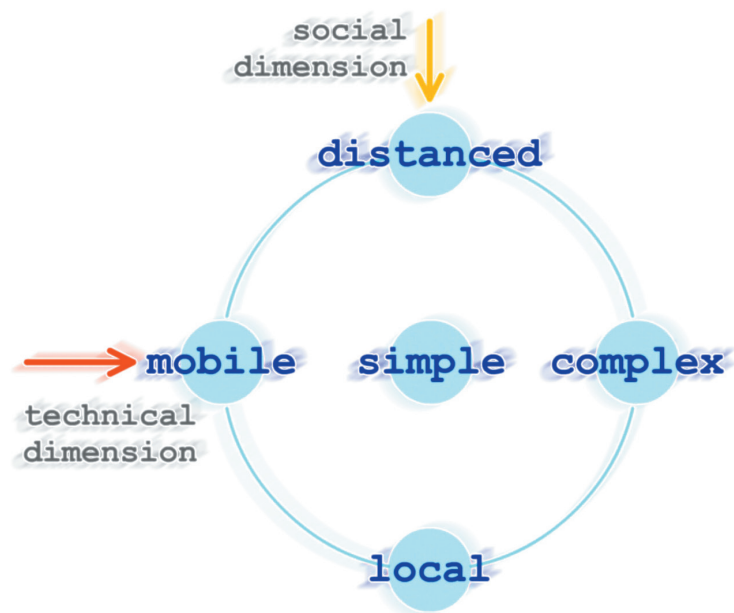


The Dimensions of Interfaces for Computer-Supported Collaborative Learning Environments



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1. Introduction

Knowledge is one of the most important human resources. In relation to this, the learning process is the essential action to build up this resource.

Novel educational theories and teaching methods show the importance of communication and collaboration to support and accelerate learning processes.

For this reason there is a lot of research in the field of CSCL (Computer Supported Collaborative Learning) at the moment, especially in undertaking concrete projects.

Since the early days of the computer, it was used in learning context. In the 60ies, the first computer-based training applications (CBT) were developed. With the ongoing improvements of technology these applications became more complex and intelligent but only since the area of the internet, research in CSCL started to take place.

But, as the learner, the human resource, is the central point in this concepts, there is a lack in research and development of the according interfaces for successful human-computer-interaction.

And as acceptance and use are the fundamentals for activating learning processes in this field, this shows the importance of interface design.

Only an optimal interface allows a successful communication of the teaching methods and the underlying educational theory to the user. (these explanations are visualized in the according concept map located in the appendix)

In this paper it is tried to give an overview on the different actual pieces of research in this field. The different types of interfaces used and the possibilities of using metaphors will be investigated.

This review shall support a previous work 'Concept and User Interface Design of a CSCL-Environment for Intercultural Communication' (Laqua, 2003) in order to give advices for the concrete development of an according interface for the in that work introduced 'Platform for Intercultural Communication (pinc)' (Laqua, 2003).

1.1. Keywords:

cscl, learning interface, interface metaphor, mobile learning, collaborative learning

1.2. Definitions:

CSCL Computer Supported Collaborative Learning - in this review CSCL stands for all situations where computing technology is used to support learning through collaboration

Interface: „(1) the way a computer program accepts information from or presents information to the user; eg the layout of the screen and the menu or command structure [...] (2) a point where two subjects, systems, processes, etc meet and effect each other [...] the man-machine interface“ (Oxford, 1995)

According to these two interpretations, the following review make a distinction into „interfaces“ as described in Oxford as second, where learners interact with the complete learning environment, and into „visual interfaces“ as described as first.

Metaphor: „...organizes, informs the unknown in terms of the known. Transfers content, scope, logic, interrelations. Makes the target understood as if it were like the source.“
(Smith, 2003)

In the following review „metaphor“ is used in the visual context for Graphical User Interfaces (GUI) as well as for mapping complex learning situations.

1.3. Questions

1. What kinds of interfaces exist for CSCL-Environments?
(interface in a broader meaning)
2. How does the use of technology influence the interface?
+ What technology is used?
3. What are appropriate methods to realize the specific interfaces?
+ What does this mean for the usage of metaphors?
+ What are possible metaphors to support learners needs in CSCL-Environments?

