Tools to Support Interaction & Cognitive Awareness in CSCL

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Abstract: The main scope of Computer-Supported Collaborative Learning (CSCL) is learners' collaborative production of new knowledge. However, participation in CSCL interactions has been found problematic due to the large number of passive participants. If these e-learners were able to observe their behaviour in relation to themselves and their peers they may be able to alter it. Based on this hypothesis and the fact that current Learning Management Systems lack social and cognitive interaction awareness levels indicators, the authors proposed 3 sets of interaction analysis tools which report upon participation, interaction and argumentation in real time. The process was anchored in Human-Computer Interaction Education design.

The workshop will initially focus on operational definitions and participants' familiarization with the procedures and tools. Then, they will have an active role for open-ended exploration and idea generation working together collaboratively in small groups. The first part is presented here.

Human-Computer Interaction Education

Educational designers need to consider not only the educational system as a whole but also the learners' dual persona as learners and as users, and facilitate learning without any additional cognitive and physical struggles. Human-Computer Interaction Education (HCI-Ed) aims to initially understand the intentional variance and learning values. These are needed so HCI-Ed processes can direct the design, evaluation and implementation of systems and tools from a user/learner-centred perspective as well as support the study of the major phenomena surrounding them (Harper et al., 2008; Preece et al., 1994). To achieve this, HCI-Ed provides three iterative evaluation guidelines: Pedagogical Acceptability, Pedagogical Utility and Pedagogical Usability. The first refers to the tools compatibility with the learning values as well as the degree to which the system is compatible with learners' motivation, emotional states, culture and values (Tricot, 2007). The second is the degree to which the functionality of the system allows the learner to reach their learning goal. The third questions whether the tools, contents, interfaces, and tasks provided within the e-learning environments can support e-learners effectively, efficiently and enjoyably.

HCI Education: Understanding the context

The Intentional Variance

The initial problem (intentional variance) was to tackle the complete absence of Greek teachers' participation in an e-learning community project hosted at the Greek School Network aimed at their professional training and development. If these e-learners were able to observe their behaviour in relation to themselves and their peers they may be able to alter it; awareness of their interaction and cognitive levels is essential.

Understanding CSCL

Cognition is a complex social phenomenon that occurs within the individual's head; it refers to intermediate variables that describe social interactions and their relationships with the conditions that facilitate learning (Lave, 1988). Because the intermediate variables are invisible, their observation and study is difficult. However, it is possible to refer their existence and states from observations of collaborative social behaviour. Collaboration is an interactive practice that engages two or more participants working together to achieve outcomes they could not accomplish independently. The key to supporting collaboration is to find suitable models to describe and support collaborative interactions and their relationships with the conditions that facilitate (Dillenbourg et al., 1996). According to UNESCO (n.d.), collaborative learning occurs when learners work in groups on the same task simultaneously, thinking together for shared creation and/or discovery. Collaborative Learning has been found to enclose more advantages than other types of group learning. It empowers and enables learners to solve problems and understand subjects more easily since discussing ideas and constructing arguments through dialogue could shape in-depth learning (Borgers & Baranauskas, 2003). Accordingly, Computer-Supported Collaborative e-Learning can be a successful mode of learning without members being physically in the same location.

Activity in the form of online discussion of shared experience has been considered an effective means for adult learning (Brown & Duguid, 2000). Participation in such discussions can be active, where the individual

participate by posting; or passive, where the individual does not participate but merely observe others. Consequently, without active participation passive participation is not possible. If passive and active modes are acceptable, there should be some processes and pedagogical methodologies to create and maintain the transition between these to enhance learning. This may be feasible within CSCL and e-learning in particular due to the possibility of manipulation of the learning environment. Thus, specific Interaction Analysis (IA) indicators can support e-learners' participation, interaction and argumentation within discussions.

CSCL Indicators for Participation, Interaction & Argumentation

Collaborative e-learning can be enhance by making visible the collaborative learning structure. To accomplish this, tools for observing social and cognitive interactions, and tools for analysing them are required (Dillenbourg et al., 1996). Thus, the design of such tools can impact collaborative learning by modifying the socio-dynamics between the learning partners. Participation, interaction and argumentation were the CSCL indicators supported and investigated in this research.

Learning has been proposed to be a process of engagement; Lave and Wenger (1991) called this learning process Legitimate Peripheral Participation (LLP). Because it is centripetal, there are hierarchical levels of participation depending on interaction. These facilitate the co-construction of a learner-generated dialogical context and have recently been studied by means of Social Network Analysis (SNA). Also, the CSCL dialogical context differentiated collaborative learning dialogue from other "simple" dialogues, providing a distinction between mere information and knowledge acquisition. A dialogical sequence can be an episode, called a Collaborative e-Learning Episode (CeLE) with a starting point, a transition and an end point. The ongoing research, based on the initial CeLE developed in LSBU (Lambropoulos, 2008) led to a Computer-Supported Collaborative Creativity (CSCC) model showed in this workshop and conference (Daskolia et al., 2009). It has been developed in collaboration with Panayiotis Kampylis from the University of Jyväskylä, Finland, and Dr Maria Daskolia from University of Athens, Greece. In CSCC, Hybrid Synergy is a 4-stages non-linear analytical framework that facilitates and enhances the e-learners' critical thinking levels. The first step refers to mere information provision, the second to the social aspect of collaborative learning, the third to the exploration of ideas, the fourth to their evaluation and assessment and lastly the fifth step to a meta-cognitive aspect with summaries and assignments.

