Working collaboratively in small groups supported by KnowCat System: incidence on self-regulated learning processes

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Abstract: The aim of this research study was to examine the development of higher students' self-regulated processes after their participation in a specific CSCL system called KnowCat. Twenty-six university students participated in a 6-month learning project. During this period KnowCat learning environment was used to support scaffolding process among students in small group collaborative work. In the research study students' scaffolding processes in the different small groups were analyzed qualitatively. The results obtained in this study showed small group interaction patterns appeared while their members were working together throughout the instructional process supported by KnowCat. These interaction patters were related with an increasing number of self-regulated processes, specially planning, asking for clarification and monitoring skills.

Introduction

Learning in CSCL environment requires a learner to regulate his or her learning in order to construct higher and deeper levels of knowledge; that is, to make decisions about what, how and how much to learn, how much time to spend on it, how to access others educational materials, whether he or she understands the material, how modify plans and strategies to learn better and when to increase effort (Azevedo et al. 2005).

Wine's(2001) model of self-regulated learning let to examine the complex interplay between learner characteristics (e.g., prior knowledge, prior collaborative experience), elements of computer-supported environments (e.g., knowledge organisation, matchmaking, condition of participation) and mediating self-regulatory processes (e.g., planning, strategy use, monitoring activities). One way to foster student self-regulation is through the use of various kinds of contextual aids and others' scaffolds which may include access to static educational resources or a peer tutor who provides adaptive scaffolding to support students' self regulated learning.

Examining the role of scaffolds in facilitating students' self-regulate learning has become a critical issue in bridging self and externally regulated learning supported by computers. The social environment is viewed as a resource for self-enhancing forethought, performance or volitional control and self-reflection. Expanding on these ideas, it is hypothesized that in networked collaborative learning environments with an appropriate CSCL pedagogical model there are self-regulated processes which can be stimulated by peers (Hurme & Järvelä, 2006). In recent collaborative design systems research, this notion of scaffolding has been generalized to refer to aspects based on software tools to assist learners in making progress on collaborative task solving. CSCL enables students to see online fellows' solutions and provide them with specific widgets for explicit assistance to improve on task and process solving or they can discuss online how to solve the task.

The research project presented in this paper falls within this line of work. Our aim was to develop and analyse a pedagogical hands-on activity for one regular course over a six-month project at the Universitat de Lleida (Spain), by using specific and innovative CSCL software called KnowCat (Alamán & Cobos, 1999; Cobos, 2003) designed for supporting collaborative learning processes. Specifically, this research focuses on the analysis of students' development of self-regulatory processes in the context of joint small-groups learning activities supported by CSCL-KnowCat in higher education.

More in detail, the purposes of the study were to investigate:

- What effect does the students' participation in the KnowCat instructional environment have on the development of self-regulated learning skills?
- Which similarities and differences are in the scaffolding processes provided by students of the different smalls groups while they are working collaboratively with KnowCat?

Description of the KnowCat system

KnowCat (acronym for "Knowledge Catalyser") is a fully consolidated and thoroughly tested and validated CSCL system which has been developed at Universidad Autónoma de Madrid (Spain) an in active use since 1998. The main aim of this system is to generate quality educational materials as the automatic result of student interactions with the materials, by catalysing the crystallisation of knowledge (Alamán and Cobos, 1999; Cobos, 2003). More specifically, the system is based on a mechanism called "Knowledge Crystallisation". This

mechanism gives us evidence about which the best contributions are in the user opinion through their interaction with the system.

KnowCat enables us to build up community knowledge sites –or knowledge sites for short. They are accessed through a specific URL using a Web browser and they are known as "KnowCat sites" or KnowCat nodes. Each knowledge site is organised around several knowledge elements. Firstly, the knowledge tree, which is a hierarchical structure of topics, displays the organisation of the knowledge site in several topics. Secondly, each topic contains a set of mutually alternative documents that describe the topic. At any given time, all documents contained in the same topic compete with each other to be considered as the "best" description of the topic. This competitive environment is achieved by the Knowledge Crystallisation mechanism of the system, which is supported by virtual communities of users (see its details below). At any time, the author of a document can contribute with a new version of his/her document.

Thirdly, each document can receive annotations –or note, for short–. A note is a review about the information presented in a document. Each note has a type that determinates its purpose. We have the following note types: a) "clarification" note: this is useful to clarify some parts of the document; b) "support" note: this is useful to express agreement with the document; and c) "review" note: this is useful to make suggestions about adding, removing, or changing some parts of the document, or for making comments regarding it. Finally, each document can receive assessments. An assessment represents a "weight assertion" which can be used by the users in order to determinate how good (with a value from 1, minimum value, to 10, maximum value) a specific aspect (i.e. correctness, innovative, etc.) of a specific part of a document (i.e. introduction, references, etc.) is.

