New media for the promotion of self-regulated learning in higher education

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In this article, some of most relevant programs of self-regulation of academic learning in the sphere of higher education were reviewed. Although there are quite a few of them, we reviewed only the interventions whose contents had been implemented in e-learning modalities or had been supported by the new information and communication technologies. For this task, we arranged the programs along a continuum that ranged from those that deal with the development of self-regulatory competences by indirect training of such competences to the programs whose impact on such competences is much more direct. Lastly, we provide information about a program that our research team is developing and implementing as a pilot study, and whose preliminary results seem highly satisfactory.

Nuevos soportes para la promoción del aprendizaje autorregulado en educación superior. En este artículo se han revisado algunos de los programas más relevantes de autorregulación del aprendizaje académico en el ámbito de la educación superior. Aunque existe un gran número de ellos, se ha fijado la revisión en aquellas intervenciones en las que los contenidos se han implantado en modalidades e-learning o ayudados por las nuevas tecnologías de la información y la comunicación humana. Para esta tarea, se ordenaron los programas en un continuo que va desde aquellos que trabajan en el desarrollo de competencias autorregulatorias mediante el entrenamiento indirecto de tales competencias, hasta otros cuyo trabajo sobre dichas competencias es mucho más directo. En último lugar se ha informado de un programa que nuestro equipo de investigación está desarrollando, e implementando de manera piloto, y cuyos resultados preliminares parecen ser altamente satisfactorios.

Currently, there is great interest in self-regulation of behavior in general, and of learning in particular, both at the level of construct (i.e., Schunk & Zimmerman, 2008) and of assessment (i.e., Lozano & De la Fuente, in press; Núñez, Solano, González-Pienda, & Rosário, 2006a) and its promotion in formal (i.e., Cardelle-Elawar & Sanz de Acedo, in press; Rosário, Núñez, González-Pienda, Valle, Trigo, & Guimarães, in press) and informal contexts (Rosário, Mourão, Núñez, González-Pienda, & Solano, 2006; Symeou, 2006). Self-regulated learning (hereafter SRL) can be defined as a series of thoughts, feelings, and actions that are self-generated by learners and that systematically orient them towards the achievement of their goals (Zimmerman & Schunk, 1989). Therefore, SRL is an active process in which students establish the goals that guide their learning, attempting to monitor, regulate, and control their cognition, motivation, and behavior with the intention of attaining such goals (Rosário, 2004).

For most students, the new European Higher Education Area is the great opportunity to become *active agents* in the learning process. The teacher plays the role of transmitter of learning and relinquishes the protagonist role to the students, thereby becoming a mediator between the students and knowledge, placing the learner at the center of the learning process. Thus, we hope to travel from the *university of teaching* to the *university of learning*, a radical turn for which students may not be completely prepared, but for which they are qualified. This situation has generated the need to design actions to help and to teach students to actively direct their learning process.

In addition to the above is the strong emergence of *e-learning*, which has become a feasible alternative to the traditional instructional model (Tallent-Runnel et al., 2006). In any case, the studies point out that we cannot yet estimate the potential of on-line learning platforms for displacing the learning model focused on the teacher in favor of a model in which the student is the protagonist (Jonassen, Howland, Moore, & Marra, 2003). The incorporation of computers in the teaching-learning process grants great advantages both to the teacher and the students; it can help students to understand the task in different contexts, thus favoring transfer, obtain help from the teacher in real time, or exchange experiences in the use of strategies, among many other aspects. In fact, computers themselves may be motivating, involving learners in tasks that allow

them to participate actively in their learning (Simpson, Hynd, & Nist, 1997). In particular, technology may promote self-regulation, acting as a tool to represent knowledge, a cognitive scaffolding, a provider of feedback, and a mechanism to facilitate collaborative communication (Schraw, Crippen, & Hartley, 2006).

Consequently, according to the recent literature, a clear tendency to involve the new technologies in the design of intervention programs to promote SRL can be observed (Cerezo, 2009). Due to their novelty and rapid proliferation, updating the reviews of these initiatives is increasingly demanding and necessary. And this is precisely the goal of this work: it is an attempt to provide a succinct review of the interventions that, using the latest technological advances and their implications for learning, aim to promote SRL in the university sphere. The ultimate goal will therefore be to provide information about the latest works on the topic and, if possible, to propose some lines for future research in this field. Our aim is to contribute to the design and improvement of the future intervention programs that are being demanded in our classrooms. Researchers, institutions, and teachers must know how to orchestrate the resources provided by the new technologies for the development of autonomous students and the promotion of their self-regulatory skills in and out of the classroom.

For this purpose, the best solution to the dilemma of classifying the diverse interventions was to establish a continuum along which to place them. Thus, the programs were classified on a continuum going from the most direct ones, focused on training general self-regulatory skills that are valid for any curricular subject, to the actions that fall within a specific subject, favoring, facilitating, and stimulating self-regulation of learning (Figure 1). This is similar to the suggestion of Perkins and Salomon (1989) when they distinguished training general cognitive skills from other skills within a specific discipline or area of knowledge.

In the review, rather than focus on theoretical models and/or empirical results that support these interventions, we investigate and describe the ingredients that favor SRL in the selected self-regulated learning programs.

INTERVENTION PROGRAMS IN SRL

The Learning Management Systems (LMSs)

The LMS are the best exponent of the environments that, accommodating the contents of any discipline, *tacitly favor* self-regulation of learning. The notable increase in their use as a platform of learning contents by universities all over the world and the research generated by this phenomenon reveal the LMSs as the ideal learning environment for students to self-regulate their learning. LMSs such as WebCT and Blackboard (www.blackboard.com), Moodle (http://moodle.org/), Desire2Learn (www.desire2learn.com), Angel (www.angellearning.com), Dokeos (www.dokeos.com), LON-CAPA (www.lon-capa.org), Sakai (http://sakaiproject.org/) or SkillFactory (www.skillfactory.com.mx). They integrate in a single medium pedagogical instruments to create, plan, and distribute contents, follow-up the learning process, tools for collaboration, communication, administration, assessment, and feedback, etc., that require and facilitate higher user involvement and self-management.

