumption, people are worried about absorbing themselves in multimedia content, which requires their visual attention and progresses at its own pace. They fear increased risks of accidents or lapses (e.g. missing train stops) [2]. Many people are wary of the effect their mobile phone usage, i.e. talking aloud, has on others in public spaces. For these and other considerate users multimedia consumption requires the use of headphones, which might further immerse them. It is currently unclear if and how mood management of ordinary TV usage will translate to the mobile context.

Previous research has shown that peoples’ average [7] usage of mobile TV is less than ten minutes long. This has ramifications both on the type of content as well as the way that people will consume it. Longer programs will be more appealing to people that experience extensive dead times; for example, long commuters [2].

How does the small screen size affect the content and its consumption? In general fidelity is traded off for mobility and availability. Mobiles have modest screen sizes. Large visual stimuli result in orienting responses (involuntary attention) and increases in arousal [8]. We do not know how attention and arousal decreases when viewing on smaller screens or whether headphone usage will partly compensate for this. A less attentive audience engages in more channel changing [9]. Less absorbing mobile television could be associated with more channel-changing and less attention to embedded commercials. Smaller screens might also affect the different content types viewed on the handset.

With reduced screen sizes screen clutter could become an issue much earlier than at traditional TV resolutions where screen clutter has been shown to impede attention and comprehension [10]. Text clearly suffers from small screen size, as a small screen renders text nearly illegible. If text were sent through a separate channel and presented separately people could easily adjust the viewing distance to the handheld device.

On current mobile phones videos are usually accessed through galleries that include a thumbnail and a title describing the content. The typical question that arises after a clip has finished playing is: What next? Whereas traditional impromptu television choices are based on the content and the point of entry to the content, the consumption of downloaded or video on demand requires more user interaction and decision-making which is partly due to the payment model. The naming of items in an EPG exerts a strong influence on user choice. In the following section we will present an alternative to this approach.

In short, the proposed design is based on the assumption that mobile users have short windows of opportunity, engage in low commitment viewing with channel changes, and need to control the content easily while in public spaces where they have unsteady visual fields. These are all challenges to the idea that mobile TV viewing should be an effortless, enjoyable experience.

I believe that the cost of choosing the next clip in current mobile interfaces, in terms of cognitive overhead, is a major inhibitor to a flow experience [11] of multimedia content, If for any reason, e.g., to get on a bus, the user needs to halt his/her viewing, he/she could use the pause button (||) and pause the program at its current position. The label of the button then toggles to a play (>) symbol. For incoming calls the presentation of the content should be automatically paused and the user confronted with the question of whether to accept or reject the call.

I have presented a design for a mobile phone based television interface, which draws from previous research on television watching behaviour and its psychology, mobile phone usage, focus groups on mobile multimedia consumption expectations and needs, and lab experiments. I believe that this user-centred approach leads to a design of a mobile TV service that will leave operators with services that offer quality of experience and which users find enjoyable and for which they are willing to pay.

I suggest a mobile television interface that aims at porting many of the standard television characteristics to the mobile phone as long as peoples' communication needs are not compromised, especially in terms of battery life and in receiving and making calls. I believe that a television service that presents content immediately on start up, that allows users to change channels, that skips boring parts and that pauses the content if necessary is a good way to approach the challenges of watching audiovisual content while on the move.

The only drawback from this approach is that the people might get too immersed in the television program because the device does not stop playing.


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# A Comperative Research in Blended Learning:
# State University vs Private University

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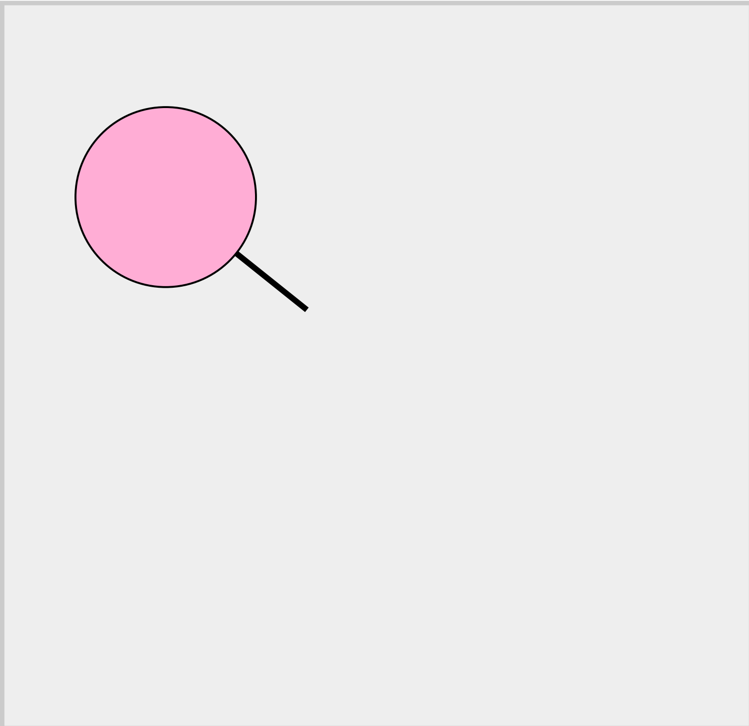
M. Erhan Ersoy
Ferhat Nutku

**Abstract**
The aim of this paper is to examine how blended learning affects learning motivation of students from state and private universities. Our hypothesis in this research is that, blended learning enables the students, who have less interest in the courses – in this case students from private university - to become more enthusiastic. We prepared a series of surveys that will be conducted to two different groups of students from two different universities. The students will be presented with surveys at the beginning and end of the course and then the results will be compared accordingly.

**Introduction**
As Gary Becker, Professor from the University of Chicago and winner of the 1992 Nobel Prize in Economics explains "We've had, until the growth of the Internet, teachers standing up in front of a bunch of students and iTW ten2 from t6T8wtpareom ed withhave7of ofes4b6m.Dude-



Focus on flexible options; Blended learning enables students to get an answer, regardless of the location, time, and learning preferences. This has positive ramifications for increasing the retention.

Embrace redundancy

# Learning Patterns

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## 1. INTRODUCTION

The process of designing software systems is, in essence, a learning process. Before the software engineer can construct a system, he or she must develop a broad understanding of the underlying process, construct a conceptual model of the desired system, and only then may proceed with the step by step design of the final system.

Many similar stages are involved in the learning process. A software engineer constructs a software system, whereas the learner constructs knowledge. Similarly to the software engineer, the learner proceeds from an initial understanding of the relevant background knowledge involved. He or she then constructs a conceptual model of the new topic, and then assimilates the particular details.

One of the long-term goals of our work is to provide tools and methodologies to guide and train teachers, and to assist in the development of appropriate learning materials. However, our emphasis is on the initial development of learning patterns, which is in itself a significant and non-trivial task.

The Pedagogical Patterns Project [2,4,5] has published a series of teaching patterns, which may be viewed as complementary to our work. The patterns developed are also based on Alexander's architectural design patterns. As described by the project members, these patterns "offer a way for experienced teachers to pass on their experiences" [4]. The project has been publicized within the community of object-oriented software pattern language researchers, and a pattern language for teaching Computer Science is evolving. Further research may expand learning patterns and teaching patterns, to provide both the theoretical background and the practical guidance for efficient learning and teaching.

