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MULTIMEDIA CSCL TOOLS AND METHODS FROM A KNOWLEDGE BUILDING PERSPECTIVE

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Abstract. This paper discusses modalities of meaningful use of multimedia sources in Computer Supported Collaborative Learning (CSCL) theory and the design of CSCL software tools. A discussion about main similarities and differences between the concepts of networking, coordination, cooperation, and collaboration is presented at the beginning. These concepts are compared with Knowledge Building. After presenting CSCL concepts and tools, the paper focuses on the use on video tools on computers and handhelds, ideas and practices that take place in today's CSCL video researches. In the final, an evaluation about the contribution of handhelds in CSCL and KB educational practices is discussed.

Zusammenfassung. Dieses Artikel diskutiert die Modalitäten der sinnvolle Einsatz von Multimedia-Quellen in Computer-Supported Collaborative Learning (CSCL) und Theorie der Gestaltung von CSCL-Software-Tools. Am Anfang des Gespräch würden gezeigt die wichtigsten Ähnlichkeiten und Unterschiede zwischen den Konzepten der Vernetzung, Koordination, Kooperation und Zusammenarbeit. Diese Konzepte werden mit Wissen aufgebaut. Nach Vorlage CSCL Konzepte und Werkzeuge, dieses Artikel konzentriert sich auf die Nutzung auf Video-Tools auf dem Computer und Handhelds, Ideen und Praktiken, die sich in der heutigen CSCL Video Forschungen zeigen. In der Schlussphase, zeigen wier eine Bewertung über den Beitrag des Handels in CSCL und KB Bildung und Praktiken.

Keywords: multimedia, video research, CSCL tools, Knowledge Building

1. Introduction

The main goal in designing Computer Supported Collaborative Learning (CSCL) software was to offer learners an environment able to support them communication face-to-face and remotely. By using computers, students wanted to have a space for storing and tracing their learning processes, to share ways that would stimulate them to communicate and elaborate their thoughts, and to reach ways that make efficient their interactions.

Multimedia sources were very important not only in diversifying channels that users can select for education but also in improving their cognitive efforts during their learning interactions with computers. In 1990s new technologies were added for sound, images and video. Learners were cognitively engaged with multimedia sources in a variety of ways, by noticing, annotating, analyzing, organizing, evaluating, and searching the contents. Video techniques brought new layers of information and complexity of information (Pea, 2005).

Mixing different type of sources enlarged the possibilities of communication. It also created ways to improve their interactions and the feedback improved their assignments. By increasing the accessibility and affordability these sources helped knowledge building communities. However, as any radical improvement, this also produced a crisis in disseminating the significant information from irrelevant data (Bereiter, 2002; Tyack, D., & Cuban, 1997). The purpose of this article is to discuss some ways in which multimedia techniques are able to improve CSCL research and practice.

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2. Networking, Coordination, Cooperation, Collabora-Tion - How They Differ From Knowledge Building?

Challenges of CSCL Environments

Often these first four terms (networking, coordination, cooperation, and collaboration) are used by people without enough differentiations as something in which two or more people attempt to learn together. Networking involves simple exchange of information, usually for mutual benefit (IRRR, 2003). Coordinating requires exchanging information and aligning activities for a common purpose.

Cooperating implies sharing information, aligning activities and sharing resources. This level of partnership involves a significant commitment of time, a high degree of trust and sharing of 'territory' between partners. Collaborating goes beyond cooperation in that it enhances the capacity of partner(s) for mutual benefit and common purposes.

As a psychological process, collaborative learning is considered a descriptive process because it acknowledges that a group of students who learn and collaborate is viewed as the mechanism which caused learning (Dillenburg, 1999). As a pedagogical process, collaboration is viewed as a prescribed method in which one asks one or more people to collaborate because it is expected that they will thereby learn efficiently (Dillenburg, 1999).