These resources compile a great number of *Web-Based Pedagogical* Tools (WBPTs), which act as a perfect scaffolding to achieve strategic learning and acquire metacognitive skills such as planning or establishing goals (Hadwin & Winne, 2001; McLoughlin & Hollingworth, 2001). Likewise, they increase students' engagement in complex tasks, raising their self-awareness and self-observation of their learning process, both central attributes of SRL (McMahon, 2002).

Therefore, we should not neglect the development of the LMSs when designing programs or materials that favor self-regulation of learning, because their WBPTs support and facilitate the promotion of diverse processes of self-regulation (Dabbagh & Kitsantas, 2005; Kitsantas & Dabbagh, 2004). However, to promote SRL within these open environments, the scaffolding must be adaptive (Azevedo, 2005), because otherwise, we will be underutilizing its possibilities (Vovides, Sanchez-Alonso, Mitropoulou, & Nickmans, 2007).

The TELEPEERS Project (Steffens, 2006)

TELEPEERS Project www.lmi.ub.es/telepeers/telepeers.php has helped to gather and assess various European initiatives in the field of Technology-Enhance Learning Environments (TELEs). Taking these results into account, we must review the projects that effectively seem to promote the use of self-regulation strategies.

Digital Portfolio www.icto.vu.nl/bbsupport/docenten/HTML-handleidingDPFEN73/index.html?digital_portfolio_in_blackboard_.htm, is an application that allows students to compile their work and also to monitor and direct their academic progress, identifying their efforts, progress, and achievements. *DiViDU* http://info.dividu.nl/, in general terms, is a repository of videos
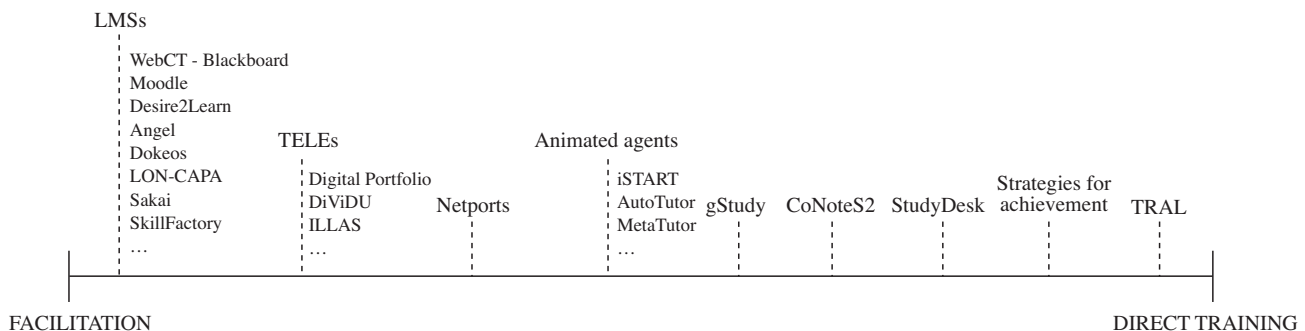

Figure 1. Distribution of the intervention programs as a function of their degree of facilitation/direct training of SRL

about real professional practices to enable future teachers to help their students to reflect on their professional skills. And lastly, ILIAS http://www.ilias.de/docu/, is an environment of learning management for university students, and also a tool to design learning materials and contents for teachers.

Networked Portfolio System (Liu, Lin, & Yuan, 2001)

The Networked Portfolio System (NetPorts) is another resource that, through the feedback that the learners receive about their work, assembled in portfolios, favors the process of self-regulation of learning in terms of self-efficacy (Wang & Wu, 2008).

The students collect samples of their work in a portfolio that will subsequently be assessed on-line by themselves, a classmate, or the teacher (Liu et al., 2001). When students send in their work, the system automatically resends it anonymously to a classmate, who reviews it and returns it to the system. When the correction is available, the system informs the author of the work that there is anonymous feedback available on-line, and the student is urged to re-elaborate the task based on the proposal received. The system allows the teacher to manage the students' progress, as well as the task characteristics and the feedback process. NetPorts also has a panel on which to hang messages, questions, answers, and to discuss aspects related to the subject, a chat room and a tool to design activities or present HTML materials, through which NetPort users become a cooperative learning community and at the same time, it makes them plan, monitor, order, and store contents (Wang & Lin, 2007).

The Animated Agents Projects

Another notable group of interventions are those that, while supporting any learning content, add animated agents to their design in order to guide the students in their process of self-regulation of learning. There are various intervention programs that use pedagogic agents as guides for optimum development in *e-learning* environments, as well as stimulators of the students' processes of self-regulation of learning, with excellent results.

The so-called animated agents, conversational agents, avatars, or simply *talking* heads, are a vanguard concept that is present in some of the most recent sophisticated tools aimed at helping and teaching students to learn. Notable are, *iSTART* (McNamara, Levenstein, & Boonthum, 2004), AutoTutor (Graesser, Jackson, Mitchell, Ventura, & Olney, 2004), *Critical Thinking Tutor* and *SEEK Tutor* (Jeon et al., 2005), *MetaTutor* (Azevedo, Witherspoon, Chauncey, Burkett, & Fike, 2009; Azevedo, Witherspoon, Graesser et al., 2009), *iDRIVE* (Craig, Sullins, Witherspoon, & Gholson, 2006), etc. Let us see some of them in detail.

iSTART http://csep.psyc.memphis.edu/istart/ (McNamara et al., 2004) designed to train university and secondary students in strategies of meta-comprehension and elaboration of self-explanations to reach deeper levels of comprehension and to elaborate written information, going back to self-regulation of reading behavior. iSTART is an web-based tool that uses animated agents to discuss, model, and provide feedback about strategies of reading comprehension (McNamara et al., 2004) revealed as a facilitator of comprehension and metacognitive strategies (Graesser, McNamara, & VanLehn, 2005). These agents teach students to self-explain their reading process, training them in five strategies that contribute to the process of self-regulation: monitoring comprehension, paraphrasing, inferring, predicting, and elaborating the material.