## 2. LEARNING PATTERNS: TEMPLATE

In order to define learning patterns, a common format is proposed below. This template is based on [3,6,1], and adapted for describing learning elements. An established format for defining learning patterns will provide a common language for their definition, and facilitate their applicability. The

6) **Examples** – Primary emphasis is placed on examples in the analysis of learning, so that it becomes clear how the pattern is expressed in practical learning situations.

7) **Scientific Background** – An attempt is made to describe and cite these results in simple terminology, which may be understood by laymen (rather than academic researchers). This summary attempts to facilitate the understanding of the sources for the discovery of the learning pattern, and the background leading up to the learning pattern definition. In case we have found a variety of inconsistent or slightly different uses of the terminology in the literature, we relate to these citations in the literature and make note how they differ from our definition of the pattern name and its components.

8) **Related Patterns** – This may assist practitioners to gain a broader spectrum of learning patterns available, and how they may relate to each other. Related patterns often present common forces, and thus their application may complement each other in a learning process.

In addition, often the resulting context will describe a potential initial context for further learning, using related patterns. Thus practitioners may more easily utilize learning patterns one after another, and describe learning as a step-by-step process or as a series of learning units which begin in one situation and proceeds to some final eventual goal.

9) **Known Applications** – This is an essential element in our dictionary of learning patterns. The aim is to provide practitioners with well-documented, successful applications of learning patterns pertaining to teaching and development of learning materials. However, since our work is only a preliminary research work, we presently cannot compile a list of known uses. Our hope is that eventually these may be appended to an established dictionary of learning patterns, and expanded to construct a dictionary of teaching patterns.

Sections 1 – 6 are mandatory; the remaining sections may be included as appropriate.

## 3. SUMMARY

Learning patterns do not provide formal mechanical rules for effective learning. They serve as guides for learners and researchers, and define the basic building blocks of well-proven genres of the past. They also provide a framework for communication between those involved in a particular learning process, or in the construction of quality learning materials. This may help facilitate efficient learning and guide in the assessment of the level of learning achieved.

Several learning patterns have been defined and utilized; they include the following:

1. Structural patterns – misconception, subsumer, schema.
2. Personal patterns – cognitive conflict, conceptual change, assimilation and accommodation, advanced organizer, internalization and externalization, induction, deduction.
3. Communal patterns – tool mediation, zone of proximal development.

Learning patterns have been introduced informally to Computer Science teachers with little or no academic training in educational theories and methodologies, who teach on the undergraduate college level. Initial attempts have been made to utilize learning patterns in designing courses in Java programming on the college level, and object-oriented programming on the high-school level. The learning patterns have served as a communication tool for bridging the cultural and academic gap between the various team members involved in designing learning materials in Computer Science education. At meetings, when discussing curricular and application details, appropriate patterns were introduced. They provided a clear, well-defined framework for practical use of important learning tools and technique.

We have found that each time a course was taught, learning patterns have helped us pinpoint areas course so that the students are left at the end of each unit in a state of stability, in preparation for the next topic to be taught.

2. *Induction, deduction, abduction*. The different forms of learning were clearly described as

The alternative is a forced choice measure which involves giving participants the choice between one of two tasks (Dweck, 2000). Each of the tasks appeals either to a mastery orientation, emphasising a learning dimension, or a performance orientation, emphasising the potential for demonstrating existing knowledge. The choice made by the participant is then taken as the measure of their goal orientation. This method adopts a dichotomous approach to learning goals in that the individual can't choose both tasks and, therefore, can only be either performance- or mastery- oriented. While this solves one of the improvement in learning, then it would be advisable to design learning activities according to that goal orientation. However, if more learning gains are found when individuals are exposed to goal-oriented contexts that match their own orientation or tendency, then more attention needs to be focused on the simultaneous effects of both aspects: dispositional and situational.

## 4 Conclusions

The main goal in ITSs is to design systems that individualise the educational experience of students according to their level of knowledge and skill. Recent research suggests that their emotional state should also be considered when deciding the strategy to follow after an action has been taken.

This paper has focused on the importance of students' goal orientation. Achievement goal theory

# Could help-seeking behaviour be improved? Reporting the effect of motivational facilities in a learning environment: a pilot study

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**Abstract**. An exploration of the use of motivational facilities in an intelligent tutoring system is presented. The M-Ecolab is a Vygotskyan system that provides a test-bed for incorporating an explicit more-able partner capable of providing affective feedback. A pilot study of the effects of the M-Ecolab in learning was carried out in a real-class situation. The results of this study showed that less motivated learners tended to have greater learning gains group. Further data analysis suggests that less motivated students tended to look more effectively both for the quantity and quality of help that they needed, resulting in more fruitful interactions.

## 1. Introduction

Effective educational settings often involve the complementary factors of the learner's cognition and affect. What is needed for the design of systems are models and theories that integrate the various cognitive and affective components [1]. Research in cognitive science has provided the means to understand better the learning process [2], and shown that meta-cognition is a crucial aspect of learning [3]. One of the meta-cognitive strategies that seems to have a great impact in learning is help-seeking [4]. This paper addresses the issue of help-seeking and its interaction with the student's state of motivation. In particular, our project focuses on the effects of motivational scaffolding in the M-E2c4M3x(the )Tj12 0 0 12 397.68

through the use of on-screen characters, de-motivated learners could be engaged in a more fruitful interaction with the system. In particular we were interested in whether by scaffolding motivation, the learner could not only be made aware of her help-seeking deficiency but also advance her help-seeking behaviour. The motivational learner model was implemented so that motivating scaffolding is available during the interaction with the software via a button within the interface.

Two types of motivating facilities exist in the M-Ecolab. The first type consists of a quiz asking the learners questions related to the domain of food-chains and food-webs. The second type consists of spoken feedback given by a more-able partner, a character called Paul. Since the system maintains a motivational model of the learner, Paul is able to alter his voice tone according to the perceived state of de-motivation in order to encourage the learner: be it to put more effort, to be more independent or to become more confident. There exist two classes of spoken feedback: pre- and post-activity. Pre-activity feedback informs the learner of the objectives of that learning node whereas post-activity feedback offers motivating scaffolding making the learner reflect on her behaviour.

## 3. Preliminary evaluation of the M-Ecolab

An exploratory study of the effects of the M-Ecolab was conducted in a local primary school at the end of the academic year 2003-2004. We measured the students' learning with the M-Ecolab using analysis of help-seeking was undertaking distinguishing quantity from quality of help and trying to understand the nature of collaborative support requested by the students:

- Participants having an above-average quantity of help, whether provided by the software or requested by the student, were catalogued as having "lots" of help, otherwise as having "little" help.
- The Ecolab provides help at four levels: The higher the level, the greater the control taken by the system and the less scope

behaviour. A further analysis of the help-seeking behaviour showed that, in correspondence with previous evaluations, it was the learners who asked for a deeper quality of help rather than more help the ones who achieved

However, whilst this may seem to represent a better definition of intrinsic integration than intrinsic fantasy, there is still no evidence to suggest that such an approach would produce more effective learning. In fact, this definition actually makes it easier to see how a more integrated approach might produce less effective learning, as an intense state of flow is likely to inhibit the reflection required for metacognition and the acquisition of declarative knowledge. This may raise further questions about the type of learning material appropriate for intrinsic games and whether their true potential is in the proceduralisation of knowledge rather than its initial acquisition. These are just some of the issues that need to be empirically investigated before any useful conclusions can be drawn from the concept of intrinsic integration.