This discussion on participation, interaction and argumentation provided the context to develop requirements and measurements for IA tools presented in the next section.

HCI Education: Design & Implementation of IA Indicators

The iterative process of design, implementation and evaluation of the tools involved the analysis of their impact on learners' communication, and hence learning. The analysis required human-human and human-computer interactions from an ethnomethodological viewpoint. Ethnotechnology, ethnography used in technology, has only recently been employed into the e-learning research (Guribye, 2005). Under this approach, fieldwork and case studies provided the data for qualitative analysis which is subsequently quantified for statistical analysis (Boyatzis, 1998). In this study, system logs, Pedagogical Acceptability, Utility and Usability evaluation and Social network Analysis (SNA) provided the data for the quantitative analysis.

Fieldwork supported by a baseline study, a case study and a focus group was conducted to determine the initial level of participation, acquire feedback for design and to test initial design. These studies functioned as iterative building blocks. We developed 3 sets of tools in order to enhance participants' interaction and cognitive awareness. The final implementation consisted of two parts. The first part was a case study hosted without the tools at the Greek School Network. The second part was another case study with the tools and the same Greek teachers in an experimental environment. The first study started on 01/03/2007 and finished on 31/03/2007 with 5 e-tutors, including the first author. The second study started on 21/03/2007 and finished on 31/03/2007 without e-tutors. Only the end design process including requirements and measurement indicators and some final results are presented here.

Participation Avatars

Table 1: Participation Awareness Requirements & Propositions.

Participation Awareness Requirements		Propositions
1	Embodied self & group presentation	Avatars as indicators of levels of activity
2	Social interaction & cognitive awareness	Levels of activity
3	Participation Measurements	Levels of activity
4	Lightweightness & Interoperability	PHP Language
5	Simple to interpret and easy to use	HCI Education

Table 2: Participation Levels Measurement.

Levels of Active participation		Measurement indicators on the highest poster's overall messages
4	High	76-100%
3	Medium	26-75%
2	Low	1-25%
1	Zero	Passive activity (e.g. vicarious learning)
Levels of Passive Participation		Measurement of viewing/downloading days (logs)
4	High	3/3 of the overall passive activities
3	Medium	2/3 of the overall passive activities
2	Low	1/3 of the overall passive activities
1	Zero	Registration only

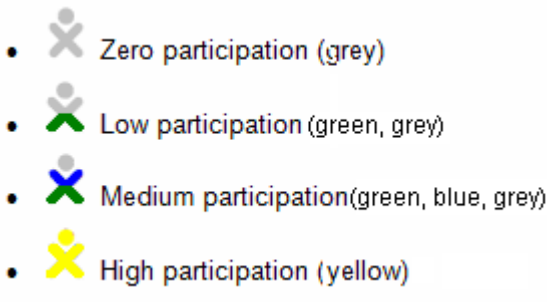

Figure 1. The Active Participation Avatars.

Social Network Analysis: Visualisation Interaction Tools

Table 3: Interaction Awareness Requirements & Propositions.

Interaction Awareness Requirements		Propositions
1	Embodied self (presence) & group presentation (co-presence)	Textual and visual information e.g. names, avatars, group network representation
2	Self & co-presence presentation	Group nodes and networks
3	Social awareness & connectedness, interaction awareness	Enhanced discussion forums, group network representation
4	Depiction of the individual and group locality to indicate the spatio-temporal relationship	Group network representation
5	Integration of social objects	Links between people and objects in a network structure
6	Depiction of the individual and group interactive patterns	Individual, complementary, cooperative
7	Lightweightness & Interoperability	JAVA Language
8	Simple to interpret and easy to learn & use	Pedagogical Usability guidelines

Table 4: Measurements of Interaction Awareness.