2. Main Part

2.1. Boundaries of Investigation

As already pointed out in the beginning, the field of CSCL is an important area of research at the moment and a lot of projects take place. While in other e-learning environments (cbl, wbl, ...) the main focus lies on the information-providing to the learner, maybe supported through a tutor or intelligent helping functions like software agents as mentioned by Paderewski-Rodríguez (2003), the essential difference in CSCL-Environments is the importance of communication, especially the peer-to-peer communication between learners.

There communication - going through the stage of coordination - shall lead to an effective collaboration to activate and support learning processes.

To facilitate these communication actions using human computer interfaces, it is important to examine the learner characteristics and needs. Within the field of CSCL-Environments the observation has to take place in often cross-cultural surroundings, what may lead to communication problems and misunderstandings (McKee, 2002) and technologically advanced situations. For this reasons it is important to develop user friendly and intuitive interfaces (Nielsen, 2000).

Therefore metaphors are known as a suitable solution to develop a deeper understanding of these abstract and complex settings.

While graphical user interfaces (GUI) are a well known area of research and a good subject to apply metaphors to, this just builds up the concrete interaction of a learner with a specific piece of technology through a display.

With a view on the complex learning situations within the field of CSCL there are much broader possibilities of applying metaphors (to much more complex interfaces). Complex learning situations like described by Price (2003) ‚using „tangibles“ to promote novel forms of playful learning‘ and by Luckin (2003) ‚using digital toys‘ give an idea of the enormous range of project settings. In these examples technology in form of handhelds, displays, electronic toys or other multi-modal devices become part of the learning situation. They are components of the overall interface between the learner and the learning environment and for this reason just elements of the underlying metaphors.

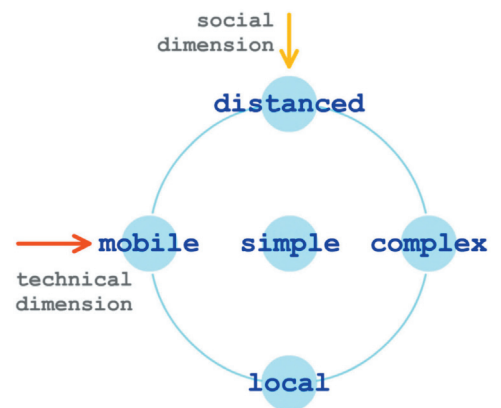
An investigation of interfaces for CSCL therefore needs to deal with graphical design issues as well as with the underlying learning concepts, the targeted user groups and the social context - there must be significant differences for in-class collaboration and distributed collaboration.

While research on CSCL and the development of appropriate environments is just in the beginning, the overall usefulness of this learning method/concept and the wide range of applicability is/should be obvious. As a result research on a variety of projects on CSCL is undertaken all over the world at the moment. To structure these projects (and the researched literature), a 2-dimensional classification will be introduced.

2.2. Interface-Dimensions of CSCL

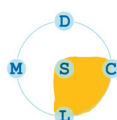
2.2.1. The Technical Dimension

The use of technology is quite varying among the different projects and therefore the complexity of the according interfaces.



2.2.1.1. Simple Interfaces

For this category exist quite a view usable software packages, like FirstClass which has been analysed by Persico (2000) and is ,used by the British Open University'. Another possibility is the development of an own solution like TimeScope3, an interactive storytelling system for heritage presentation, which is used for fostering collaboration among visitors and is described by Pletinckx (2003).



2.2.1.2. Complex Interfaces

With an extensive use of technology Price (2003) argues that ,using „tangibles“ to promote novel forms of playful learning' will bring ,the passion and pleasure back into learning'. Further more Luckin (2003) indicates the positive aspects of digital toys for increased social interactions.



2.2.1.3. Mobile Interfaces

The growing importance of wireless-LAN, the spreading of notebooks, powerful mobile devices like smartphones or PDAs and UMTS technology imply the reasons for CSCL-research in this area. One example is reported by Gay (2001) who reflects a university-based research on ,the effects of wireless computing in collaborative learning environments.'