**Zombie Division: An experimental evaluation of intrinsic integration.**

The next stage of our research is to design an empirical study to investigate the relative effectiveness of intrinsic and extrinsic approaches in creating educational games. The Zombie Division concept integrates mathematical division strategies into the combat mechanic of a mathematics game for primary school children. This is a third person action adventure game in which the player must defeat skeletal enemies in hand-to-hand combat in order to progress. Enemies take the form of long deceased athletes from the time of Ancient Greece, who have risen from the dead to prevent the hero from completing his quest. As a result each enemy has a competitor number on their chest, which provides the key to defeating them in combat. Different attacks divide skeletons by different numbers and skeletons are only defeated if the attack will exactly divide their number without a remainder. Defeated skeletons break into smaller skeletons with appropriate numbers on their chests in order to reinforce this external representation of division.

**Figure 1: The Zombie Division Concept**

An extrinsic version of the same game would be produced for the purposes of the comparative study. Many considerations need to be made to ensure that it is truly comparable, and there are too many to go into here. However, broadly speaking this would be identical in all respects to the intrinsic version except that the numbers on the skeletons and their relationship to combat would be removed. In it's place the player would be drilled on the same mathematical content at the end of each level.

The first planned study using this software will compare learning outcomes given a fixed amount of time in the classroom. Process measures will be taken in addition to (pre and) post tests to compare the difference between transferable learning outcomes and learning outcomes in the gaming context. A later study is also planned to look at free use of the different versions without artificial time constraints.

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# Domain-Independent Strategies for an Affective Intelligent Tutoring System

A general affective ITS framework has two major components: the detection of the student's affective state phase and the reaction phase to the student's affective state (see e.g Conati, 2002; del Soldato & du Boulay, 1995). Several methods have been deployed to infer the student's affective state. Del Soldato & du Boulay (1995) and de Vicente & Pain (1999), for instance, inferred the student's affective state through the interaction between the student and the ITS. Picard (1997), on the other hand, inferred the student's affective state using special wearable and sensor devices such as cameras and microphones. In her research, Conati (2002), used a Dynamic Decision Network to model the user's affective state in an educational game. In the reaction phase, although present ITSs deploy various techniques, the emphasis is mostly on the use of domain dependent strategies to manage the student's affective state. These include, provision of feedback or solution to the student's problem, or scaffolding the student with appropriate help level to suit his or her individual learning style.

However, according to emotion regulation theory (Gross, 1999, Lazarus, 1991), an individual uses two strategies to manage his or her affective state: the emotion-focused strategies and problem-focused strategies. Emotion-focused strategies refer to thoughts or actions whose goal is to relieve the emotional impact of stress. Examples of emotion-focused strategies are avoiding thinking about trouble, denying that anything is wrong, distancing or detaching oneself as in joking about what makes one feel distressed, or attempting to relax. Problem-focused strategies, on the other hand, ref
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The second stage of the domain-independent strategies is the relaxation activities. The student who is experiencing either a positive or

## 3. Conclusion

In the near future, a prototype system of ESA framework that combines both mai


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# Can Technology Support the Development of Students' Epistemological Beliefs?

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## Introduction

There is growing evidence that epistemological beliefs play an important role in student learning (Hofer, 2001). Personal epistemology has been found to influence many aspects of learning such as comprehension, persistence, and engagement (Schommer, 1994). The development of students' personal epistemology has been described in terms of multidimensional stages that correspond to progressively more sophisticated beliefs (e.g. Perry, 1970). Given the evidence of their importance in student learning, the development of epistemological beliefs has been recognised as an important goal of teaching (Laurillard, 2002). However, little research has been done to identify how the structure of learning environments actually influences their development. To what extent does engaging students in certain types of activity support their epistemological development? Moreover, given the integral part of technology in higher education, the question arises of what role technology plays and can play in supporting students' epistemological development. More specifically, I am interested in exploring how the ways of conveying information through different forms of technology influences students' conception of knowledge and learning.

## Epistemological beliefs and learning

Epistemological beliefs are beliefs about the nature of knowledge and how one can come to know. There is no single theoretical framework for conceptualising epistemological beliefs (Hofer & Pintrich, 1997) and a number of different schemes have been developed for classifying them along a continuum of increasing complexity (e.g. Perry, 1970). In general terms, simple epistemological beliefs are those that define knowledge as objective and handed down by authority, whereas complex beliefs are those that view knowledge as relative and socially constructed.

Recent research indicates that students' epistemological beliefs play an important role in learning. More complex epistemological beliefs have been associated with more sophisticated thinking and problem-solving skills, higher motivation, and persistence (e.g. Schraw, 2001; Hofer & Pintrich, 1997; Schommer, 1994). Moreover, a study by Jacobson and Spiro (1995) suggests that students with simple epistemological beliefs have difficulty with hypertext systems. Thus it appears that students' epistemological beliefs will affect the way they engage in learning and utilise learning resources that in turn will age in leaa development. It is, therefore, important to study the impact of different learning environments.

## The impact of learning environments on students' epistemological development

The progression from simple to more complex epistemological beliefs is not uniform amongst students in higher education. Each individual student will possess different beliefs on entering university and will develop in a different way from their peers. Moreover, large student populations, the short length of the majority of university courses, and the lack of resources for supporting small group face-to-face interactions between students and tutors are all factors that make supporting students' epistemological development a difficult task. Hofer & Pintrich (1997) argue that the type of tasks that students are required to engage in will affect their epistemological development. Laurillard (2002) suggests that students' epistemological development can be supported by engaging them in activities that support active, collaborative and independent learning. It appears reasonable to assume that when students are exposed to a variety of opinions, are forced to elaborate and support their own views, are given the responsibility of finding information themselves and are not allowed to rely on the lecturer to supply them with knowledge, that they will develop more complex understanding of what knowledge is. However, it is necessary to understand how such activities actually support epistemological development for different students and what factors determine their success.

There is limited research that has explored how course structure and, in particular, new technology-supported learning environments affect epistemological development. It is becoming increasingly important to study the impact of computer technology as it is now an integral part of higher education. In particular, the web is a major source of information for students and also an important form of communication for face-to-face as well as online courses. Through the web students now have easy access to a wealth of information of many different forms, such as online journals and books, online discussion forums, student essays, unpublished papers, peer discussion groups, and personal web-sites.

Existing research findings suggest that students' epistemological beliefs are influenced by the learning environments they participate in (Tolhurst, 2004; Jacobson & Spiro, 1995). Tolhurst (2004) reports on a study which investigated how changing the structure of an undergraduate course to make students more active learners would influence students' epistemological development. The results indicated that the course structure had a positive effect on students' epistemological development as measured by some scales, but also a negative or no effect as measured by others. They concluded that encouraging students in being active and independent learners can support their epistemological development, but that further research is clearly needed.

## Evaluating the role of technology in learning environments

I am interested in studying the relationship between students' epistemological beliefs and computer-supported collaborative learning environments. The research questions I am interested in exploring are how students' epistemological beliefs affect their learning experience within computer-supported collaborative learning environments and how in turn such environments impact on students' epistemological development.

# Teachers need help too: aiding the marking process through a Human-Computer Collaborative approach

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## Introduction

When looking at how computerised technology can improve the learning process it is important not to overlook the potential benefit to teachers. Assessments are used frequently in education and require substantial work on the part of the teacher. Tools can be developed to aid in both the setting and marking of assessments. Our research looks at how a Human-Computer Collaborative (HCC) approach can be used to improve the marking process.