AutoTutor http://www.autotutor.org/ (Graesser et al., 2004) intends to contribute to the development of the ideal student, the active and self-regulated learner who asks good questions and gives even better answers, assesses them, and constructs explanations that can be applied to future learning challenges (Graesser et al., 2005). For this purpose, it simulates *tutor-student* dialogue by means of a conversation in natural language between the *pedagogic agent* and *the student*, which trains students to construct good answers to profound questions, and to use metacognitive strategies to achieve deep reasoning, and promotes learning by inquiry, a subtype of self-regulated learning (Graesser et al., 2005).

The animated agent (Figure 2) can carry on a fluid dialogue, display facial expressions, make gestures, and point, and it is even sensitive to the emotions of its interlocutor. In the latest version of AutoTutor, the agents can interact with students by recognizing their facial expressions, the parameters of their discourse, body posture, or the history of their previous dialogue (D`Mello, Picard, & Graesser, 2007), that is, a system that is sensitive to learners'
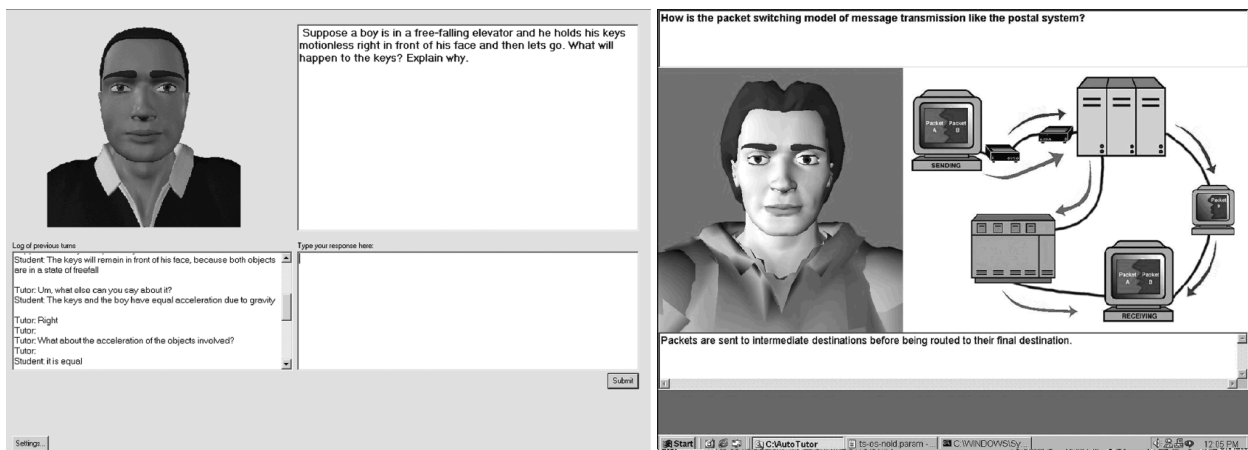

Figure 2. Aspect of AutoTutor with physics and computer science contents (Graesser et al., 2004)

emotions and cognition. These virtual agents perform the function of a tutor, carrying out a task of continued and personalized scaffolding in the construction of knowledge, with satisfactory results (Graesser et al., 2004; Graesser, Jeon, & Dufty, 2008). The students give their responses either by writing them on the keyboard or by means of a voice-recognition device.

MetaTutor (Azevedo, Witherspoon, Siler et al., 2009). Azevedo and his team have developed this training in SRL as a facilitator to learn particularly complex topics in hypermedia environments.

There are certain disciplines or contents, which Azevedo calls *Complex Topics*, that, due to their complexity, require a higher effort by the student. These difficulties are particularly notable in novel learners, who in their reference population, are students from the first university courses (Azevedo, 2005). Various investigations have confirmed that students have added difficulties self-regulating their learning when they address these contents by means of hypermedia environments (Azevedo & Cromley, 2004; Azevedo, Cromley, & Seibert, 2004; Green & Land, 2000), and they verified that a brief SRL training can facilitate comprehension of the complex material within these frameworks (Azevedo & Cromley, 2004). Within this context, MetaTutor promotes SRL, detecting, modeling, registering, and interacting with students (Azevedo, Witherspoon, Graesser et al., 2009; Azevedo, Witherspoon, Siler et al., 2009), through stimulation of students' cognitive, metacognitive, motivational, social, and affective regulation, thus successfully coping with their learning (Azevedo, Witherspoon, Graesser et al., 2009).

This tool, fruit of the fusion between cognitive psychology, educational psychology, and artificial intelligence, is designed to facilitate learning about the different systems of the human body (circulatory, nervous, respiratory, etc.) but it could be adapted to the contents of any other type of knowledge, such as geography, algebra, or statistics (Biemans & Simons, 1997; Kao & Lehman, 1997). The animated agent helps students during their learning process, urging them to plan, monitor, and implement self-regulation strategies, or assess their mastery of the contents, and the students can select the SRL process they wish to train with a single click. The interface of the tool includes a space reserved for goals and subgoals, topics and subtopics, contents presented statically and dynamically, a variety of animated agents, etc. (Azevedo, Witherspoon, Chauncey et al., 2009).