Comparing these concepts with knowledge building (KB), KB goes deepest, establishing not only a mutual benefit among members but also being concerned with the advancement of knowledge in that community. As the name suggests, the first goal in knowledge building is not accomplishing projects or tasks but the acquisition of knowledge (Scardamalia, 2003).

Discussion could be done from the perspective of exchanging information. Coordinating involves exchanging information and aligning activities for a common purpose. Cooperating involves sharing information, aligning activities and sharing resources. This level of partnership involves a significant commitment of time, a high degree of trust and sharing of 'territory' between partners. Collaborating goes beyond cooperation in that it enhances the capacity of the other partner(s) for mutual benefit and a common purpose. For Scardamalia (2003), in knowledge building theory collaboration takes place through symmetry in knowledge advancement. This means reciprocal exchange among learners, "the fact that to give knowledge is to get knowledge" (Scardamalia, in press; p.7). This notion is one of the 12 principles in knowledge building theory.

Another important aspect brought by knowledge building theory is that KB tries to provide learners a path for advancement of ideas and knowledge. In knowledge building theory the advancement of learners takes place through Epistemic Agency. Learners having a high epistemic agency are able to evaluate themselves, to establish their personal goals and self-engage in these pursuits. They have "metacognitive awareness" (Scardamalia, 2002). In fact, Epistemic Agency is one of the major concerns of Knowledge Building theory.

Probably the most important aspect that takes place in a knowledge building community pursuit is Rise Above. By interacting inside the class community, the effort of synthesis in a KB class enhances students' skills and abilities to reflect on how different ideas are related and how they can better be integrated. This means that students raise their understanding to a new level of knowledge. When a community fulfills this level, their members are able to foster integration, enhancement and synthesis of new ideas of understanding from different sources.

3. About The Beginnings Of Cscl

Computer supported collaborative learning (CSCL) has grown out of two areas of research: computer supported collaborative work (CSCW) and collaborative learning (CL) (Hsiao, 2006). CSCW is defined as a computer-based network system that supports group work in a common task and provides a shared interface for groups to work with. There are some differences between CSCL and CSCW. The first obvious distinction is the domain of expertise: CSCL is focused more in education and learning environments while CSCW is used more in corporations and working environments.

There are many theories (Hsiao, 2006; Roschelle & Pea, 2003; Scardamalia, in press) that contribute to the understanding of CSCL: a) Socio-cultural theory (based on Vygotsky's theories on intersubjectiveness and the Zone of proximal development); b) Constructivism theory; c) Self-regulation learning (skill, will, and execute control); d) Situated cognition; e) Cognitive apprenticeship; f) Problem-based learning; g) Cognitive flexibility theory; h) Distributed cognition ("effect of" and "effect with" technology); i) Fostering learning communities; j) Distributed intelligence.

By using multimedia sources of data, researchers gather and analyze unprecedented amounts of data in digital format that might help them for advancing learning. The effects of collaborative learning are currently assessed by individual task performance measures. Many researchers considered the individual assessment approach not enough. Instead, they recommend to measure group performances (van Aalst, Kamimura, & Chan, 2005).

CSCL software design is very diverse. There is a concern that CSCL tools and theories treat collaboration only as a storing place for common work and less than an encouraging place for communication or as a place designed to improve learners' knowledge. In these cases, Symmetry Advancement and Raise Above principles are not accomplished. At other times, knowledge building environments (KBE) are reviewed almost synonymously with CSCL tools (Koschmann, 1996), sometimes explicitly. For example, Stahl (2000) defines a KBE as "a software environment designed to support collaborative learning" (Scardamalia & Bereiter, 2003; p. 4).

The lack of information about other learners in a multi-user environment is addressed by providing users with so-called awareness tools. These tools try to recreate on a computer based environment the information landscape of a topic from the real-world. Consequently, the awareness tools are designed for the purpose of enhance social interactions. They also provide more efficient team collaboration by showing information about learners' identity and their subsequent actions (Nova et al. 2003).