The marking of paper-based assessments is inefficient as it involves a lot of shuffling between different student answer papers. Computer-Aided Assessment (CAA) systems can make the process more efficient by transferring assessments to an online format. While Multiple-Choice Questions (MCQs) can be marked automatically by computer, answers where the input is not constrained – be it in the form of free text, diagrams or mathematical equations – are considerably more problematic. Student answers to even the simplest of free-text questions can be enormously variable [1].

Previous approaches have tended to concentrate on creating a detailed model of the answer in advance and then leaving the computer to mark automatically based on this model. *C-rater* breaks an answer down into simple subject-verb-object concepts and concentrates on short answers [2]. Systems such as *Intelligent Essay Assessor* take a holistic approach; answers are compared to other answers through statistical methods such as Latent Semantic Analysis and assigned marks based on their similarity [3].

With these approaches human involvement is limited to the setting of the original model. This can cause problems when answers don't match the model. We are looking at a Human-Computer Collaborative (HCC) approach in which the model, or *answer judgement representation*, is grown dynamically during the marking process. A HCC approach combines the best aspects of both a human and computer marker [1]. A computer does not get bored or tired and can mark large numbers of similar answers faster and more consistently than a human. A human is better able to recognise those answers which convey the correct meaning, but in an unanticipated form. Challenges lie in determining whether an answer is similar, and then displaying this information clearly to the human user.

## Developing a Marking Tool

A CAA system – Assess By Computer (ABC) [4] – has been in place at the University of Manchester for the past three years. It has been successfully used in a number of assessments including first year exams in Artificial Intelligence Fundamentals, and Java at both the third year B.Sc and M.Sc level. This provides a great wealth of "real" data with which to test possible marking aids.

A marking tool was begun as an M.Sc project [5] by a former student. Presenting answers online to the marker offers immediate benefits. All answers to the same question are presented together and there are no longer any problems trying to decipher student handwriting.

Currently the marking tool is being developed further with the addition of functions to cluster similar answers together and present them clearly to a human marker. It is hoped that marks can be assigned by cluster rather than by individual answer, with this marking information clearly displayed to a human user.

Preliminary work has focused on questions where the answer is a simple key word or key phrase. An example question is (from first year Artificial Intelligence Fundamentals): *"What are the three components of a production system?"*

The answer consists of three key phrases: *"Rule memory, World memory, Interpreter."*

A computer marking automatically on the presence of these key words would be overly harsh. A human would give credit to answers that contained a typographical or spelling error (*"Interpretor")* and to answers that contained a correct *microcytic anaemia?"* with the correct answer *"Iron Deficiency"*, an answer of *"Ion Deficiency"* may represent a simple typographical error or a fundamental lack of understanding.

With a HCC approach this is less of a problem as the human marker is there to handle this kind of ambiguity. The computer clusters answers based on whether they contain the key word or key phrase. These clusters contain sub-clusters representing weaker matches. By presenting this information to the user as a navigable tree as in Figure 1 a human marker can review the variants accepted by the computer and remove those answers where the match is an incorrect term with a small edit distance from the key word (for example any cluster where "*iron*" is "*ion*".)

## Conclusions and further work

Increased consistency and transparency in both formative and summative assessment does improve quality of learning. A more efficient marking process frees up more time a teacher can spend with their students. Accurate fully automatic marking of free-text answers by computer is difficult if not impossible. A HCC approach is a pragmatic solution that allows the computer to automate what it can while passing the

# 'StoriesAbout… Assessment': On-line storytelling to support collaborative reflective learning

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### Abstract

By applying a Constructivist approach to on-line learning environments - where students actively engage in the learning process rather than obediently waiting for the next chunk of information to be learnt - we can go some way to advancing computerised technology's potential for learning. Computer technology has the potential to support fundamental aspects of the learning process, such as reflection. This paper will describe an on-line learning environment, 'StoriesAbout... Assessment', which has a dual role: to investigate the extent to which on-line storytelling can be used as a collaborative reflective tool to enable students to reflect on, and learn from their assessment experiences; and to understand students' experiences of the assessment process in art and design.

### Introduction

Many on-line learning environments have an inbuilt passivity not conducive to a Constructivist model of learning, being merely tools to deliver information and instruction to students. A Constructivist model encourages students to actively engage with the learning process as they seek to make meaning out of their interactions. Using computers as 'cognitive tools' can support the cognitive processes required for learning and promote the reflective thinking required for meaningful learning to take place (Jonassen & Reeves, 1996).

The introduction of the Personal Development Planning (PDP) document has emphasised the importance of the reflective process in learning and the need to ensure students are able to reflect on their progress and plan for future development. The specific context of this research, art and design, has also seen changes which have sought to encourage independent learners who take a deep approach to learning, the importance of transferable skills and skills related to self, peer and group assessment (Davies, 1997).

This paper proposes that we should explore the potential of storytelling as a reflective tool in the education process. The act of telling a story requires us to do more than passively review an experience: we need to reflect on that experience, reconstruct it from a particular perspective and convey that to an audience in a way in which they can engage with (McDonnell, Lloyd, & Valkenburg, 2002). On-line storytelling is proposed as it enables the

The nature of art and design can lead to a surface learning approach being adopted as the quality of the artefact is often focussed on rather than what the student has learnt during the process (Davies, 1997). Students need to be supported in developing the skills they need the system to gauge their reactions to it. The other students involved were postgraduate students.

*Students' experiences of 'StoriesAbout... Assessment'*

Students had no problems using the environment and felt that the interface was clear and uncluttered and did not hinder them from telling their stories. There was some reluctance to tell stories as there was only one 'seed' story and students did not want their story to be in the spotlight. Students were unsure whether their experiences were the type of stories they should tell and this uncertainty was most likely made worse due to the lack of seed stories. Students wanted stories grouped according to themes to help them focus their stories.

They were also uncertain who would see their stories, and given the personal nature of their experiences, this put off some students or made them more aware about what they were writing. Students expressed a natural curiosity about other students' stories which was a prime reason for reading them. One student even stated that they were interested in 'sensational' stories, the more sensational the better. Overall, students were happy to tell their stories on-line, but some would have preferred a face to face setting.

*Students' stories*

The stories that students told were largely about negative experiences of the assessment process and some were about how a previous negative experience had left lasting effects on them. Although largely negative, many of the stories showed that the students were attempting to take a deep approach to their learning, but were being hindered by factors outside their control, often the management of the course or the assessment process. The introduction of story themes may redress this emphasis on negative stories and will actively encourage positive assessment stories as well. Students stated that themes with examples would help them think about their own experiences.

*Reflection*

Students commented that writing their stories had made them re-evaluate the experience they had written about and reflecting on it and writing it down had served to reinforce and clarify important aspects of it. They found it helpful to read other students stories and compare them with their own experiences. Students had also spent some time thinking about their assessment experiences even if they had not told a story. This resulted in some students recounting their stories orally to the author of this paper and although they were encouraged to put these stories on-line they did not appear. This perhaps highlights the cathartic nature of telling a story (McDrury & Alterio, 2003) and once they had told their story they did not feel the need to tell it again.