Adaptive scaffolding is the key to optimizing the learning process in hypermedia environments (Azevedo et al., 2005; Azevedo et al., 2004). This provides students with pre-established learning sub-goals, in addition to assisting them in the activation of prior knowledge and planning their learning, monitoring their comprehension and progress, implementing strategies (formulating hypotheses, contrasting different sources of information, inferring, using mnemonic rules, summarizing the information), and coping with the difficulties and demands of the task. Virtual agents are in charge of this scaffolding, they presumably help learners to score higher in declarative knowledge of SRL and to be capable of maintaining this status (Azevedo, Witherspoon, Graesser et al., 2009).
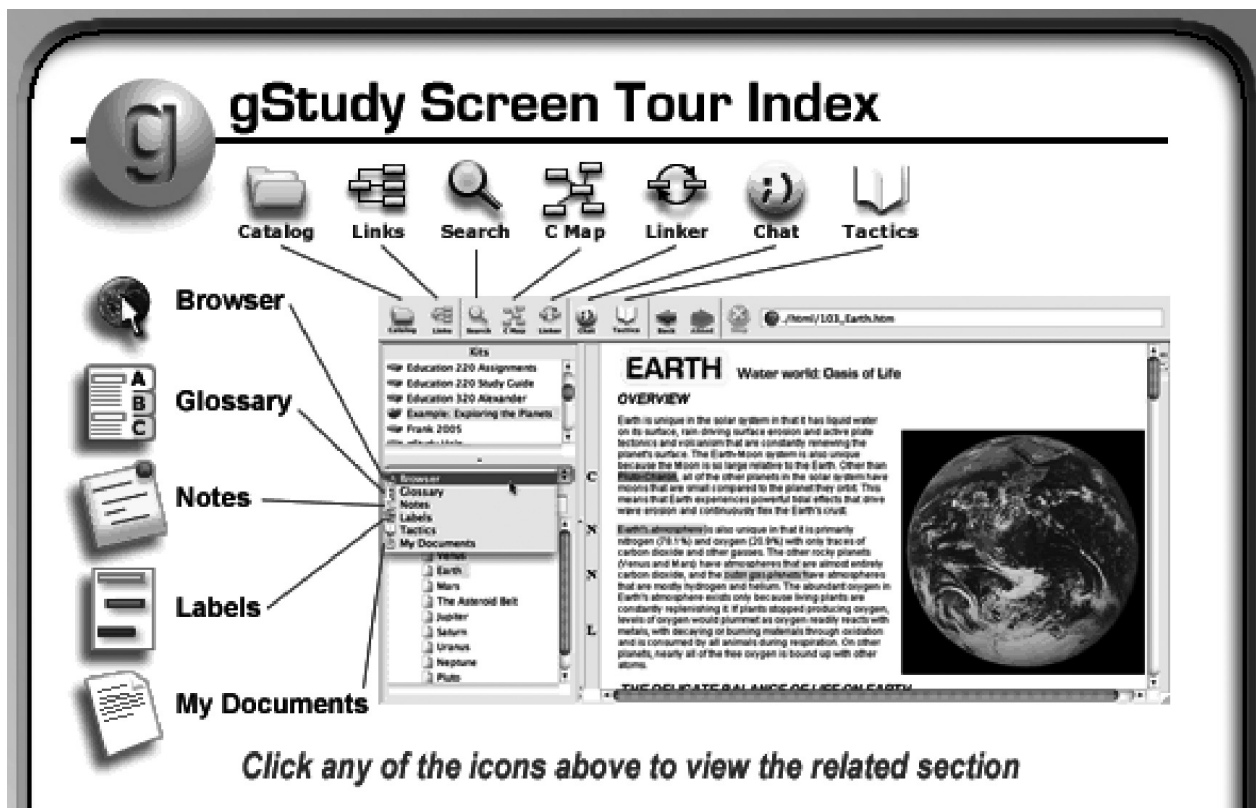

Figure 3. Screen dump of gStudy (taken from http://www.learningkit.sfu.ca/)

The Learning Kit Project (Winne, Hadwin, Nesbit, Kumar, & Beaudoin, 2005)

gStudy *http://www.learningkit.sfu.ca/* is a tool developed by Winne and colleagues within *The Learning Kit Project*, which aims to help learners become self-sufficient through *gStudy software* (Winne, 2006).

Its authors designed a collection of digital materials *(learning kit) and a software (gStudy)* that promote learners' engagement with the information in a multimedia format in order to learn, apply, and transfer the information to new contexts. The kits include texts, diagrams, geographical maps, images, charts, tables, audio and video clips, Java Applets, etc. They also aim to favor the development of SRL efficiently by means of a web search, the elaboration of works, when reviewing, etc. (Steffens, 2006).

gStudy serves as a platform for diverse materials (Figure 3). Its implementation helps students to engage cognitively in the learning materials and to deal with the contents strategically by elaborating classifications, indexes, notes, organizing the information, assessing, searching for contents, using conceptual maps, etc.

Winne and his team aim to promote learners' study and knowledge of their own learning process, just as an investigator would explore it as a scientist (Winne, 2006). From this viewpoint, the usefulness of gStudy to help these learners to analyze their self-regulation processes is ratified (Winne, 1992).

CoNoteS2 (Winne, Hadwin, McNamara, Chu, & Field, 1998)

CoNoteS2 is a sort of "*electronic notebook*" designed to structure the process of self-regulation when studying. This software provides the medium to facilitate students' monitoring and engagement in the diverse phases of the process of self-regulation of learning. CoNoteS2 is designed to manage learning texts, providing students with *pop-up* menus, organizers, and classifiers of the material, tools for text processing, building glossaries, taking notes, etc. (Figure 4) that promotes self-regulation both explicitly and implicitly (Hadwin & Winne, 2001).

