Learning using Virtual Shared Workspaces

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1. Introduction

New technologies are rapidly being introduced into the market and with them come social and political pressure to introduce them into schools. Every new technology is expected to change dramatically the whole learning process therefore their effects tend to be studied in isolation from other tools already in use. Nevertheless, in practice, no single tool has shown itself capable of making a revolutionary change and every new tool is used in conjunction with existing tools. Hence, we believe that every new technology is a gateway to new teaching and learning possibilities and its use is affected by, and affects, the use of tools already in use. Therefore, research should take an holistic look at the whole range of tools, and their use, rather than exploring single tools in isolation.

We consider video communication and the ability to share an application to be two of the emerging technologies that, in the near future, will be massively adopted by schools and education programmes. We have reason to believe that providing these new possibilities, for students and teachers, who are already overwhelmed by the set of alternatives, will not be as smooth as with other technologies (Cifuentes, Beller, & Portela, 1999).

The purpose of this paper is to present the work carried out at our centre. This work explores both the effectiveness of distance support for teaching and learning processes and how learners develop the skills to exploit the technology and become active members of an online learning community. The study takes an holistic approach to the use of new technologies, considering the interaction of the learner with a number of tools. This approach is based on notions of distributed cognition and affordances.

Firstly, the theoretical background that supports this work is presented. Secondly, the theory is applied to analyse an electronic conferencing system as an academic support tool for students. The issues raised are used as a basis to reflect about what happens when video communication is added to the virtual shared workspace. Thirdly, an initial study is described and some conclusions are drawn from this. Finally, a summary of the main issues discussed is presented accompanied by a description of future work.

2. Theoretical background

Theoretically the study takes the position that learning occurs within a socio-cultural framework (Vygotsky, 1978; Wertsch, 1991). Two elements of this theory are crucial here. First is the idea that learning occurs first on an intermental plane (i.e., social) and then on the intramental plane (i.e., internal to the individual). The second idea concerns the zone of proximal development which is the difference between what individuals can do by themselves and what they are capable of doing with the help of tools, signs or more expert individuals. In this way, learning can be seen as occurring through an active interaction with tools, ideas and other people.

Although we normally consider that the capacity to perform an activity (Rogoff, Radziszewska, & Masiello, 1995) lies within an individual, the means and resources that enable an activity to be performed are distributed between people, environments and situations. According to Pea (Pea, 1993) the world is shaped by the intelligence "left behind" in artefacts, conventions and practices by past generations' activities. Therefore, when we use

a tool we are, in a sense, enhancing our intelligence by borrowing the intelligence of the tools. Distributed cognition theory deals with issues of how this aggregate intelligence is used and organised between the different actors.

Since we are interested in the cognitive processes involved in the activities performed by the person and his surrounding we will use the term coined by Perkins (Perkins, 1993), person-plus. According to Perkins, people normally use tools, situations and other people to perform an activity. This combination of the individual plus elements of his/her environment is called person-plus. We believe that when an individual is communicating with others through certain technology, he or she is relying on the communicational cognition embedded in this technology. The individual enhance his/her communicational intelligence by adding communication tools to his person-plus. We are interested in the skills involved in this process, and in how the environment can help the learner to acquire them.

A second concept we use, to help us as a comparison framework for the different technologies, is the notion of affordances developed by Gibson (Gibson, 1966, 1979). The original theory was concerned with visual perception and how individuals learn to notice and perceive what an object affords, or allows the individual to do with it. Using this notion, we can compare different technologies by considering potential affordances for users. In these terms, for example, electronic mail and electronic conferences can be compared by their communicational affordances.

Finally, we use the term virtual shared workspace (VSWS) to refer to the different combinations of collaboration tools that can be involved in a distance communication process. The term 'shared' implies that the other person has the same kind of tools available. There are two levels of sharing: one when both individuals manipulate the same virtual object e.g. working on the same spreadsheet. At the second level, we share at a conceptual level; there is a common virtual space that everybody in a group can access even if using different systems e.g. electronic conferences. The sharing is in the objects rather that in the environment. This concept helps us to characterise the interaction of the individual with different tools and the interaction between tools. For example, we can talk about the affordances of a VSWS or we can study the affordances of a VSWS with and without certain tools.

3. Applying the model

So, let us see how we can characterise an electronic conference using this framework. In general, an electronic conference will have a certain number of members interested in a particular topic. The main features of this kind of VSWS are to: send and receive messages, reply to a posted message, send files attached to the mails, read and write at anytime, and, in many cases, to protect identity behind an alias. In terms of affordances, the electronic conference allows communication between an individual and a group. This communication is asynchronous so it does not require the immediate participation of the other. Another affordance is the possibility of maintaining anonymity. Anonymity may allow some individuals, who would not feel able to contribute under their own names, a way of participating without risking their identity. The effect of allowing anonymous users may reduce the "lurking" effect often reported in electronic conferences. In terms of the distribution of cognition, the individual knows whom he wants to communicate with, and what he wants to communicate. He relies on the system for sending and receiving messages, checking spelling, delivery and addressing and storing messages.