*Changes*

The interface is being redesigned to enable stories to be grouped around themes, for example, peer assessment, feedback, assessing creativity. Each of these themes will have seed stories to help spark off stories and should address peoples' natural reluctance to tell stories (Lawrence & Thomas, 1999). A facility to upload an image to illustrate a story will also be added as students felt that this feature would be useful. Introductory sessions to the new system will be broadened to explore issues coTc 0e they

## Conclusions and future work

Rather than view computer-based learning environments as an all encompassing alternative to the teaching and learning process, we can use computers as cognitive tools to support and

them (53%) would have preferred their course material to be available as digital files rather than hard copies. So what is the impact of this on student attitudes to their learning resources?

Thomas Mallon (2001) writes that he believes an *epistemological shift* unacknowledged text or with the student's own words. These figure are consistent with studies done at other UK institutions (Carroll, 2002). In the small number of cases (17%) where students had used paper sources alone these were usually course texts and/or recommended reading that the lecturer was very familiar with. Either these students were very poor at cheating or they are a very good example of what may be the main issue, i.e. that some students fundamentally misunderstand what is required of them at this level, which is to demonstrate mastery not only of the subject but also of its literature. Plagiarism is usually defined as follows

> **Plagiarism** is the use, without acknowledgement, of the intellectual work of other people, and the act of representing the ideas or discoveries of another as one's own in written work submitted for assessment. To copy sentences, phrases or even striking expressions without acknowledgement of the source (either by inadequate citation or failure to indicate verbatim quotations), is plagiarism; … (University of Sussex handbook for undergraduate examiners Section 12.1(b))

Ownership of the intellectual work of others must be recognised and acknowledged by students – failure to do so is considered academic misconduct. This makes the issue of ownership of resources for learning a central one in academic life (Robin, 2004), students must come to understand that ideas have to be attributed, that they *belong* to someone. In critiquing Lave and Wenger's (Lave and Wenger, 1991)concept of *situation learning* within an academic context Laurillard ( 2002) writes that learners have to engage '*not just with their own experience, but with knowledge derived from someone else's experience*' (p.19). There is a difference, she argues, between academic knowledge and everyday knowledge; '*The point about academic knowledge is that, being articulated, it is known through exposition, argument, interpretation. It is known through reflection on experience and represents therefore a second-order experience of the world'* (p.21). This second order experience of the world, Laurillard terms, after Vygotsky, *mediated learning*

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this is the case, as has been suggested in earlier studies then how can we model this in order to develop systems that can effectively support student learning, in the HE sector?

## 4. Conclusion - 'It's all because of the Internet'?

It must also be remembered that plagiarism existed before the advent of electronic texts (Carter Simmons, 1999) and also occurs in situations where students do not have access to electronic texts (Angélil-Carter, 2000). Concerns within the HE community about the apparent rise in plagiarism are, however, increasingly being phrased in terms of easy access to electronic sources. A recent article in the UK HE newspaper, The Times Higher Educational Supplement, quotes the support officer from the UK's Higher Education plagiarism detection service as saying that '*It's down to things like the internet and the very different make-up of the student population that is under more pressure to perform well*' (Thomson, 2004). Raising the question again as to whether students plagiarise using electronic sources just because it is easy to do so – and they are fully aware of what they are doing, or whether they have different perceptions of ownership / authorship of digital texts.

Having explored the attitudes to students and digital resources in study one, and looked at the date arising from plagiarism cases in study two, the proposed lab-based study is designed to clarify this research question by determining whether or not students **do** attribute differently when their sources are digital (online) rather than physical (books and hard copies).

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plagiarism: its apparent increase in student work as a result of the new technologies, how "it" is clearly to be defined, and how they should react to it.

My interviewees varied as to which of the above issues they were concerned about. Most said that they did not mind their work being copied by other academics provided they were given due credit and only about half said they were worried about inadvertently copying an other academic's work. However, almost every interviewee expressed disquiet about student plagiarism and all who voiced concerns about any of these issues seemed to feel that they had been significantly exacerbated by the advent of the internet and educational technology such as VLEs.

*Control* issues included the perception – and in some cases the fear – that:

teachers might lose control over the method and/or the content of their teaching;

they had no control over the nature or pace of changes that were taking place; and

the balance of control was shifting towards, variously: the students; the university's 'management'; the technologists; and the Government's educational policy makers.

Most researchers in this area (for example: Clegg et al, 2003; Holley & Oliver, 2000; McWilliam & Taylor, 1997; and Paechter et al, 2001) appear to view this loss of power or status as a threat to teachers and to the teaching profession. This was not always the case with my interviewees. Some expressed the view that their status relative to the students was irrelevant ("I see teaching as a partnership between me and them") and some were positively exhilarated by the change ("I **love** it when they take control like that"). On the other hand, every interviewee who discussed the possibility of their managers, the technologists or an external body taking more control over their teaching methods or subject matter was horrified at the prospect. However, most of my interviewees seemed resigned to their lack of control over the nature and pace of the changes in the use of technology that were being introduced in their university.

*Privacy* issues certainly pre-date the internet. The ability to monitor students' or teachers' activities covertly through technology such as VLEs has been likened (Land & Bayne, 2002) to Bentham's panopticon, a "surveillance machine" designed over 200 years ago. However, although Jeremy Bentham envisaged the panopticon as a **benign** prison where prisoners could be kept under control through the **possibility** that the guards were monitoring them, whether or not they actually were doing so (Bentham, 1962), the panopticon was still a prison, and this parallel to a teacher's working environment makes for uncomfortable reading.

Few of my interviewees seemed particularly aware that their work on the VLE could be monitored – some even described the idea that it could happen as ridiculous – but Land and Bayne, among others, claim that this is an issue which **should** concern academics. When the topic arose (or, more often, was introduced by me), discussion centred around two aspects of the issue:

the (disquieting) feeling that the privacy of both student and teacher was in danger of being compromised by the new techniques; and

the concern that this would seriously damage the relationships between students and their teachers, on the one hand, and teachers and their managers on the other.

Only a few of the interviewees admitted to using their VLE's inbuilt student monitoring facilities, only one of these had told the students he was doing so, and none had asked for the students' permission to monitor them. However, almost all my interviewees thought that any monitoring of their own use of the VLE without their knowledge and permission would be unacceptable and that it implied (or would lead to) a breakdown in relationships in the university. Some tried to differentiate between monitoring for 'benign' purposes (which was acceptable) and malign purposes (which was not) but had difficulty in clearly differentiating between the two. In all, the

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# Ubiquitous Computing and Smart Homes – Distribution of Data within Domicile

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**Abstract**

Ubiquitous Computing is a multidisciplinary field of research that explores computing technology as it moves beyond the desktop environment and becomes increasingly interwoven into the fabric of our lives [2]. It is this idea of interweaving technology into our daily lives, which will be looked at in this research. This paper presents the development of a generic Home Information System (HIS), which will allow us to support everyday activities in domestic settings. A typical domestic setting has a vast variety of data coming into the environment, some of which is in different formats (Digital/Analogue) and use different proprietary protocols to interact with relevant devices and applications. The aim of the prototype will be to allow for the distribution of data coming into the house to various devices. The data could incorporate Audio/Video, Telecom, Images/Photos, and user input etc.

**Keywords**: - Ubiquitous Computing, Smart Homes, Centralised Control, Data Distribution, Standardisation, System Integration, User Centred Technology, and Home Information System.