Study Desk (Narciss, Proske, & Koerndle, 2007)

The program *Study Desk* proposes a work and study environment designed to complement instruction in diverse

learning contexts (Narciss et al., 2007). This application allows students, not only to prepare their classes, but also to elaborate the knowledge in the self-regulated sense and to promote SRL in a hypermedia environment such as the one used for its diffusion.

This software offers such varied materials, for instance, texts, slides, experiments, practical exercises, references, www-links, etc., but it promotes SRL by means of the following instructional elements (Narciss et al., 2007):

Orientation and support to surf the virtual environment (Figure 5): information that facilitates students' planning and monitoring their learning process. The interface of *Study Desk* facilitates students' development in this specific learning environment by means of elements such as hierarchical tables of contents, information presented by main and secondary contents, or labeled keys in the lower part connecting to expanded information (references, links to relevant websites, tasks, and exercises).

Tools to activate and elaborate learning: they allow students to reframe sections, underline material, store it, and manage it in an individual file, etc. For this purpose, there are specific tools such as the *Marking Tool, Note-taking Tool, Integrator Tool or The Glossary*.

Tools to monitor and assess learning (Figure 6): the software facilitates students' exhaustive reports of their progress and
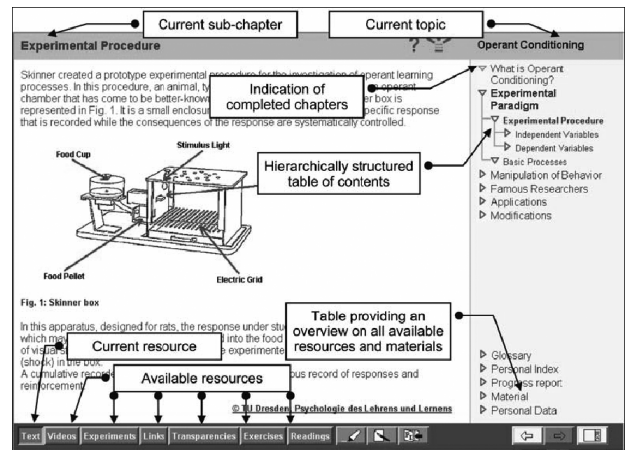

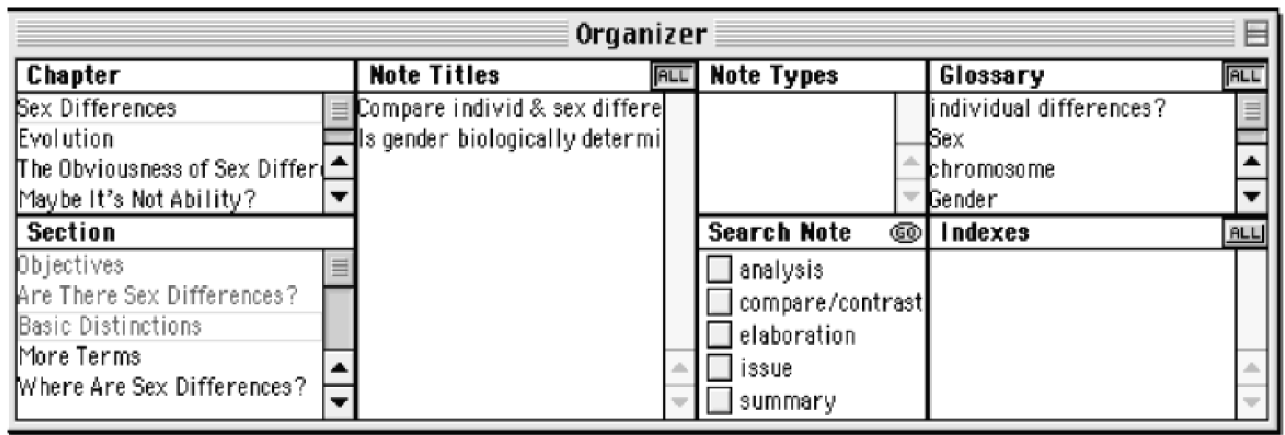*Figure 5. . Interface of Study Desk (Narciss et al., 2007)*

Figure 4. Sample of the CoNoteS2 organizer interface, showing the available notes and glossaries (Hadwin & Winne, 2001)
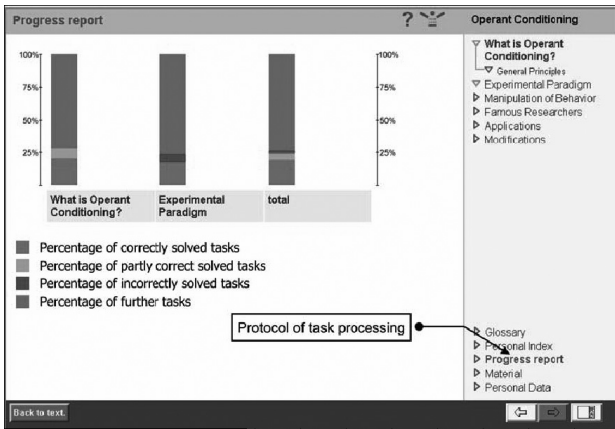
Figure 6. Example of a progress report from Study Desk (Narciss et al., 2007)
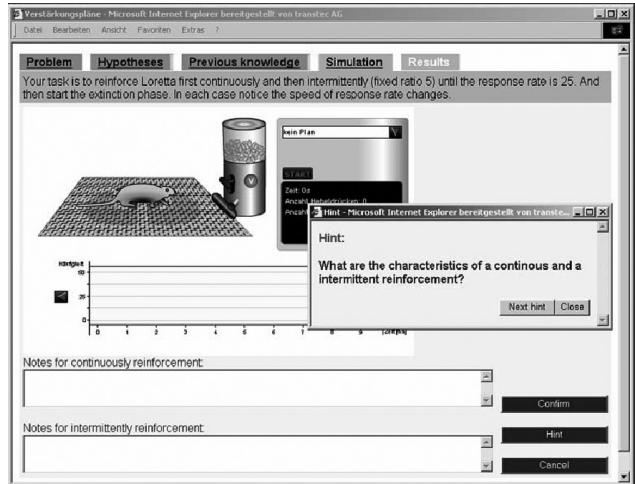

Figure 7. Example of a task with activated ITF (Narciss et al., 2007)

performance on the topics they have worked on, the tasks carried out, pending material, etc. in addition to a broad array of tasks of varying complexity so that students can assess their activity within the application itself.