We are using an electronic conference system called FirstClass (FC) to support a group of students. Although these student are not actually at a distance, due to their different activities and study regimes, it is difficult for them to get together outside class hours. In our work using FirstClass, we have had great difficulty developing a critical mass of users over a period of time. What we are finding is that there is initially much but, after only a few weeks people find that it is difficult to sustain the discussion over time, and the conference lapses. Where our use of FC has prospered has been when the use of the conference was made a

mandatory component of the course and when certain documents and assignments were only sent electronically.

As other researchers exploring conferencing systems (Pearson, 1999, 2000) have stated, we find that:

- Group dynamics are crucial for effectiveness of communication
- Many people 'lurk' on conferences – reading what is posted but not contributing
- Social cohesion of the group is very important. For educational purposes, knowing other group members seems to give people more confidence to participate in conferencing systems.
- There must be a real need to communicate through conferences. When people have the opportunity to meet face-to-face, they are less likely to use a conferencing system.
- Someone needs to mediate and keep the conference going.

When we add video communication and application sharing to the VSWS of the learners the first question is if they will be able to incorporate these new tools into their person plus. This is likely to depend on the affordances the individual can see within these new technologies, compared with the ones his current VSWS already provides.

In theory, perceiving the affordance of the current system for an individual and the potential affordances of a new technology could allow us to predict the future level of use of that technology by that individual. Even if this were possible to do, it would only be true for the initial time, since the interaction with the new technology will also affect the affordances of the initial technology and this change will affect the affordance of the new technology and so on. Therefore, we must consider the system of available communication tools as a dynamic set. The next paragraph is an attempt to reflect on the possible effects of the massive introduction of video communication and application sharing to communities of learners already using other technologies.

On the one hand, the communication potential of video conferencing and the ability of application sharing to allow two people to discuss over interactive media such as, for example, shared text, diagrams or spreadsheets, should lead to a major increase in the level of electronic communication, and a feeling of more natural communication. On the other hand, these two technologies require both individuals to be connected at the same time. Therefore, to be able to use these technologies some previous coordination is needed. In addition, having their image on the screen means the end of anonymity, which is one of the favourite affordances of electronic communication for many people.

As we have said it is our belief that tools should not be studied in isolation because their use affects the use of other tools. For example, people could start sending video messages as attachments because of their knowledge and interaction with a videoconferencing system. This residual effect will be ignored by a video communication study that does not consider the whole set of tools used by the student. In this case, the individual becomes aware of the technology's affordances through his interaction with another technology. Maybe, in this case, the ideal for the user would be to enhance e-mail to be able to send video messages more easily and not use video communication.

Some of the questions we will address in our work are:

- How does synchronicity affect both the communication habits of the users and the level of use of communication tools?
- How does seeing each other's faces modify the social relationships within a group?
- Does the use of these technologies solve any of the problems observed in electronic conferences?
- How is cognition distributed between the individual and the virtual workspace?

4. A Case study

Currently we are running an initial experience aimed at studying the potential of a VSWS that includes text-based chatting, video communication and application sharing, as a distance teaching learning tool. The idea is to observe these technologies in a distance tutorial setting i.e. informal or semi-informal individual or small group communications.

This study is part of a project aimed at exploring the use of dynamic geometry software to help develop the notion of proof in A-level students[1]. The subjects of the project are five seventeen-year old students from a comprehensive school in the Southwest of England. The project includes seven face-to-face sessions of 1 hour and 45 minutes each at the school followed by the development, by the students, of an individual project. During this final stage, students are being supported by distance tutorial sessions with tutors from the University of Bristol. In addition, students will discuss their projects through a final presentation at a distance.

Before the start of the distance tutorials, training was given to the tutors. The idea was to simulate the tutorials including the use of all the possible tools and most of the technical problems they could face. At the end of the process, tutors were much more confident in their abilities and new skills. In addition, very valuable technical experience on how to configure the equipment and arrange the different windows was learnt in these training sessions.