## 1. Ubiquitous Computing and Users in Smart Homes

It is widely recognised that Mark Weiser is the father of Ubiquitous Computing as he introduced the concept in 1988 [3]. Weiser has put forward some ideas as to how the future of computing should allow the users to interact more freely. The technology should allow the user to do multiple tasks simultaneously and should be a quiet and an invisible servant [4]. The prediction about the future by Weiser has to some extent been realized and extended to other domain of daily lives by system designers, however unless this technology is at a very low price, the consumer market will not be tempted into such an expense. An important factor for the future of ubiquitous computing will be the comfort with which the users and technology can co-exist.

Ubiquitous computing will allow automation of routine physical tasks, which will liberate us from all the hard work in the home and help us live more independently. This is achieved by introducing the technology in the home at three levels, which are external infrastructure, basic utilities, and domestic appliances [4]. The use of these technologies tends to change our traditional perceptions of space and time, breaking away from the limits imposed by physical limitations of the home. Smart Home systems could simply offer additional convenience in everyday activities adding to the benefits provided by the mechanical and electrical technologies. One of the many projects [4,6,7,8,10] that have been researched towards making our lives more enjoyable in the home is the Smart Home Project by the Personal Electronics Group [5]. The idea behind this project is to design and develop electronic devices to be used in home technology. They will be devices that a user could not perceive, until he would actually use them. The project included technologies like a plant watering monitor, motorised curtains, intelligent locks, controllable lights, centralized equipment control, identification of inhabitants, air quality measurements, floor sensors etc. the home of the future will need to provide an environment where so many technologies can interact with the user and with each other without causing interference to the user's natural instincts and to each other.

In doing so, it is important to construct electronic devices which are small in size, use wireless communications, have low power consumption and visually difficult to detect i.e. embedded into the fabric of the home and should not restrict the natural movement of the user within the home environment. The Smart Home project [5] points out that the control of the devices could be a PC, Laptop, or a smaller handheld device. This means that the control of these devices should be centralized. The project brings us one step closer to controlling the home technology by voice and remote controls. A truly ubiquitous technology will allow the focus to be completely shifted from the enabling technology to the application and delivered services, for example the computer system built inside a MP3 player is natural to use. However no one cares if there is Java inside it or how the TCP/IP stack is implemented [4].

[illegible]

allow us to start with a top-level description of a system and then refine this view step by step. With each refinement, the system will be decomposed into lower-level and smaller modules. The major higher-level system requirements and functions will be identified, and will be broken down in successive steps until function-specific modules can be designed. The prototyping will help in collecting feedback from the users who have used the system. This will be an iterative process, which will allow us to implement a usable interface for the system. Novel developments are expected in the methodological approach used, the devices developed and the results of the evaluation of these interfaces will provide insight to how users cope with the technology and the ubiquitous paradigm.

The project is concerned with extending/improving the quality of life for the people in their home in the future. However, consideration will also be given to the features provided by such a system, and the user's motivation to employ those features. It is envisaged that there will be a large number of influencing factors affecting the adoption of home technology by home users. The research will help in finding the factors, which influence the performance of the user and their interaction with the interface, both positively and negatively. What will be required is technology that will create a calm and comforting environment within our homes. The research aims at answering some of the questions about the adoption of ubiquitous technology in the home by people and how this change is going to affect the social interaction between home occupants. The research will address the factors, which will affect the design of interfaces to interact with the technology, and what are the best ways in which people can interact with this ubiquitous technology. The more you can do by intuition the smarter you are and the computer should extend your subconscious [4].

The prototype will be tested in a laboratory setting, which will simulate the home environment. It will then assess the feasibility of the system under conditions that equate to everyday use. In addition to experimental collection of data, attitudes to home technology and motivation towards its use will be measured using custom survey tools and a limited-ethnographic approach. Ethnographic evaluation will be used to compose a description of a group or culture, by focusing on the more predictable patterns of thought and behaviour when using the technology. As the system is going to be used by the general public in their home, it is necessary that they test the interface. The testing of the interface by the users will help in providing feedback, which will help the development of the application. The development of interface will consist of close consideration of its various aspects including a combination of different Human Computer Interaction (HCI) evaluation techniques [13]. The project will involve a combination of methods for evaluating usability (Cognitive walkthrough, Heuristic Evaluation, Model-based, and User-based evaluation [14]) and collecting relevant data from the user. The interviews and questionnaires will allow us to collect information regarding interface styles, what influences people to use the system, HCI, and the future trends of home technology. This will provide the essentials needed for technology adoption and their affect on human living. The proposed research will concentrate on the utilisation of information systems in the home by people. A retrospective comparative study of other applications and their uses will be included to provide a picture of developments in the field of ubiquitous computing, which may help determine the influences, that affect the inclusion of home technology into the daily fabric of the home and becomes a daily routine for the people at home. It is envisaged that there will be a large number of influencing factors affecting the adoption of home technology by home users. The research will help in finding the factors, which influence the performance of the user and their interaction with the interface, both positively and negatively.

## 3. Conclusion and Future work

The rapid growth in ownership of home-based leisure goods including PC's, video-recorders, fitness equipment, gardening, DIY etc. suggests that people's lifestyles have become increasingly home-centred. Involving real users in the design of smart homes projects and in the evaluation process is critical to the development of new technologies. Failure to involve users can lead to products and services which are poorly matched to their requirements, and which seriously under-perform from a users perspective. In the long run this is likely to result in persistent disappointment with new technologies and financial costs arising from poor market take-up.

The future implementations of technologies for smart home systems will largely depend on the extent to which they offer improvements in the quality of life, solutions to actual household problems and reductions in cost. The technology will have to prove its benefits and not prove a burden by their installation. The use of smart home technologies offers prospects of removing

the fact that the tasks being performed may not have necessitated the translation of information from another form of representation to verbal, or that verbalisation is more beneficial for certain types of task (for example, when digesting information). Ericsson and Simon (1980) suggest that thinking aloud merely decreased the speed of performance due to the additional processing required to find understandable referents.

## Verbal overshadowing

Schooler, Ohlsson et al. (1993) posit that creative thoughts and insights are distinct from language processing and that, as verbalisation can interfere with non-verbal tasks as varied as face recognition, the memory for colour and jam tasting trials, this might be extrapolated to all insight problems. Insight problems are defined as those which have a high probability of an impasse followed by a `eureka' moment and their solutions often involve a sudden reorganisation of information. Schooler et al. (1993) performed a series of studies to further investigate this phenomenon and assess the limits of its effect. The findings show that verbalisation significantly effects performance on insight problems and does so differently than other similar types of interruptions. It is suggested that verbalisation may cause the participant to favour working memory manipulation rather than long term memory retrieval, and that it may overshadow the critical, non-reportable processes required in order to solve insight problems. However, they also suggest that, for problems that can be solved in a more step-by-step manner, verbalisation either has no effect or may even help to highlight useful information. Work by Meissner and Memon (2002) also suggests that verbal overshadowing takes place when stimuli are 'difficult to describe', and notes that this is particularly apparent when participants are asked to verbally describe their mental model of a spatial map. Alongside knowledge on expertise, for example findings by Adelson (1984) showing expert representations to be more abstract than those of novices, one might consider that verbalisation could prove a hindrance to expert problem solving in many domains.