Informative feedback (Figure 7): the platform does not offer just any feedback to the students, it provides Informative Tutoring Feedback (*ITF*; Narciss, 2004) that provides strategic and particularly useful information to achieve the learning goal.

Lastly, we note that the programs *CoNoteS2* and *StudyDesk*

train explicitly, but not exclusively, self-regulation strategies, at the same time serving as a medium for curricular contents of diverse subjects.

Strategies for Achievement (Tuckman, 2003)

The program *Strategies-for-achievement "Individual learning and motivation: strategies for success in college"* (Tuckman, 2003) combines new technologies with classic procedures. It is
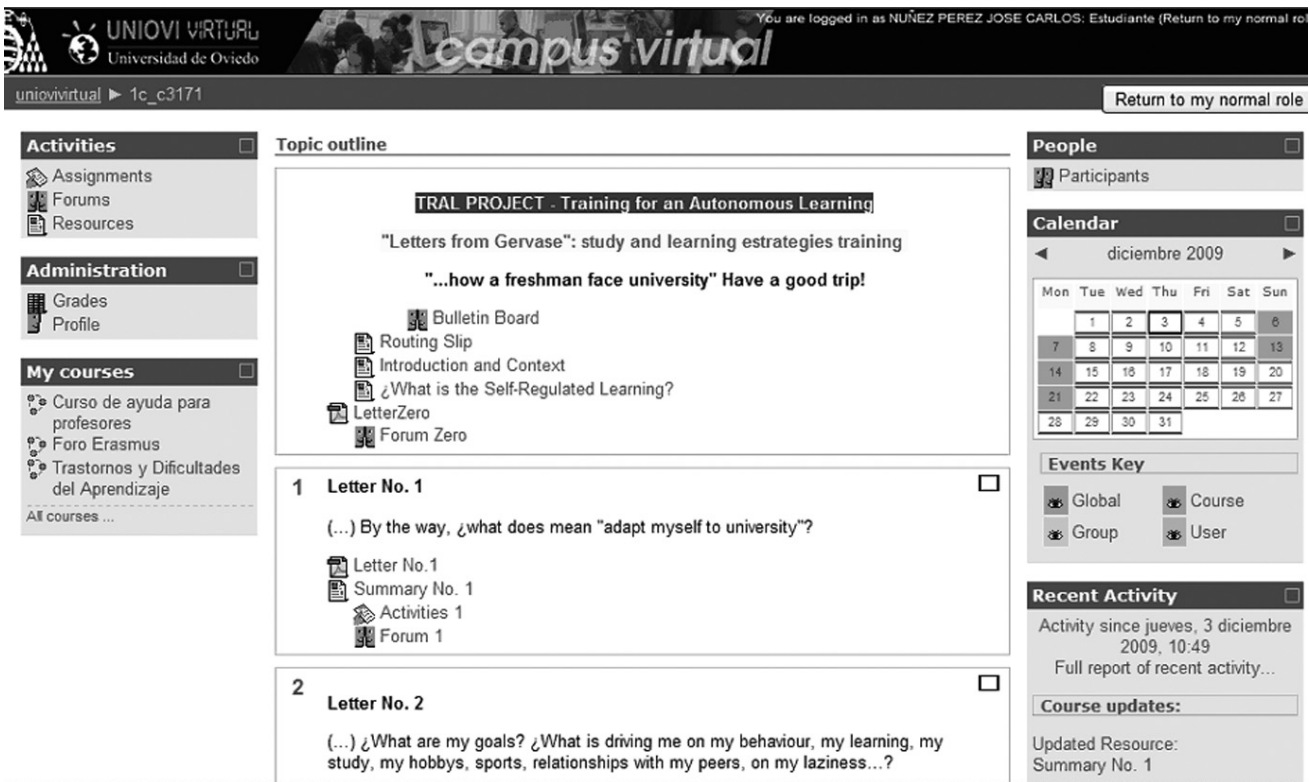

Figure 8. : Project TRAL in Moodle format

conceptualized as a course to "learn how to learn" based on the teaching of strategies (Tuckman, 2002, 2003) from a theoretical framework that emphasizes strategic and self-regulated learning. Its goal is to teach learning and motivational strategies to students to improve their subsequent performance, an aspect that has been corroborated (Tuckman, 2002, 2003; Tuckman, Abry, & Smith, 2002).

The most characteristics trait of this program is its innovative design. It is applied in a class with computers using the web-based hybrid instructional model *ADAPT "Active Discovery and Participation through Technology* (Tuckman, 2003). This procedure combines the main traits of traditional instruction (compulsory attendance, presence of the instructor, textbook) with the characteristics of e-learning. To carry out the course, the students use the text *Learning and Motivation Strategies: Your Guide to Success* (Tuckman et al., 2002) and a computer program that includes learning activities whose goal is to provide an optimal sequence to

master the learning, the necessary practice to change behavior, and opportunities to transfer the strategies to other contexts.