Interaction Awareness Requirements		Measurement Indicators
1	Interaction density	Nodes' weight
2	Reciprocity	Nodes' similarities
3	In- and out-degree centrality	Location
4	Interaction latency	Distances between the nodes

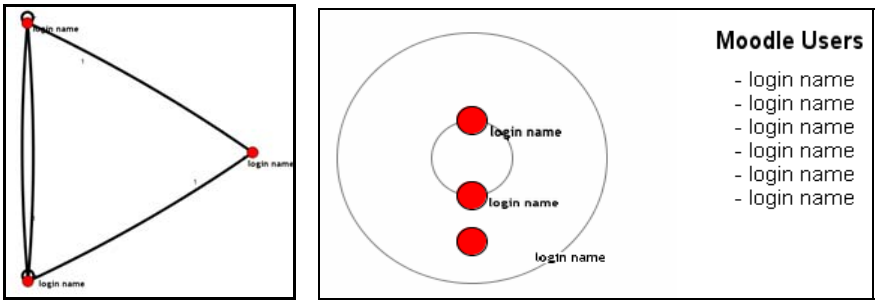

Figure 2 & 3. The Visualization Interactions Tools Nodes and Centrality.

CSCL Argumentation: HySynTag Tool

The tags are: [-], Inform, Feel, Explore, Idea, Evaluate, Summarise, other

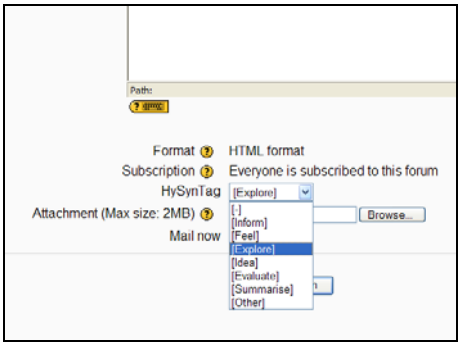

Figure 4. The Hybrid Synergy Tag (HySynTag) tool integrated in the 'Reply' function in Moodle.

THE INTERACTION ANALYSIS TOOLS ON THE DISCUSSION INTERFACE

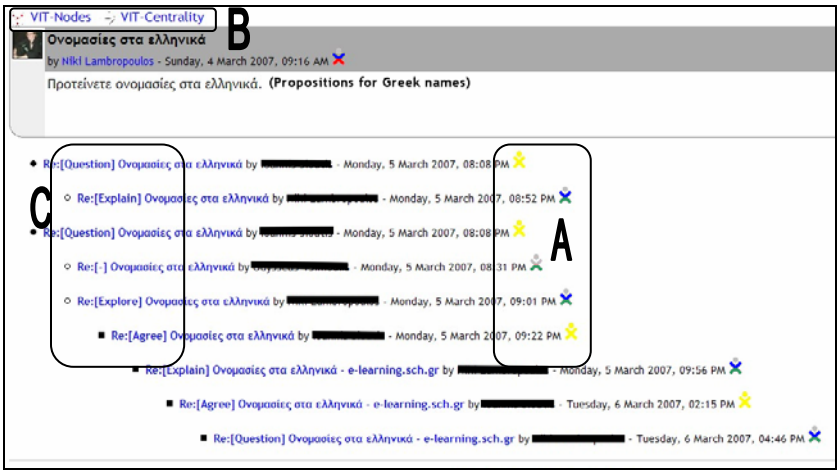

Figure 5. The Interaction Analysis Tools on the discussion Forum Interface.

A: Location of the Participation Avatars
B: Location of the Visualisation Interaction Tools
C: Location of the HySynTag Tool

HCI Education: Overall Evaluation

From a technical viewpoint, it appeared that several groups need to evaluate learning technologies and applications; these are novice, average and expert users; developers and e-tutors. Also, there were interoperability problems indicating the need for new programming techniques. Another interesting point was that if such tools and evaluation techniques do not exist, it is difficult to observe that they are missing. All tools supported self and group representation, locality, e-learning community organisation and assessment. The Participation Avatars received the highest evaluation scores. The Visualisation Interactions Tools (VIT) depicted the local networks in discussion topics;

however, they were more useful to the e-tutors. VIT Nodes and Centrality provided opportunities for the e-tutors to observe and reflect on their personal styles and performance within small groups. The participants were unfamiliar with them and it was difficult to interpret their use and incorporate them in their practice. HySynTag has not been fully evaluated yet as it is a later version of a previous tool. However, results may be available on the day of the workshop.

Conclusions

Overall, it appeared that interactions and cognitive awareness are interrelated and thus their observation and analysis support social, cognitive as well as metacognitive awareness in CSCL. As for analysing interactions, tools could capture the social, cognitive and metacognitive clues, for example exploring and verifying solutions, discriminating between social communication and task, and identifying critical thinking levels. Different learning styles were also evident such as vicarious and instructional learning as well as collaborative learning. Based on the successful intervention, it appears that in such favourable circumstances and appropriate tasks and associated tools, passive participants can get engaged. Consequently, technologies need to be able to adapt to individuals' changing needs, learning and interaction styles. In conclusion, the overall design of Learning Management Systems such as Moodle does not encompass specified ontology and tools to coerce the needed activities (Kirschner et. al, 2008). HCI Education can be a practical, effective and reliable process to support CSCL design.

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Access to the tools on Moodle: http://intelligentq.net/e-learning/