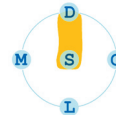
2.2.2. The Social Dimension

For a deeper investigation of the different interfaces it is additionally necessary to look at social issues of the specific projects because the development of social networks is essential for successful collaborative environments.



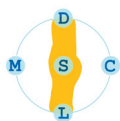
For this reason, *classroom settings* like researched by Pimentel (2001) and Hoppe (2000) work under different conditions than *distance learner environments* like investigated by Cronjé (2001) and Persico (2000).

Corritore (2003) indicates that building up trust is ,a key element of success in the on-line environment‘.



While complex environments and their interfaces are mostly experimental and strongly specialized without many possibilities of generalization, they are of minor interest for researching functional, innovative and reusable interfaces for collaborative learning. Therefore this review concentrates on design issues for simple and mobile interfaces.

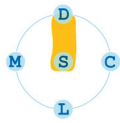
2.3. Interface Realizations



Cronjé (2001) strictly follows the paradigm of authenticity (Schulmeister, 1996) and explains that ,„virtual teaching“ is like actual teaching‘. Consequently he investigates a virtual classroom that offers discussions, case studies, workshops and „buzz groups“ using a *classroom metaphor*. The examined project took place in a 2-year tutored masters‘ degree and the students met once a month for three days. The provided distance learning environment is a website with four sections: the presenter’s desk, the resource cupboard, a poster wall and the learner desks. Cronjé points out the importance of a social network and the success of applying visual metaphors to support learning processes.



In the same direction goes the analysis done by *Persico and Manca (2000)*. They draw their ,experience in using ... FirstClass™ as a collaborative learning environment.‘ Being aware of the ,poor technology‘ they focus on the objectives, the content of the communication and the methodological aspects. The system offers electronic mail, file-sharing, electronic conferencing and online chats (Persico & Manca, 2000). The FirstClass™-interface uses a ,very simple and easy to use‘ (Persico & Manca, 2000) windows-like *desktop metaphor* with various folders. ,It has very good user-friendly facilities both for managing and participating in collaborative learning processes‘ and flexibility as ,a real asset‘ (Persico & Manca, 2000).



Sato et al. (1997) describes a cognitive engineering model (cem) as technique to design metaphors for large-scale distributed systems. ,To facilitate utilization of the system and to aid construction of the mental model‘ (Sato et al. 1997) he uses the analogy of a *city metaphor* in a realization example to develop an appropriate environment. Drawing a comparison to other metaphor models he concludes his cem as the most suitable one for UI construction in this area.

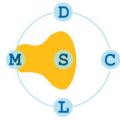


Going beyond the simple interface of a pc-display, *Pimentel et al. (2001)* describes an in-class project with the focus on capturing all communicated information. This 5-year project, called Classroom2000, aims to ,transfer the rich content of a traditional university lecture into browsable, searchable and extensible digital media that serves both short- and long-term educational goals‘ (Pimentel et al., 2001). Learners are enabled to interface with Classroom2000 and other learners through ,electronic whiteboards, large projected displays, networked computers, and streaming digital audio/video‘ (Pimentel et al., 2001). CoWeb is used as technology to support collaboration in content creation and to communicate all captured informations offering a *simple html web-interface* (with frames, tables, graphics and plain text).



Another in-class project is developed by *Hoppe et al. (2000)* and provides a ,Distributed Visual Language Environment (DVLE)‘ as a framework called CardBoard ,for specifying shared workspace environments for different domains‘ (Hoppe et al. 2000). CardBoard allows a standardisation of the interface including plugged in components (for semantic support and learner modelling). It uses the *card metaphor* to visualize its content, works ,as a medium for protocolling significant results within the flow of discussion‘ (Hoppe et al.,2000) and is regarded as ,more effective than working in conventional settings‘ while using Intranet, Notebooks and large projected displays.