The user operations provided by KnowCat are the next ones: modifying the knowledge tree, adding a new document to a selected topic, accessing to a document, voting a document, adding an annotation and assessments to a document, displaying the content of a note and the content of assessments, adding a new version of a document, displaying the content of a new document version.

The Knowledge Crystallisation mechanism takes into account the user opinions about the documents and the evolution of the opinions received to determine what documents are socially acceptable, in which case they remain in the knowledge site, and which of those are found unsatisfactory, in which case they are removed from the knowledge site.

Whether or not a document is socially acceptable is determined by its "degree of acceptance" as calculated by the Knowledge Crystallisation mechanism. More specifically, the degree of acceptance of a document is formulated using the explicitly received opinions concerning the document: the received votes, how these votes were received, the received annotations and their respective types, and the received assessments and their values; and the implicitly received opinions regarding access to the document.

Moreover, we have taken into account in this mechanism the "quality" of the users. In other words, we prefer to give more credibility to opinions from experts than those from occasional users. KnowCat establishes categories of users through the same means as the scientific community establishes its member's credibility, that is, by taking into account past contributions. Therefore, this system deals with "virtual communities of experts".

KnowCat has been tested in several research studies with student communities at Universidad Autónoma de Madrid (Spain) and Universitat de Lleida (Spain). These studies and results are detailed in Alamán & Cobos (1999); Cobos (2003); Cobos & Pifarré (2008) and Diez & Cobos (2008).

Research Methodology

Our study took the form of a case study conducted in an authentic university class environment. The purpose was to follow the scaffolding processes among students working in small groups over a six-month learning project. The study was conceived as a field case study and the analysis was initially planned on a descriptive level. Nevertheless, as we were addressing to study the evolution of the development of self-regulated skills a long the learning project we analysed the changes in using self-regulate skills to solve two problem-based activities using the CSCL-KnowCat; one activity was solved at the beginning of the learning project and the second activity was solved at the end of the six-month learning project. We adopted a coding scheme which would allow quantitative results to be stated.

Participants

Twenty-six university students participated in the research. They used KnowCat during one term in the context of the university course "Psychopedagogy Intervention in children development disorders" of the Psychopedagogy degree. The course lasted for 12 weeks (4.5 hours per week).

The students were randomly distributed in six small groups to solve the two problem-based activities of the study. Each small group was composed of 4-5 students.

Intervention: Main pedagogical characteristics of the CSCL instructional context

In order to assist the students in the use of KnowCat to construct knowledge collaboratively, and more specifically the KnowCat notes as improved scaffolds that could help their classmates to improve their

documents, we designed a specific educational process in which the pedagogical prerequisites pointed out in CSCL literature were introduced.

The collaborative KnowCat system was used in authentic problem based activities in which students had to design a pedagogical intervention to respond a real case. Students solved two-problem based activities with KnowCat. To solve the two problem-based activities, students work with the assistance of KnowCat at two collaborative levels: in small group level in phase 1, and group class level (all students formed this group class) in phase 2. The main aim of the students' work with KnowCat in the phase 1"working in small groups" was to elaborate a common pedagogical intervention report to respond a real educational case. The collaborative small group procedure characteristics in phase 1 were as follows:

a) Each student wrote an individual report containing the individual resolution of the real case and submitted it as a document in KnowCat.
b) The other members of the small group read all peer's report separately and annotated them –i.e. by giving assistance– in order to help a fellow classmate to improve it.
c) The document's author read the notes concerning his/her own report taking into account both the classmates' notes and documents, re-wrote his/her own document and submitted it to the system again as a new document version. When students re-wrote their document, they could introduce ideas included in clasmates' documents, because the objective of re-writing the document was to elaborate collaboratively the best group pedagogical intervention to the real case.
d) The members of each group vote the best report which contained the adequate respond to the real educational case. The document which was the most social accepted one (calculated by the KnowCat Knowledge Crytallisation mechanism) was submitted to the system in the "class section" as a group document, and shared it to the other groups of the class (see figure 2).

The aim of the students' work with KnowCat in the phase 2 "working with the whole group class" was to decide which small group document was the best educational intervention to respond each real case. The procedure was as follows:

a) Students read all the documents submitted by the six different small groups and voted for the best one. Students argued their reasons in the voting process.
b) KnowCat Knowledge Crytallisation mechanism was a great help in order to select which the social accepted document of the whole group class was.

