Self-regulated Learning in Technology Enhanced Learning Environments

Antonio Bartolomé
Universitat de Barcelona
Pg. Vall d'Hebrón, 171
08035 Barcelona
0034 93 403 50 65
abartolome@lmi.ub.es

Karl Steffens
Universität zu Köln
Albertus-Magnus-Platz
50923 Cologne
0049 221 470 5811
Karl.Steffens@uni-koeln.de

ABSTRACT

The present contribution describes a project which was carried out by nine European Universities to explore Self-Regulated Learning (SRL) in Technology Enhanced Learning Environments (TELEs). The methodology of identifying and evaluating TELEs which support SRL and the results from case studies are described and discussed.

Keywords: Self-regulated Learning, Technology Enhanced Learning Environments

1. INTRODUCTION

Self-regulated learning (SRL) has become an important topic in educational research. But even outside the realms of research, there is an increasing awareness that our societies need to prepare their citizens for lifelong learning and that this new and extended way of learning will require the self-regulation of individual learning processes to a far greater extent than traditional teacher-regulated learning used to do.

At the same time, recent developments in Information and Communications Technology (ICT) have made it possible to create powerful Technology Enhanced Learning Environments (TELEs). It is therefore of interest to know whether these TELEs have a potential for supporting self-regulated learning.

This question was addressed by the TELEPEERS project which was carried out by universities from nine European countries from January 2004 to January 2006.

2. SELF-REGULATED LEARNING

In defining self-regulated learning, some authors refer to the components which are considered to play an important role in self-regulated learning: "Students can be described as self-regulated to the degree that they are metacognitively, motivationally, and behaviourally active participants in their own learning process" [8, p.5]. Other authors describe the process of self-regulated learning: self-regulated learning "can help describe the ways that people approach problems, apply strategies, monitor their performance, and interpret the outcomes of their efforts" [3, p.3]. It is important to point out, however, that self-regulation not only involves monitoring and regulating one's cognitive activities; emotional and motivational processes also need to be regulated [1, 4, 5]

Zimmerman [6, 7] suggested a social cognitive model of self-regulated learning which is richer with respect to the processes which are considered at each stage. According to this model, self-

regulation is achieved in cycles consisting of (1) forethought, (2) performance or volitional control, and (3) self-reflection:

(1) *Forethought*. In the forethought phase, task analysis and self-motivation beliefs are important. Task analysis refers to planning processes like goal setting and strategic planning. Self-motivational beliefs comprise a student's self-efficacy beliefs, his outcome expectations, intrinsic interest and goal orientation.

(2) *Performance or volitional control*. In this phase, the chosen strategy is implemented and monitored by the student. Zimmerman distinguishes between self-control and self-observation. Self-control refers to regulatory processes like self-instruction, imagery, attention focusing and task strategies. Self-observation includes monitoring strategies like self-recording and self-experimentation.

(3) *Self-reflection*. In the self-reflection phase, the student tries to evaluate the outcome of his efforts.

This model was taken up in a number of studies on self-regulated learning [6], and it was also used as a point of departure for our own research on self-regulated learning in TELEs.

3. TECHNOLOGY ENHANCED LEARNING ENVIRONMENTS (TELES)

Any environment which facilitates the acquisition of knowledge and skills is a learning environment, and any learning environment that is supported by the new Information and Communication Technologies (ICTs) can be regarded to be a Technology Enhanced Learning Environment (TELE). There are two caveats, however: (1) learning may be more than the acquisition of knowledge and skills. Learning may also include the acquisition and regulation of emotions, motivations, attitudes and values, i.e. learning usually comprises more than merely cognitive activities. It is true, however, that many learning environments only focus on cognitive aspects of learning. (2) A TELE is more than just the technology or the technological component of a TELE. In many cases, the TELE consists of the

learner and the technology plus a teacher/coach, peers and tasks given by the teacher or emanating from the environment. However, even in our research we had to remind ourselves at times that we were trying to evaluate a complete TELE and not just its technology.

4.TELEPEERS: THE PROJECT

The TELEPEERS project[1] was carried out from January 1st 2004 to January 1st 2006. Project partners were Universität zu Köln / Germany, Vrije Universiteit Amsterdam / The Netherlands, Universidade Católica Portuguesa / Portugal, Aalborg Universitet / Denmark, CNR Istituto per le Tecnologie Didattiche / Italy, Nottingham Trent University / U.K. , Universitat de Barcelona / Spain, Université de Technologie de Compiegne / France, Universitetet i Bergen / Norway.