Challenges of CSCL Environments

The term collaborative learning describes situations in which particular forms of interactions among people are expected to occur, which would trigger learning mechanisms. Unfortunately practice demonstrates that the collaboration among learners is often inefficient and there is no guarantee that the expected interactions will take place (Dillenbourg, 1999).

Haber (2001) mentioned the fact that CSCL software requires a complexity that makes CSCL environments expensive. For this reason, when designed, CSCL developers and designers should correlate the following factors:

- The content to be learned
- Social aspects of working in groups
- User interface design
- The distribution of the software
- Networking facilities.

Woodruff (2002) traced the following recommendations for group participants:

- Learners have to receive a clear outline about their group
- Consolidate each member's identity as belonging to the group
- Learners should identify the value shared by the group
- They should look for a discursive participation.

Scardamalia & Bereiter (2003) recommended that a computer environment should not become overly prescriptive. Instead, a flexibility of the discourse that makes it consistent with the emergent goals should be pursued. Also, for a knowledge building community, they did not recommend the use of pure computer artifacts (such as intelligent agents, prescribed projects, fixed task sequences, templates) or any other tools designed to narrow-down learners to known endpoints. Instead, they recommended "capturing the human capacity for inventiveness and help convert that inventiveness into something of social value" (p. 7).

4. Using Multimedia Facilities In Cscl Tools

This section intend to present several tools offering multimedia facilities and has two parts: the first is focused on showing multimedia facilities for CSCL tools and the second to present software that offers multimedia perspectives and knowledge building facilities.

CSCL Tools Specialized in Video Processing

CSCL environments should enable a detailed recording of all interactions, a careful support for their members, and the design of empirical situations. Santoro and Borges (2000) noticed that most groupware tools are too generic. They are not concerned with focusing on specific areas such as in education or the age of users. For this reason they do not often too much support for collaboration.

From CSCL tools that incorporate enhanced CSCL facilities could be mentioned:

a) TeachScape; b) CoVis; c) Collaborative Notebooks; d)TurboTurtle; e) Habanero; f) TheU; g) CyberEd; h) SAIL; i) GroupKit; j) CoNotes; k) Belvedere; l) TOP; m) LessonLab.

TeachScape was implemented by a group of researchers from Stanford, leaded by professor Pea. TeachScape is a product designed for training teachers from all grades. It contains a large array of facilities and a library with a large amount of videos containing exemplary cases in classrooms. Services could be on-site or online and incorporate many specialist commentaries. Also there are tools for self-reflection.

TurboTurtle is collaborative software designed by the University of Calgary, for science education. More precisely, a small virtual world is created emulating Newtonian physics. A virtual environment with a set of objects is created with the subsequent field of gravity, allowing users to learn physics through their interactions with computer. Each sited separated, users need to communicate each other, in order to be able to manipulate the objects and control the environment. In order to communicate, users have speaker phones and Telepointers, which are graphics symbols that allow them to gesture to others. Anyone can manipulate any control at any time so there are few constraints. For this reason occasional conflicts might frequently occur and students should be able to negotiate their issues.

Habanero was designed by National Center for Supercomputing Applications (NCSA). It allows users to share Java objects distributed around the Internet. Students are provided with a chat facility which can annotate and share arbitrary images, an X-Y plot facility and a web-browser synchronization unit. Communication between students is text-based or by using a set of emoticons. Sessions are managed by arbitrators one for turn-taking and another which implements a free-for-all policy).

TheU is considered the first product simulating a virtual university using three dimensional graphics. The product has as main goal to let users feel as participating in a real campus. The product use enviromorphing, which means that each user has a different display according with their characteristics and declared areas of interest. For instance, any piece of information is displayed if refers to the participant's declared areas of interest. Students can use different ways to communicate each others: chat with text, voice, or video, passing documents, forums where users can share their experience, sketchpads, and whiteboards.