## Verbalisation and Pair Programming

There are a number of ways in which the findings discussed above can be related to the practice of pair programming. First, a number of studies show that pair programming takes more programmer hours (but sometimes less elapsed time) to produce the same amount of work (e.g. Cockburn and Williams ,2001). This is consistent with the findings of Ericsson and Polson (1988) and Ericsson and Simon (1980) that verbalisation increases the amount of time it takes to perform a task. A more complex issue relates the findings regarding verbalisation to studies showing that pair programming improves software quality. On one hand, verbal overshadowing would seem to suggest that verbalisation would have a negative effect on software quality, but on the other, self-explanation suggests that the effect would be positive. There are a number of factors that might help to resolve this potential conflict, amongst them are the nature of the task, the type of verbalisation and the profile of the programmer performing it. It would be interesting to consider whether the same quality improvement would be found if a single programmer were to spend the same amount of time producing the final product, or whether particular types of verbalisation (e.g. suggestions or explanations) which are prevalent in expert pair programming sessions, particularly assist in programming tasks.

# Seeing Eye-To-Eye: Supporting Transdisciplinary Learning

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**What is Interactive Art? What is Programming?** For the purposes of this paper, interactive art is an art system that changes as a result of the presence of or action by the audience-participant. Viewing interactive art as an art system shows us that it is actually quite a complex field, involving various creators and audiences, not just a set of computational artefacts with an 'optimal' configuration.

will mean a simpler structure paradigm to learn and explore, as opposed to the chimeric amalgamation that today's applications, languages and operating systems impose. Secondly, that programming environments need to represent structure (in terms of concrete objects, not just abstract classes) in an appropriate, manipulable, navigable form (in other words, not as static diagrams, or pages of ASCII) Messy programming should look messy, clean programming should look clean. Thirdly, in the case of interactive art, structure proceeds bottom-up, so it would be useful to visualise ways of making low-level toys easily abstractable within the environment. Fourthly, ways of seeing programming elements already situated within a structural context would be useful, so interactive working toys within the help system for the environment would assist in discovering the use of structure (one interview respondent mentioned that the quality of the help infrastructure was a crucial element of his decision to use any given tool).

Which brings us on to the next important finding – that 'play' is crucial to the development of interactive art systems – for finding rules, developing the 'character' of the system, learning the 'language' of the system, making the toy's place within the system apparent, producing technical and aesthetic meaning simultaneously (which also assists transdisciplinary collaboration), and making the artist feel more comfortable and empowered. So making 'toys' is useful, and consequently should be easy, and therefore well visualised. One way this could happen is to automatically generate a control panel for a chunk of code as the development of that code chunk progresses, which would act as a 'toy' for that code chunk, allowing people to play with the toy and become acquainted with the behaviour of the code chunk, particularly in terms of its inputs and outputs.

These recommendations also align well with the creativity support guidelines listed earlier. Edmonds and Candy's guidelines are largely satisfied by implementing an expressive system and its technological consequences: For example, having no technological distinction between programming and using the system mean that there is no distracting code-compile-execute cycle, allowing 'immersion in the activity'; having the environment written in itself allows the 'breaking' of its own 'convention', and 'breaking of convention' is supported within a system where only fundamental limits exist; a single universal concept aids the production of 'holistic views'. Terry and Mynatt's 'near-term experimentation' and 'evaluation of actions' are also addressed with the support of toy creation.

**Conclusion.** The topics dealt with in this paper have important high-level implications for designers of programming support environments. Such designers must learn to free themselves from thinking of programming as the manipulation of a one-dimensional ASCII language; abandon the concept of algorithms as 'recipes', and treat them more as situated actors in a system; abandon the code-compile-eractive art syists transdisciplinaryollabora',s oDtsews gr arttructusocietytion.

# An Intelligent Cognitive Tool To Foster Collaboration In Distributed Pair Programming

Edgar **ACOSTA CHAPARRO**

Despite some criticism [6, 7, 14], there is enough evidence to suggest that pair programming in some situations appears to be more engaging and enjoyable [15].

## 2.1 Distributed Pair Programming

It is well known that distance matters [16]. Consequently, as argued in [17] collocated pair programming will most likely outperform distributed pair programmers in terms of productivity. On the other hand, it is difficult to ignore some enthusiasm for distributed learning. Indeed, there are many factors motivating distributed technologies. Organizations have offices in multiple locations with teams interacting across geographical sites in different time zones. Universities are launching distance learning courses to reach wider populations and, of course, expecting students to work together [10].

With this idea in mind, Baheti, Gehringer et all [18] conducted an experiment with 132 student, 34 of whom where distance learning. They concluded that distributed programmers foster teamwork and communication. Furthermore, they argued that distributed pair programming seems to be comparable to collocated pair programming in terms of productivity and quality. Hank (2002) also showed some evidence of the efficiency of distributed pair programming.

Considering the literature it follows that more research must be done in the field to understand the gains and costs of distributed pair programming; however, it is reasonable to argue that a tool that successfully supports distributed pair programming will bring many benefits. For example, it will remove conflicts with collocation requirements [10] and it could support synchronous and asynchronous cooperation among student who will be geographically distributed [18]. Therefore, Distributed Pair Programming will help to address at least one of the three problems mentioned earlier in this document: Schedule Conflicts.

What about the others issues? Indeed, in the design of tools for supporting pair programming less importance has been given to pair incompatibility and unequal contribution of participants. However, these two problems has been subject of study in the important field of Collaborative Learning for a long time. As argued in [19]21(dis )-322(p)

7. Tessem, B.

# Diagrammatic Representations of Online Discussions: Maximising Communication and Learning Potential By Supporting User Tasks Without Forcing Their Choice

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Online discussions have been around for a quarter of a century (USENET) and have recently become more popular and ubiquitous thanks to newsgroup archives (e.g. Google™ Groups) and the availability of web interfaces. E-learning initiatives (e.g. Ikarus 2004 Online Seminar) invariably include discussion components, due to the perceived importance of online discussions in e-learning. Compared to face-to-face meetings, asynchronous discussions have the advantages of convenient "any time, any place" access, allowing the development of parallel discussions and providing permanent written records. Their main disadvantage is that of creating "overload" in discussion participants (Erickson and Kellogg 2000, Jarrett *et al*. 2003, Newman 2002, Smith and Fiore 2001, Xiong and Donath 1999). In fact, they require users to carry out costly operations to "make sense of" and track the current state of a discussion, whether this is a "new" discussion ("overview" task) or just new developments in a discussion they have previously participated in ("catch up" task).

It is known that external representations (ERs) such as diagrams play facilitatory roles in inference, problem-solving and understanding by reducing working memory load, serving as retrieval cues for long memory and promoting discovery and inference (Larking and Simon 1987, Suwa and Tversky 2002). ERs may thus help alleviate cognitive load in users of online discussions.

Users sometimes experience "co-text loss" (Pimentel *et al*. 2003) across messages: this may lead to incorrect mappings of the referent and misunderstandings in discussions. Quoting is (often but not always skilfully) used to maintain context (Severinson Eklund and Macdonald 1994).

# Pair Programming: Matching Pairs in a Sequence of Learning Sessions

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## 1. Introduction

In collaborative learning, students are required to work together on a common goal. Many studies have shown the effectiveness of collaborative learning in many areas including computer science courses, it develops communication and higher level thinking skills (Paintz, 1997).