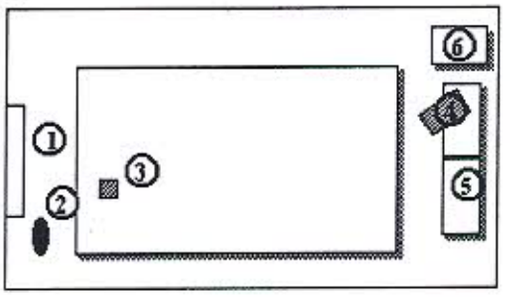

Fig: 1 School Setting

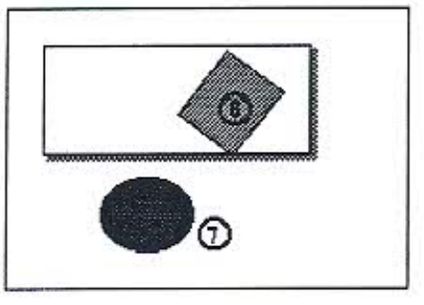

Fig. 2 University setting

The distance tutorials were performed using a computer-based program at the university and a stand-alone videoconference equipment at the school, connected through an ISDN line. The tutors had two video images, their image and the school one, available on the screen. Since the connection did not include data sharing, it was necessary to use a flip chart (1) for the student (2) to draw the geometrical diagrams and equations being discussed with the tutor. A microphone (3) was placed on the table near the student. The student (2) stood beside the flip chart in front of the table. A long table separated the flip chart from the camera (4) and the two monitors (5) where the student could to see the tutor and his own image.

In the case of the university tutor (7), the camera was on top of the computer monitor (8). The school camera was mainly focused on the flip chart and the student while the tutor camera just showed her face. The tutor put the window with her image on the top-right hand corner of the screen using the rest of the screen to show the incoming images. There were other people in the rooms in charge of the technical issues.

We chose to hold individual tutorials since the students were carrying out individual projects. Each tutorial lasted around half an hour and was carried out in an unstructured way. A typical session started with a brief introduction of the setting for the student, followed by a student's presentation about what he or she had done. This took between 10 and 15 minutes and included geometrical diagrams drawn on the flip chart and the development of some equations. Normally the tutor did not intervene at this stage except to ask for clarifications or

[1] This project is actually being carried out by: G. Moënne, C. Mogetta, F. Olivero & R. Sutherland, Graduate School of Education, University of Bristol.

voice's raising. Then, the student established his or her main doubts or problems preventing him or her for going on with the project, through a dialogue with the tutor. After responding to the student' doubts, the tutor tried to orient his ideas towards a concrete project. This last part usually included some discussion over diagrams.

As we have said, tutors received basic training in video conferencing techniques. On the contrary, students were completely new to this technology. We were impressed by the way in which students behaved, considering that this was their first experience with videoconferencing. They were all confident and natural when speaking to the camera. The ones that were talkative and clear in the face to face situation were talkative and clear in their video presentation. The student who garbled his words during face-to-face sessions also did it in the distance tutorial. For a wider view about related issues, see (Doherty-Sneddon et al., 1997).

All the students agreed that discussion over a diagram could have been easier with some way of sharing the dynamic geometry software. Their opinions about the difficulty of working at a distance ranged from "it was not so difficult" to "it is the same". The level of perceived difficulty has more to do with personality issues than with other matters.

The video analysis showed a high number of times where the tutor was pointing and dragging with the fingers on the diagram in the video screen. Sometimes the tutor was using the pointing and dragging as a tool for thinking about what the student was saying. However, most of the times she really meant to point to an object thinking that the student could also see it. Usually this action was accompanied with a phrase like "This point...", "This is an ellipse.." or " On this line...". A first observation is that our particular VSWS was lacking tools for this important communicational element, namely pointing. This behaviour decreased after reviewing the first session.

One of the factors that perhaps contributed strongly to the success of the distance tutorials is the fact that students already knew the tutors from the face-to-face sessions. Some evident consequences of this were that there was no need for introductions during the sessions and the informality of the face-to-face sessions was translated to the distance tutorial.

Sometimes the setting of these technologies can create artificial environments that do not work in a natural way, hence confusing the user. For instance, although a student had the microphone only half a metre away from him, having the voice and image of the tutor coming from the monitor in other side of the room, made him think that he had to speak loudly as if to a distant person. This issue raises the question of what is more valuable, from the learning point of view, to teach the learner how to work in these 'unnatural' conditions or to arrange the setting in a more natural way. For the time being, we are trying a more natural setting but this is still an open question.

Although most of the videoconferencing literature highlights the importance of eye contact (McKillop & Lee, 1998), during our sessions eye contact was established only on a few occasions. This was because the focus of the discussion was the geometric diagram on the flip chart. Subjects did not seem to care about eye contact when they were focusing on the diagram. All students, to some degree, looked at the tutor when she asked something but very few turned to look at her when explaining the diagram. This is similar to two people working side by side on a mathematics problem not looking at each other but talking through the common construction. Therefore, we suggest that in this kind of setting, where the focus is on a mediating object, the eye contact rule does not apply.