Data Analyses

A coding scheme was used to study possible changes in the content of the notes and in the learning processes required for the writing of these notes during the solution of the two activities. The coding scheme was based on the categories developed by Veldhuis-Diermanse (2002). The scheme distinguishes three general types of learning activities (or categories) and nine subcategories: (1) cognitive activities –three subcategories are distinguished: debating ideas, using external information and experiences, and linking or repeating internal information; (2) metacognitive activities –three subcategories are distinguished: planning, keeping clarity and monitoring; (3) affective activities –three subcategories are distinguished: general reaction, asking for general feedback and chatting or social talk.

This paper pretend to study deeply the regulation of group processes aimed at stimulating collaborative learning, for this reason we will focus on a deeper analysis of the metacognitive categories. The definition of the three subcategories of metacognitive learning processes referred to the students' self and external regulation shaped during the annotation process and is presented next:

Planning, when students present or ask for an approach or procedure to carry out the task. This presentation is followed by an argumentation or illustration.

Keeping clarity, when students ask for an explanation, synthesis of information, clarification or illustration as a reaction to certain information of the document. They give an example and/or add a new point to specific information

Monitoring, when students monitor the original planning or aim. The students mention the work done by their classmates and propose how to improve on it. Either that, or when students reflect on their own actions or on certain contributions to the database.

The coding process consists of two steps: a) dividing the messages into meaningful units and, b) assigning a code to each unit. We decided to segment the notes into units of meaning by using semantic features such as ideas, argument chains, and discussion topics, or by regulative activities such as making a plan, asking for an explanation, or explaining unclear information. Validity and reliability aspects were considered in the study.

Results

In this section, we analyse the development of students' learning activities during their interaction with KnowCat. To reach this objective, we carried out a detailed study on the content of the notes written by the

students during phase 1 "working in small groups" to solve collaboratively the two problem based activities. Figure 1 provides a general picture of the learning processes developed by the different small groups in solving the two problem-based activities -for example G1A1 represents the meaningful units contained in notes written by students of group 1 (G1) to solve activity 1 (A1).

The total number of notes and the meaningful units identified in these notes in the two activities are different; the number of meaningful units identified in the second activity is higher than the number of meaningful units identified in the first activity in all the groups.

Particularly interesting is the increasing in all the small groups the number of metacognitive meaningful units in the resolution of the second problem-based activity. In our research we emphasized the use of the KnowCat notes as improved scaffolds among peers in order to write collaboratively the best solution to the presented problem based activity, and therefore in studying the students' metacognitive learning activities, our main focus was analysing external regulative learning which can help students to run group processes, to make plans aimed at successfully carrying out the task, to monitor their learning processes and to assist each other for learning ends.

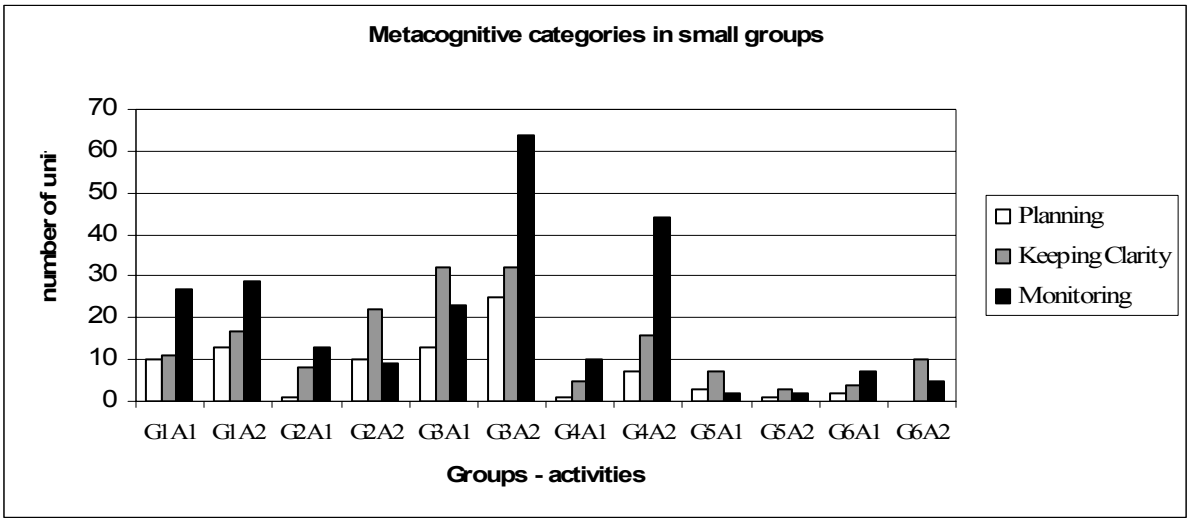

Figure 1. Distribution of the meaningful units identified by the different small groups (G1-G6) in the two activities (A1-A2) in the metacognitive categories.