The TELEPEERS project aimed at identifying Technology Enhanced Learning Environments (TELEs) that have a potential for supporting self-regulated learning. Each partner selected TELEs which were being used at his home institution and which at first sight seemed to have a potential for supporting self-regulated learning, and these were than studied in depth. The evaluation was carried out in a peer review manner, i.e. each partner evaluated at least one TELE from the other partners. In addition, each partner evaluated at least one of the TELEs that he had selected at his home institution.

As part of our research, we developed two questionnaires, one for experts in the field of Technology Enhanced Learning (TELE-SRL), and one for students who actually worked in TELEs (TELESTUDENTS-SRL). While the first questionnaire was used to evaluate a TELE's potential for supporting self-regulated learning, the second one was to give us information on how

TELE / home	Description
Container systems with tutor	
Digital Portfolio / Vrije Universiteit Amsterdam	a web-based collection of student's work to demonstrate his/her efforts, progress and achievements in one ore more areas
DiViDU / Vrije Universiteit Amsterdam	web-based digital video used in teacher training to help student reflect on professional skills and attitudes
ILIAS / Universität zu Köln	an Internet-based authoring environment for course designers as well as an Internet-based learning environment for students at university level
Weblogs / Universitetet i Bergen	a personal, but public web space for self-expression
Content systems with tutor	
ICT-based Teacher Training / Universidade Católica Portuguesa	an ICT-based teacher training master course to improve ICT knowledge and skills
Cognitive Psychology Course / Nottingham Trent University	web-based support for an undergraduate course on cognitive psychology
Digital Video Course / Universidad de Barcelona	a blended learning course aimed at helping students acquire appropriate skills to use digital video and increase awareness of the media
Teacher Training Course on ET / CNR Istituto per le Tecnologie Didattiche Genoa	a Computer Mediated Communication Systems (CMCS) used in teacher training to improve knowledge and skills in Educational Technology
Content systems without tutor	
Sunpower / Universität zu Köln	a CD ROM program to improve communication strategies in English for business purposes targeted at adults with an intermediate level of English
Databases / Université de Technologie de Compiègne	an online tutorial on databases with topics ranging from design issues to practical aspects
Programming Tutorial / Université de Technologie de Compiègne	an online tutorial algorithms and programming based on Pascal
SWIM / Aalborg Universitet	a streaming web-based information module which serves as an online tutorial to help students acquire adequate strategies for information seeking

Table 1: TELEs which were studied in the TELEPEERS project

the students who were working with a specific TELE perceived the affordances of this kind of learning environment [2]

There was a wide variety of TELES which we studied whose technology components included multimedia programs on CD-ROM, digital video, Information Management and Learning

Management Systems (LMS). We decided to categorise these TELEs into three different classes:
1. Container systems with tutor
2. Content systems with tutor
3. Content systems without tutor.

Container systems are Learning Management or Information Management Systems whose content is provided by the user while content systems already contain specific content.

Table 1 gives a short description of the TELEs studied.

[2] Both questionnaires can be downloaded from PRODUCTS at www.lmi.ub.es/telepeers ; they are available in all the languages of the consortium; there is also an online version in English.

5.MAIN RESULTS

We had not entertained any specific hypothesis concerning the potential of the TELEs in the different categories for supporting self-regulated learning. We were therefore surprised that all the TELEs in the first category (container systems with tutor) received mean values of 3.0 or above (one a scale from 0 to 5) with respect to total evaluation as well as to component specific evaluation, i.e. they were evaluated as supporting self-regulated learning quite well (see table 2). This might be due to the fact that container systems require students to invest quite an amount of effort because they have to fill the corresponding TELEs with content.

The content systems with tutor we studied seem to favour the social component of self-regulated learning (communicating with tutor or peers) and to some extent also the emotional one. This is probably due to the fact that these TELEs were courses give at the corresponding universities where the technological component played a major role. We do not know, however, whether the facilitation of self-regulated learning was attributed to the technological component or to the social setting of the courses.

Content systems without tutor seem to support the cognitive and motivational components of self-regulated learning. Since these TELEs are multimedia or Internet applications designed for and used by individuals, they cannot facilitate social aspects of self-regulated learning. Evidently, they also do not support emotional aspects of self-regulated learning. In these instances, the technological components presented the complete TELEs. It would, however, not be a problem to implement them in a classroom and have students work with them and interact with each other, thus making these technological components part of a richer learning environments.

Notwithstanding the differences between groups of TELEs, all of them - with two exceptions - seem to have a good potential for supporting self-regulated learning as indicated by their above-average total values.