In a face-to-face conversation, we do not see the image we are presenting to the other person. Therefore, it is difficult when what the other person sees is just part of what you are presenting. This is the case of video communication where you must be aware of this effect. In our experiment, users tended not to look at their own images. Many times either the tutor or the student used their hand to point to things outside the frame of the camera, without noticing that the other person could not see these things. Therefore, people need to be trained

to be aware of the frame of the image that it is actually being communicated to the other side. In this case the technical support is there but people do not use it. The tutor, who received some training, was much better at this but it is something that takes more time to get used to.

At the time this paper is being written, only one round of individual tutorials has been run and due to technical problems, just the video/audio connection could be established. Although this left us with just video and audio based communication to study, interesting conclusions are being drawn from the experience.

First, the experience was easier for the tutor and students than they expected. Generally, people were surprised at how naturally it was to interact through the technology. There is a general perception that video communication is more complicated to perform.

The rehearsal phase was crucial in building the tutors' confidence with the technology. They gained confidence by simulating and rehearsing the actual learning situation. In this stage, many set-up details were sorted out, which helped the fluency of the tutorials.

The teaching and learning aims of the tutorials were achieved. Students clarified their doubts and tutors were able to take students' initial ideas and guide them towards a 'realisable' project. Nevertheless, the need for using other tools, such as application sharing, was evident. For example, the tutor frequently spoke and pointed to the image of the diagram. Image that the student could not see. In addition, confusion about the name of a point, a person was referring to, arose at some moments. This might have been overcome by using a chat facility.

5. Summary and Future work

In order to study learning processes mediated by different communication tools we have chosen to use the following theoretical constructions: person plus, affordances and virtual shared workspace. The notions of person plus and affordances enable us to study people interacting with cognitive tools with the set of tools being referred to as the virtual shared workspace. In applying this framework to electronic conferences as an example of virtual shared workspaces a number of issues arose such as: participation is not automatic, group cohesion is crucial and the 'lurking' effect.

The introduction of video communication and application sharing is expected to solve or reduce some of these problems. Nevertheless, it is also expected to bring new problems. In order to explore these potentialities and drawbacks a first study was set-up. Although, video communication affords a more natural and very fluent interaction, we believe that its sole use is not enough to ensure effective communication. This is particularly the case when mediating elements such as diagrams are an integral part of the communicative activity.

In the near future, the present study will be extended by incorporating the use of chatting and application sharing tools in order to develop more understanding about their potential for teaching and learning mathematics. In the long term, two main modifications will be introduced: the introduction of these technologies to learning communities with a high previous use of other electronic communicational tools, and collective tutorials and discussions will also be explored.

6. References

Cifuentes, L., Beller, C., & Portela, J. (1999). Integrating desktop videoconferencing into middle school classrooms and teacher education. *International journal of educational telecommunications, 5*(1), 79-91.

Doherty-Sneddon, G., Anderson, A., O'Malley, C., Langton, S., Garrod, S., & Bruce, V. (1997). Face-to-face and video mediated communication: A comparison of dialogue structure and task performance. *Journal of Experimental Psychology: Applied, 3*(2), 105-125.

Gibson, J.J. (1966) *The senses considered as perceptual systems*. Boston: Houghton-Mifflin.

Gibson, J.J. (1979) The *Ecological approach to visual perception*. Boston: Houghton-Mifflin.

McKillop, S., & Lee, M. (1998). *Using Video Conferencing to Support Distance Learning; A Staff Development Course* . Belfast: The Queen's University of Belfast.

Pea, R. D. (1993). Practices of distributed intelligence and designs for education. In G. Salomon (Ed.), *Distributed cognitions: psychological and educational considerations* (1st pbk. ed., pp. 47-87). Cambridge [Cambridgeshire]; New York: Cambridge University Press.

Pearson, J. (1999). Electronic networking in initial teacher education: is a virtual faculty of education possible? *Computers & Education*(32), 221-238

Pearson, J. (2000). Lurking, anonymity and participation in computer conferencing. In D. M. Watson & T. Downes (Eds.), *Communications and networking in education* (pp. 79-89): Kluwer Academic Publishers.

Perkins, D. N. (1993). Person-plus: a distributed view of thinking and learning. In G. Salomon (Ed.), *Distributed cognitions: psychological and educational considerations* (1st pbk. ed., pp. 88-110). Cambridge [Cambridgeshire]; New York: Cambridge University Press.

Rogoff, B., Radziszewska, B., & Masiello, T. (1995). Analysis of developmental processes in sociocultural activity. In L. M. W. Martin, K. Nelson, & E. Tobach (Eds.), *Sociocultural psychology : theory and practice of doing and knowing* (pp. 125-149). Cambridge [England]; New York, NY, USA: Cambridge University Press.

Vygotsky, L.S. (1978) Mind *in Society: The development of higher psychological processes*. Cambridge, Mass.: Harvard University Press.

Wertsch, J.V. (1991) Voices *of the mind: A sociocultural approach to mediated action*. Cambridge, Mass.: Harvard University Press.