CyberEd is a distance learning environment that rivals the traditional classroom environment. CyberEd offers a full-credit university courses to the global audience of the Web. Students receive appropriate images, sound and video files via the Web. Instruction and testing will utilize forms on the Web as well as email, mailing lists and Chat. Mostly communication will be asynchronous, but more rapid exchanges may be used where appropriate. Students are encouraged to create their own Web home page to introduce themselves to their fellow students. This is particularly useful because many classes incorporate peer editing and team projects.

There are also several tools that incorporate in their theory knowledge building pedagogies:

a) CSILE/Knowledge Forum (Scardamalia, 1996); b) Flexible Learning Environment; c) CoViS (Collaborative Visualization Project); d) Collaborative Notebook.

CSILE (Computer Supported Intentional Learning Environments) with its new variant known as Knowledge Forum is an educational software designed to help and support knowledge building communities. Presently is designed by OISE/University of Toronto and Learning in Motion Inc. developed to support knowledge building pedagogies, practices and research designated in this area. CSILE was considered the first networked system designed for collaborative learning (Carl Bereiter webpage). The main contributors were Marlene Scardamalia and Carl Bereiter. It facilitates collaborative knowledge building approaches, textual, audio, graphical and video representation of ideas and reorganization of knowledge artifacts. CSILE/Knowledge Forum is used in a wide variety of Knowledge Building organizations worldwide, and for a wide variety of educational purposes, from kindergarten-to-post-secondary education.

CoVis and Collaborative Notebooks were developed at Stanford, by a group of researchers headed by Professor Pea was. Collaborative Networks is one of the main components parts from CoVis, which can operate also individually. It is designed to implement scientific collaboration among students by using the virtual concepts of bookshelf, notebook and page. CoVis contains facilities to explore and visualize a complex database containing information related to weather and pollution around the world.

DIVER and WebDIVER

DIVER (Digital Interactive Video Exploration and Reflection) was designed by a team from Stanford Center for Innovations in Learning (SCIL) led by Roy Pea. It has two major versions:

- A desktop product named DIVER
- A product incorporated in any web browser named WebDiver

The tool was not designed only for non-linear video editing (Pea et al, 2004). One of the key aims of DIVER was to make it a proficient video tool in reflection and research. In the analysis of video records, there has been no existing toolset before, able to enable distributed communities of learners and engage them in providing comments on a shared and accessible body of video material with anything like referential precision.

In Guided Noticing, LNC (Look, Notice, Comment) Cycle is a main idea. The cycles of looking, noticing, and commenting (Diver webpage, 2006) have the following steps:

1. Look at a visual frame,
2. Notice a pattern or a detail of interest
3. Comment on it.

If others are involved, the noticing can call out a particular item of interest from the scene, so that others can connect the comment to the particular element that is being referred to. This LNC cycle is generative and recursive and is in many respects familiar to anyone. Other learners can return to the scene to offer annotations, amendments or counter-opinions to negotiate differences in meaning, tying the sequence in discussion and building a common ground of understanding.

What makes DIVER different is its design built to support collective understanding, from multiple perspectives. DIVER uses a special video format called DIVE, designed for the special purpose of facilitating its use for learners who have different ages and skills. All DIVE files are available and shareable for comments on WebDIVER servers.

The software was designed to support users to focus group attention along video scenes using a special method called “guided noticing” (Pea, 2005). It offers possibilities to annotate video sequences from multiple users’ perspectives.

Because achieving “common ground” in referential practices can be difficult to achieve it is crucial for making sense of novel experiences and especially in the context of learning and instruction. Picture an in-service teacher immersed in a classroom situation: how does she come to learn “what is going on” and how should her interpretation of the meaning of events guide what she does next? (perception and action cycles).

There is a serious and persistent gap between such promise and the usefulness of video records. First, video data circulates rarely and slowly within scientific research communities, even as more researchers use this method. Second, video research analyses are typically restricted to text-only displays for presenting findings; original data sources are not made available for reanalysis by other researchers. It is typically impossible for collaborators working at different sites to conduct joint analysis of shared video records.