TELE/home	Total	Cognitive component	Motivational component	Emotional component	Social component
Container systems with tutor					
Digital Portfolio / Amsterdam	4.0	4.1	3.5	3.8	4.5
DiViDU / Amsterdam	3.9	4.0	3.6	3.5	4.5
ILIAS / Cologne	4.2	3.7	3.7	4.0	4.8
Weblogs / Bergen	3.1	2.8	3.4	2.7	3.4
Content systems with tutor					
ICT-based Teacher Training / Lisbon	3.2	2.3	3.0	3.5	4.6
Cognitive Psychology Course / Nottingham	1.4	1.7	1.8	1.1	0.8
Digital Video Course / Barcelona	3.1	2.3	2.7	3.2	4.5
Teacher Training Course on ET / Genoa	3.3	2.6	3.1	3.3	4.5
Content systems without tutor					
Sunpower / Cologne	2.4	3.2	3.0	1.9	0.6
Databases / Compiègne	3.0	3.8	2.6	2.9	2.4
Programming Tutorial / Compiègne	3.0	3.6	3.6	2.9	1.6
SWIM / Aalborg	3.0	2.4	3.6	3.2	3.3

Table 2: Expert evaluations of TELEs

TELE	Total	Cognitive component	Motivational component	Emotional component	Social component
Content systems with tutor					
ICT-based Teacher Education / Lisbon					
experts	**3.2**	2.3	**3.0**	**3.5**	**4.6**
students	**4.0**	**4.1**	**3.6**	**3.6**	**4.4**
Cognitive Psychology Course / Nottingham					
experts	1.4	1.7	1.8	1.1	0.8
students	2.8	**3.1**	2.7	2.8	2.5
Digital Video Course / Barcelona					
experts	**3.1**	2.3	2.7	**3.2**	**4.5**
students	2.6	2.4	2.4	1.9	**3.4**
Content systems without tutor					
Sunpower / Cologne					
experts	2.4	**3.2**	**3.0**	1.9	0.6
students	2.1	2.9	2.3	2.1	1.1

Table 3: Evaluations by experts and students

For four TELEs, we had evaluation data from experts as well as from students (table 3). While two of the TELEs received higher ratings by the students than by the experts, for the other two TELEs, the reverse was true. In order to understand these findings, we analysed the students' response to a questions which was to indicate their attributions (see table 4). The TELESTUDENTS-SRL questionnaire contains the following list of possible causes for one's learning outcome: (1) tutor/instructor, (2) peers, (3) technology, (4) ability, (5) effort and (6) prior knowledge.

Between the four TELE student groups, there were no significant differences with respect to technology and prior knowledge; significant differences, however, were observed with respect to tutor, peers and effort.

	tutor**	peers**	technology	ability	effort**	knowledge
ICT-based Teacher Education / Lisbon	4.8	4.6	4.3	4.0	5.0	3.8
Cognitive Psychology Course / Nottingham	4.8	2.8	3.7	3.7	4.3	3.2
Digital Video Course / Barcelona	3.5	3.9	4.2	3.7	3.7	2.8
Sunpower / Cologne	0.5	1.0	4.6	3.9	3.5	4.2

Table 4: Students' attributions of learning outcomes (= $p < 0.01$)**

The first two differences are not surprising since one of the four TELEs (Sunpower) did not provide for tutors and peers. The differences with respect to effort are interesting, however, particularly since the two TELEs whose facilitating power for self-regulated learning was evaluated higher by the students than by the experts were also those TELEs with regard to which students indicated that their effort played a very important role. It seems possible, therefore, that the perception of one's own effort might moderate the perception of the affordances of a TELE with respect to its potential for self-regulated learning.

6.CONCLUSIONS

In the TELEPEERS research project, we were able to identify a number of TELEs which according to our findings do have a potential for supporting self-regulated learning. The questionnaires which we developed seem to be sufficiently reliable and valid.

One question which we did not answer and which will have to be addressed in future research is: do TELEs which are evaluated as having a potential for supporting self-regulated learning by experts and which are actually perceived by students as facilitating self-regulated learning indeed improve learning outcomes and self-regulated learning skills?

In our research, we only studied TELEs in academic settings. The contributions which were presented at the TACONET conference in Lisbon on self-regulated learning in TELES (Carneiro, Steffens & Underwood, 2005)[3] indicate that the topic of self-regulated learning in Technology Enhanced Learning Environments is not only attracting interest from academia; members from industry as well from communities of practice agreed that the respective intervention models and research results should also find their application in educational endeavours that take place outside the universities.

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[3] TACONET conference in Lisbon, Sept.23, 2005, www.lmi.ub.es/taconet.

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