Training for an Autonomous Learning «TRAL» (Cerezo, Núñez, González-Pienda et al., 2009)

The *TRAL Project* is an experimental adaptation of the program "Letters from Gervasio" (Rosário, Núñez, & González-Pienda, 2006) to the virtual environment Moodle (Figure 8). Moodle, which we have mentioned in this work, is an LMS that allows the integration of a broad range of educational resources as a function of the goal of learning. To this advantage is added that of an interface that allows surfing through its contents intuitively (Brandl, 2005). Therefore, this intervention combines the facilitating capacity of a medium like Moodle with direct training of an effective program to promote SRL (Rosário et al., 2007; Solano, 2006).

Table 1
Contents and strategies trained within the framework of Project TRAL.

LETTER	CONTENTS	TRAINED STRATEGIES	
		MACRO-STRATEGIES	MICRO-STRATEGIES
Zero	(…) "if you read these letters carefully, you will understand my experience as a novice in the university and share my experience" Have a good trip	Understanding the learning process	The student's role in the learning process
nr. 1	(…)By the way, what does adapting well to the university mean?	Adapting to the University	Organization and time management
nr. 2	(…) What are my goals? What really guides me in my behavior, my studies, in the University, in my hobbies, in sports, in my relations with others, in my laziness…?	Establishing goals	Goal characteristics (CREVA) Long-term and short-term goals Goals oriented towards learning and oriented towards results
nr. 3	(…)How can I take better notes?	Organizing information	Summaries, outlines, idea maps... Taking notes Cornell technique Controlling distracters
nr. 4	(…)Do you know how to overcome putting off tasks?	Putting off tasks	Time management TTD (Things to do) Lists Structuring the environment "Procrastination" of tasks Relaxation techniques
nr. 5	(…)Why do we forget things?	Information processing	Short-term memory Long-term memory Forgetting Instrumentality of learning
nr. 6	(…)Who controls your learning? Do you know how to distinguish academically successful students?	Self-regulation of learning	Cyclical model of self-regulated learning (Planning, Performance, Assessment) Establishing goals Monitoring Volition
nr. 7, 8 and 9	(…)Which of these statements is true? (…)How are problems solved? (…)I am counting on you to solve it, O.K.?	Problem solving	Steps in the process of problem solving Exercises in logic
nr. 10	(...)How do you manage to get this subject so well organized? How do you manage to prepare the exam so intensely?	Preparing exams	Time management establishing goals organization of information Reviewing/going over the subject Inquiry Doing previous exams
nr. 11	(…)The way you study should be different depending on the type of exam?	Coping with exams	Types of questions (exams with short answers, tests, or long answers to be elaborated) Controlling distracters Reviewing the responses Working in groups
nr. 12	(…) Lastly, what is test anxiety?	Test anxiety	Dimensions of anxiety (Worry and Emotionality) Internal and external distracters Plagiarizing and copying Relaxation techniques
nr. 13	(…)How are your studies going?	Reflecting on the learning process	Assessment of the experience

The essential goal is to promote the autonomy of university students by means of the development of competences of self-regulation, both instrumental and interpersonal. The intervention is done by means of "Letters from Gervasio" (Rosário, Núñez et al., 2006), a collection of stories, narrated in a pleasant and relaxed way, that guides learners through the diverse phases that make up the process of self-regulation. The stories are written by a fictitious first-grade university student; their easy tone facilitates the experiential proximity of the protagonist of the texts and the students, who can then experience vicarious learning through these stories and inductively learn a self-regulated model to deal with their learning experiences.

Planning, performing, and assessing are the three key elements of the material and, in each letter, a series of learning strategies about each one of them is developed. Each topic is completed with a series of activities so that students will internalize and practice autonomously each one of the strategies modeled by the texts. These activities require students to have declarative, procedural, and conditional knowledge of each strategy dealt with. Training is structured in thirteen content topics, each one dedicated to one or various strategies of self-regulation of learning (Table 1).

As can be seen by the distribution of the material, the program was designed to allow selection of the learning strategies to work on depending on the students' demands. Their plastic nature aims to conform to the two principles of the process of self-regulation of learning: selection and control. The students have the letters in PDF documents for each topic of the texts, their corresponding summaries and activities—which, when carried out will "float up" into virtual space so that the teacher can correct them and provide the corresponding feedback—, a forum for each topic—a basic tool for communication among teachers and students of the course—and a glossary with the definition of all the new concepts or the concepts that are particularly relevant to comprehend the information (Cerezo, Núñez, González-Pienda et al., 2009; Cerezo, Núñez, Rosário et al., 2009).

As a result of the use of the Moodle environment, there is a large amount of qualitative information, about the tasks and the interventions in the discussion forums, which indicate that the students—the true protagonists of the project—are highly satisfied with the program. Thus, with regard to the narrating style, in general, the students consider that "...*Gervasio's letters are easy to read and fun*", "...*as the tasks advanced, I became more and more hooked*", perhaps because of the experiential proximity aimed at in the stories: "...*I saw myself reflected in a lot of Gervasio's letters*", "...*starting with the first letter, I considered Gervasio and his letters more like a novel than a learning project*" and "...*after finishing the last letter, I felt like when they announce the last chapter of our favorite TV series.*"

But the important thing is that, according to their testimonies, the stories "...*provided suggestions about how to study, organize their work, etc. But especially, they made us reflect on how we do things, and how we should do them*", "...*they help us to self-analyze our way of working, (...) because there are some things we think we do well, (...) but there are thousands of ways to do them better.*" "...*was a very interesting experience and completely different from anything done till now. To perform an introspective review of the study of each one is very useful*" because "...*we all have our strong points and weak points in studying; but we don't always know them and if we do know them, we try not to think about them very much.*"

It is interesting to reflect that the great majority of the students lamented "...*why didn't we do this before?*", because