The investigation of *Cates (2002)* differs from the previous mentioned concrete projects while he presents a *model (POPITS) for applying metaphors* to technology-based learning products. He uses a division into ,underlying (or primary) metaphors and auxiliary (or secondary) metaphors‘. To develop a concrete metaphor POPITS advises to consider its (p)roperties, (o)perations, associated (p)hrases, (i)mages, (t)ypes and (s)ounds. Furthermore Cates (2002) applies this model to from his point of view suitable underlying metaphors for technology-based learning products - the book metaphor and the map metaphor - to demonstrate its usefulness.



According to the introduced classification, the investigation of *Gay et al. (2001)* took place within a mobile environment of university courses. ‚Students and instructors ... were provided information services and laptop computers equipped for wireless networking‘ (Gay et al., 2001). Using standard tools like websites, bulletin boards, web folders for information sharing and Microsoft© Netmeeting the interface between learners and there collaboration environment developed, reasoned by the mobility given to them, growing authenticity. This *mobile interface* ‚supports ‚just-in-time“ learning‘, stronger social networks and therefore social navigation.

3. Conclusion

The focus of research in this review was set to journal articles about collaborative learning where interfaces between learners and learning environments were described or investigated.

As there exist a variety of different ways to use computer support for collaborative learning, a classification has been introduced. This classification bases on a technological dimension, differentiating between simple, complex and mobile interfaces, and a social dimension that is divided into local and distanced learner scenarios.

With the support of this classification it is easier to give an overview of the different kinds of interfaces that exist for CSCL-Environments.

The work and research on complex interfaces using tangibles (Price, 2003) or educational toys (Luckin, 2003) may be interesting and shows the enormous possibilities for innovative learning environments but it is connected with extensive efforts and restricted to a small number of users and usually a local setting. In these two cases children are the addressed user group and while reporting on the successful results the authors might have forgotten to include the influence of novelty. Especially children seem to be motivated of everything new but lose their interest after some time. Therefore it is necessary to have long-time studies on these projects to confirm the successes of the complex interfaces.

With regard to the development of an innovative and user friendly interface for the 'pinc' (Laqua, 2003), as been introduced in the beginning as underlying motivation, this review focusses on simple and mobile interfaces for distanced learner scenarios.

Quite a number of different metaphors are used in this context:

- classroom metaphor by Cronjé (2001)
- desktop metaphor by Persico and Manca (2000)
- city metaphor by Sato et al. (1997) and Dieberger et al. (1998)
- book metaphor and map metaphor by Cates (2002)
- simple html web-interfaces by Pimentel et al. (2001) and Gay et al. (2001)

But as all these represent just the usually used and well known standard metaphors, it shows the often missing sensitization for issues of design theory or cognition psychology in research on and projects of computer-supported collaborative learning environments.

Technology is used instead as the (by mistake seen as the only) possibility to support and enhance learning processes and knowledge building.

Keeping the overall importance of the visual interface in mind, as visualized in the concept map, would probably improve the success of most learning environments. This includes detailed research in areas of online-trust (Corritore, 2003), awareness, communities, social networks, adaptivity, personalization and the growing mobility (of people and technology). All these factors are important for the development of computer-supported collaborative learning environments and need optimal visual representations to support the underlying concepts and succeed in their individual aims.

It seems to be essential to enforce a stronger collaboration between actual researchers in CSCL and interface designers. This would allow to enhance the specific projects, which are state of the art in educational theories as well as in usage of technology, by the equally essential visual component.

4. Abstract

Computer-Supported Collaborative Learning (CSCL) offers innovative, intelligent and effective possibilities for education. Reasoned by the enormous variety of existing projects, this review introduces a two-dimensional interface classification for CSCL-Environments. Furthermore an overview of the actual research in this area is given and the connections towards the technical and the social dimension are drawn. The use of technology and the according influence on the interface is investigated. Additionally the relevance of metaphors for developing interfaces is analysed and common examples are mentioned. The general importance of visual design for learning interfaces is pointed out and recommendations for further research are given as closing remarks.

Keywords:

cscl, learning interface, interface metaphor, mobile learning, collaborative learning

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6. Appendix

6.1. Concept Map