The results obtained in our study show that students increase the presence of self-regulated processes while they were working in the CSCL-Knowcat environment. Students while regulate their own activity in the collaborative learning environment they were also able to monitor and control how their peers were working in the same task. From our point of view, these results give experimental data that KnowCat knowledge elements could support the development of external and self-regulated skills.

The increasing of the number of self-regulated processes in students' active participation in the networked learning –specially those processes referred to monitor and control other's work– is very challenging because educational research has shown that one benefit of students participation in CSCL environment is the fact it requires students to construct explanations which formulate their ideas or construct scaffolds which provide help to others during the collaborative task (Ploetzer, Dillenbourg, Preier & Traum, 1999).

Furthermore, the results of the current study illustrate how the students' participation in KnowCat instructional process might have an effect on the students' cognitive regulation particularly in planning actions (see figure 1). In the "Planning" category were coded meaning units where students asked for a new approach or procedure to carry out the task or where students presented or illustrated a new approach or procedure to perform the task and monitoring the learning processes. A growing body of research evidence demonstrates the positive effects of CSCL on self-regulated learning. CSCL sets demands and provides unique tools for engaging in specific self-regulation processes and the positive incidence of these processes in students' learning results (Koschmann, Hall & Miyake, 2001; Paris & Paris, 2001; Salovaara, 2005).

Conclusions

The instructional application of the KnowCat system could favour and improve the development of students' self-regulated skills. The results of the content analysis of our study highlighted that task resolution and networked discussions engaged students in specific self-regulation processes. Therefore, these results revealed that our study applied a good CSCL project to enhance the development of students' self-regulation skills and

gave experimental data that the KnowCat system can assist students in the development of this cognitive self-regulation.

The results of our previous studies and the study presented in this paper have corroborated that KnowCat can support the construction of quality community knowledge and the learning processes among peer interaction.

It should be noted that the results of the current study are based on a reduced number of subjects and therefore, the emphasis of the study is on qualitative findings. However, the results of the current study illustrate how the students' participation in the CSCL-KnowCat instructional process might affect students' self-regulated skills.

References

Alamán, X., Cobos, R. (1999). KnowCat: a Web Application for Knowledge Organization, in: Chen, P.P., et al. (Eds.), *Lecture Notes in Computer Science 1727*. Springer, New York, pp. 348-359.

Azevedo, R., Cromley, J., Winters, F., Moos, C. & Greene, J. (2005). Adaptative human scaffolding facilitates adolescents' self-regulated learning with Hypermedia. *Instructional Science, 33,* 381-412.

Cobos, R. (2003). Mecanismos para la cristalización del conocimiento, una propuesta mediante un sistema de trabajo colaborativo (Mechanisms for the Crystallisation of Knowledge, a proposal using a collaborative system). Doctoral dissertation. Universidad Autónoma de Madrid.

Cobos, R., Pifarré, M. (2008). Collaborative knowledge construction in the web supported by the KnowCat system. *Computers & Education, 50,* 962-978.

Díez, F, Cobos, R. (2008). A Case Study of a Cooperative Learning Experience in Artificial Intelligence. *Journal Computer Applications in Engineering Education*. *15(4),* John Wiley & Sons, Inc. January, 2008. 308-316.

Hurme, T., Järvelä, S. (2006). Metacognition in joint discussions: an analysis of the patterns of interaction and the metacognitive content of the networked discussions in mathematics. *Metacognition & Learning, 1,* 181-200.

Koschmann, T., Hall, R., Miyake, N. (Eds.) (2001). *CSCL2: Carrying forward the conversation.* Lawrence Erlbaum Associates, Publishers, Mahwah, New Jersey/London.

Paris, S. G., Paris, A. H. (2001). Classroom applications of research on self-regulated learning. *Educational Psychologist, 36,* 89-101.

Ploetzer, R., Dillenbourg, P., Preier, M., Traum, D. (1999). Learning by explaining to oneself and to others. In P. Dillenbourgh (Ed.). *Collaborative learning: cognitive and computational approaches.* Amsterdam: Pergamon, 103-121.

Salovaara, H. (2005). An exploration of students' strategy use in inquiry-based computer-supported collaborative learning. *Journal of Computer Assisted Learning 21(1),* 39-52.

Veldhuis-Diermanse, A. E. (2002). CSCLearning?. Participation, learning activities and knowledge construction in computer-supported collaborative learning in higher education. Doctoral dissertation. Veenendaal. Wageringen University.

Winne, P. H. (2001). Self-regulated learning viewed from models of information processing. In B. Zimmerman & D. Schunk, ed. *Self-regulated learning and academic: Theoretical perspectives*. Erlbaum: Mahwah.

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