Pair programming, where two programmers code side by side on the same algorithm, is a form of collaborative learning and an effective approach to teaching programming. For instance, Williams (2003) applied pair programming to an introductory computer science course and reported that students who programmed in pairs got better results in assignments and were more satisfied from doing course projects. However, matching partners appropriately is an issue in pair programming. VanDeGrift (2004) showed that students complained about working with people with different personalities and skill levels.

Most studies on matching pairs have been concerned with matching in one single learning session only (Katira, 2004, Williams 2003). We will investigate the benefit of the partner changing in several learning sessions according to skill level. This paper outlines a study to address questions in this area. This paper is divided into 6 sections. The following section talks about collaborative learning and its practice in the computer science course. Section 3 briefly reviews pair programming as a dimension of eXtreme Programming. Effectiveness of pair programming in the computer science course will also be discussed in the same section. Group dynamics will be defined in Section 4. In addition, pair matching and user modeling as a possible solution for it will be discussed in the same section. In Section 5, we will describe our study including our research question. We will also talk about what further steps will be taken based on the aim we would like to achieve. Finally, in section 6, we will conclude the research proposal with useful suggestions for the user model.

## 2. Collaborative Learning

Dillenbourg (1999) defines collaborative learning as the "*situation in which two or more people learn or attempt to learn something together*." According to him, the three dimensions of collaborative learning are group size, form of interaction and time span. In this paper we will focus our attention on pairs of students learning a programming language using pair programming in a computer science course employing a computer mediated environment.

Collaborative Learning has been employed in Computer Science courses for decades with reported success (Yerion and Rinehart 1995). Well-designed collaborative learning exercises develop higher level thinking skills, stimulate critical thinking and help students clarify ideas through discussion. It also develops oral communication skills and fosters metacognition in students (Paintz, 1997).

LeJeune (2003) discusses key components that may affect the success of collaborative learning in a Computer Science course. According to him well-designed collaborative learning exercises should comprise key components such as a common task, small-group interactions, collaborative behavior, positive interdependence and individual and group accountability and responsibility.

Collaborative learning requires working in groups in which students are actively working on problems (Yerion and Rinehart 1995). Group size is one of the issues that may influence the effectiveness of collaboration. LeJeune (2003) suggests a group of five to seven people is an optimal size. Moreover, Trowbridge 1987 showed that pairs are more effective than larger groups. This paper focuses on paired collaboration rather than larger groups.

## 3. Pair Programming

Pair programming has recently been introduced to academia. Pair programming is a technique in which two programmers work collaboratively on the same code at one computer. One of the programmers is the driver who has control of the mouse and keyboard. The other is the navigator who actively observes the work of the driver, offers advice and corrects mistakes in both code and design. Partners should change frequently (Wake, 2002).

Studies from academia highlight the effectiveness of pair programming. Williams and Upchurch (2001) reported that by applying this method to computer science students they completed programming assignments faster and the assignments were of a higher quality. McDowell et al. (2002) showed that students who work in pairs produce significantly better programs than students who work individually.

## 4. Pair Formation

Differences between group members are an issue that may influence the effectiveness of collaboration. Skill level as an individual difference is probably the most studied variable. Katira et al. (2004) examined the influence of different skill levels on the compatibility of pair programmers. The study showed a strong link between skill level and compatibility of graduate object-oriented programming students. Many other studies report that students perform better with partners of the same skill level (Thomas et al. 2003).

In general, the smaller the skill gap the better the match. However weak students can benefit from the interaction with stronger ones. There will probably be periods when weak students will benefit from bigger gaps. Vygotsky (1978) identifies it as Zone of Proximal Development, in which a student can perform a task in collaboration with more able partner. Additionally, Davies (1993) reported that '…the transition from lower to higher levels of skill in programming does not follow a continuous developmental path…' Therefore it seems sensible that matching strategies should look beyond a single session and plan for a sequence of sessions.

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# Qualitative Analysis of User Preference with UML Interaction Diagrams

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## Abstract

It is of key importance that all representations used in the software development process can be clearly understood by all who must use them. User preference is one area that may influence the effectiveness of the representations presented. Described in this paper is a study that was carried out to explore the relationship between user preference for UML sequence and collaboration diagrams. Analysis suggests sequence diagrams as being easier to follow and understand. It is hoped a further more formal study will provide more detail on reasons for preference for one of the diagram types.

## Introduction

The UML (Booch, 1999) is a general purpose visual modelling language that is used to specify, visualize, construct, and document the artifacts of a software system.' [1]. Diagrams are widely used as a tool to aid software development and the selection of appropriate tools can influence the success of the development process. The choice of diagram for particular projects often reflects the experience or preferences of the development team more than objective consideration of possible alternatives [2].

The UML provides two diagrams for representation of scenarios during the software development process, known collectively as interaction diagrams. Interaction diagrams, which are isomorphic, consist of sequence and collaboration diagrams. The sequence diagram emphasises time sequences whilst the collaboration diagram emphasises object relationships.

One factor that may have a strong influence on the success of the use of diagrams during the requirements process is the users' preference for a particular type of technique. Intuitively, it would be expected that any tools and techniques users prefer will help them to perform their job better. As Petre [3] points out "The importance of sheer likeability should not be underestimated; it can be a compelling motivator." This intuition is, generally, supported by research, which has shown that overall, if users prefer one way of solving a problem to another, they will perform better with the technique that they prefer [4].

The Diagrams Research Group (DRG) is based at the University of Hertfordshire and the University of Salford. The DRG's main focus is to conduct research into software engineering diagrams. The most recent study makes comparisons between the two types of interaction diagram to try to improve the ease with which people can understand them. As a first stage to this work an empirical study was developed which investigated factors identified as being important in the related literature, previous research and feedback. These factors are diagram type, preference and performance, cognitive style, text direction, scenario and question type. Our findings on the effect of cognitive style on interpreting diagrams are beyond the scope of this paper. The work is currently in press and will be presented elsewhere [6]. The findings for diagram type, text direction and scenario are also beyond the scope of this paper. The work is currently submitted elsewhere.

Previous studies by the DRG into the relationship between user preference for UML sequence and collaboration diagrams and objective performance with the diagrams have shown mixed findings.

The current study shows that participants who preferred sequence diagrams showed improved performance when using sequence diagrams. However, participants who did not prefer sequence diagrams showed an overall improved performance for both types of diagram over the group that preferred sequence diagrams. These results were from the quantitative analysis of the study. Some qualitative data was collected in the study which will be discussed in this paper. It was expected that the results from the qualitative analysis would deepen the understanding of earlier results from the quantitative analysis.

## Design of the study

question type. These were analysed using time and accuracy as measures of performance and are reported elsewhere [7]. This paper reports on the qualitative preference information gathered in the study.

A series of four diagrams were displayed to each participant, two of which were sequence diagrams (fig. 3.) and two of which were collaboration diagrams (fig . 4.). The order in which the diagrams were displayed was randomised to ensure there was no learning effect. The diagrams were comprised of approximately thirty interactions each and were of similar complexity. Two different scenarios were modelled in the diagrams – an ATM scenario and a lift scenario.

Each diagram had six questions associated with it relating to the information contained in it and the diagram was visible throughout the time the participants were answering questions. The questions asked related to either ordering information or activity information. To ensure that the information in the diagrams was read carefully, the questions asked about information that was specific to the particular scenario represented in the diagram, rather than the general case of using a lift or ATM machine. The answers were usually a numeric value as opposed to a simple yes, no or don't know i.e. Which floor did the lift start