5. The Use Of Handhelds In Cscl

Handhelds changed perspectives on using multimedia very radically. The use of handhelds spread very fast in society and was eagerly praised by numerous researchers (Roschelle & Pea, 2003). Nowadays they are offering different resources: transmission and collection of digital data, documents, pictures, video, audio, ipods, etc. It was considered that handhelds will improve problem solving and transferring knowledge to different contexts, in order to put better learners in charge. Due to their tiny dimensions and easiness in use, the use of handhelds was reviewed as boosting the efficiency of CSCL software. Also, due to their affordability and use in classrooms, handhelds can be used on a on-to-one ratio which is so necessary for supporting pervasive knowledge building (Nirula et al., 2003; Scardamalia, 2002).

Nirula et al. (2003) studied a class with 22 children from grade two in a technologically enriched school in Toronto. They had worked for seven months previously with Knowledge Forum software. The researchers investigated the use of handhelds working with CSCL software. The study collected data during a two-week period, taking a naturalistic approach. The researchers noticed students’ and teachers positive attitudes towards the use of handhelds. They suggest that handhelds can be useful in a knowledge building classroom.

Farook et al. (2002) evidenced modalities to enhance the potential of M-education (mobile education) by designing classes using an integrated solution (both desktops and handhelds). They tried to learn users how to use both types of computers and to better understand their limitation. Learners had to participate in a community project called Save Our Stream. This project instructed participants in ecological, recreational, and economical aspects of keeping clean water in their community. The program for M-Education made participants more aware and more actively involved in their local community.

Roschelle and Pea (2003) developed a complex project for using handhelds in education called Wireless Internet Learning Devices (WILD). The projects contained some classrooms experiences such as;

- ClassTalk - A classroom communication network system that helps to monitory and to offer feedback for students.
- ImageMap - An assessment feedback system for supporting media-learning system.
- ProbeWare - A set of probes and sensors, connected to collect real-time measurements.
- Participatory Simulations - Simulate complex participatory activities such as the spresd of viruses
- SimCalc/NetCalc- Assigned to use computers in mathematics' classes.

During these experiments, the researchers noticed positive changes in teachers' role. Teachers's new role as "guide-by-the side" was strongly improved. It was considered that handhelds gave them more accuracy in tracking students' contribution. Communication between students also drastically improved, helping them to carry more transformative learning conversation rather than a simple transmission.

Other effects observed were:

1. Augmenting physical space with information
2. Leveraging topological space
3. Students' acts become artifact.

On the negative side researchers noticed that sometimes handhelds did not offer enough clarity in displaying images and the speed of transmitting data was sometimes inadequate. This was especially the case for video data. In the final, Roschelle and Pea (2003) concluded that "frankly, we do not yet know about what peer to peer knowledge sharing systems for CSCL will be like, but chances are they will be more ad hoc, more diverse, more fragmentary, and more decentralized than today's client-server knowledge spaces." (p. 28)

6. Conclusions

Using multimedia in collaborative learning proved to be a radical innovation. For this reason, as in any major innovation, the implementation was challenging in educational settings. Using multimedia facilities did not produce an automatic improvement of education through CSCL and knowledge building practices.

If the advancement of knowledge does not take place in class, then the multimedia modules and the conversational treads are browser-dominant only and not knowledge building communities. As Bereiter (2002) mentioned "failures of radical innovation need not be attributed to resistances to change in the education system or in the psychological makeup of teachers. They can be attributed to the economics of innovation, which requires that an innovation pay off within a certain time frame." (p. 4)

Instead, the outstanding capabilities of computers of organizing and finding complex information should be looked and used appropriately. CSCL and KB researchers proved that multimedia technology can increase opportunities to teach and learn. Rather than replacing the field of practical experiences, multimedia technologies can enhance the instructional curriculum field making it rewarding. As Bereiter (2002) mentioned, instead of innovation, education as any human domain needs sustained innovation.

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