"...*they never taught me such specific study techniques before, it was always general things like plan your work, keep your work up-to-date.*" They also demanded this type of training in earlier educational stages, "...*perhaps this kind of programs is very useful for the students from high school who think that if they study three days before an exam, it will be enough to get a score of 9, and that they don't have to attend class at the university because they will always get the notes from former years,*" although they also acknowledge that "...*these tasks are appropriate for any age; even at the University. It is essential to know: first, how you study, and how you perform the activities and second, the alternatives to change your method and improve it.*"

Lastly, they valued it globally as "...*a good idea for students, fun and didactic at the same time*" and ultimately, some of them even admitted that "...*in the end, I will miss Gervasio.*"

FINAL COMMENTS

The contemporary university, if it hopes to face the future with some guarantees of success, should begin by truly assuming a new approach of teaching-learning, focused on learning and characterized by incorporating a series of assumptions, goals, strategies, and resources aimed at achieving meaningful learning of the curricular contents and at learning how to learn, facilitating students' autonomous activity. For this purpose, it is necessary to conceive of teaching and learning as strategic activities that demand implementing mechanisms of cognitive-motivational-affective self-regulation and to consider the autonomy of students' learning as the ultimate end of university teaching in order to promote cultured people, citizens, professionals, and investigators. To promote autonomous learners, with the capability to plan, manage, and assess their behavior, seems an unquestionable goal in this university of the future. And, consequently, one of the challenges that university teachers face consists of adapting their teaching strategies to the new model that characterizes university education.

In this article, some of most relevant programs of self-regulation of academic learning in the sphere of higher education were reviewed. Although there are a large number of them, we decided to review the programs whose contents had been implemented in e-learning modalities or had been supported by the new information and communication technologies. For this task, we arranged the programs along a continuum that ranges from those that work on the development of self-regulatory competence by means of indirect training of such competences to those whose impact on such competences is much more direct. Lastly, we provide information about a program that our research team is developing and implementing as a pilot study, and whose preliminary results seem highly satisfactory.

Specifically, with regard to the Moodle platform used as the medium of the contents of the program, the students classified it as a "*comfortable and very practical method, as well as fun*". They even considered that "*the fact that they were on the virtual campus facilitates the tasks*" and it allows them "*to perform them more independently, because they are available (...) at any time of the day*". They not only value the flexibility of programs available on Internet, they find also the initiative of the discussion forums particularly useful. Regarding this aspect, one student said the following:

"I thought that writing in the forum was stupid, but in the end, it's what I like the best. I learned a lot by reading my classmates' answers; you realize so many other things...," "it has motivated me a lot," *"sharing experiences with others is a fantastic way of learning."*

Lastly, the success of any of these programs is conditioned by their perceived utility by the students. They will use all these trained competences if they observe that their use allows them to learn more and better, be more efficient in task and time management, and, particularly, if the result obtained in academic performance is favorable compared to any other work method. And, to a great extent, this will depend both on the personal conditions (motivational, individual, and group profile, perceived self-efficacy, critical thinking, etc., i.e., Núñez et al., in press; Phan, 2010; Valle et al., 2008, 2009a, 2009b, in press), and on the contextual conditions (processes of teaching-learning, family involvement, etc., i.e., Rosário, Mourão et al., 2006; Rosário, Mourão, Baldaque et al., 2009).

Although these personal and contextual variables have been abundantly investigated and written about (i.e., Boekaerts & Corno, 2005; Brophy, 2004; De la Fuente, Pichardo, Justicia, & Barbén, 2008; Elliot, 2008; Elliot & Dweck, 2007; Midgley, 2002; Moskowitz & Grant, 2009; Núñez, Solano, González-Pienda & Rosário, 2006b; Riggs & Gholar, 2009; Schunk & Zimmerman, 2008; Zimmerman, 2008), it is possible that the great challenge we face is, primarily, to create and test instructional models that support and promote self-regulated learning at school (Cardelle-Elawar & Sanz de Acedo, in press; Perry, Hutchinson & Thauberger, 2008; Rosário, Núñez, González-Pienda, Valle et al., in press) and, complementarily, to design processes and structures of family involvement that favor the development of progressively autonomous work habits (González-Pienda et al., 2002; Rosário, et al., 2005; Rosário, Mourão et al., 2006; Symeou, 2006).

References

Azevedo, R. (2005). Using Hypermedia as a metacognitive tool for enhancing student learning? The role of self-regulated learning. *Educational Psychologist, 40*(4), 199-209.

Azevedo, R., & Cromley, J.G. (2004). Does training on self-regulated learning facilitate students learning with hypermedia? *Journal of Educational Psychology, 96*, 523-535.

Azevedo, R., Cromley, J., Fielding, I., Winters, F.I., Moos, D.C., & Greene, J.A. (2005). Adaptive human scaffolding facilitates adolescents' self-regulated learning with hypermedia. *Instructional Science, 33*, 381-412.

Azevedo, R., Cromley, J.G., & Seibert, D. (2004). Does adaptive scaffolding facilitate students' ability to regulate their learning with hypermedia? *Contemporary Educational Psychology, 29*, 344-370.

Azevedo, R., Witherspoon, A., Chauncey, A., Burkett, C., & Fike, A. (2009). *MetaTutor: A metacognitive tool for enhancing self-regulated learning*. Paper presented at the AAAI Fall Symposium Series.

Azevedo, R., Witherspoon, A., Graesser, A.C., McNamara, D.S., Chauncey, A., Siler, E., et al. (2009). MetaTutor: Analyzing self-regulated learning in a tutoring system for biology. In V. Dimitrova, B. Mizoguchi, B. du Boulay & A.C. Graesser (Eds.): *Artificial intelligence in education; Building learning systems that care; From knowledge representation to affective modeling* (pp. 635-637). Amsterdam, The Netherlands: IOS Press.

Azevedo, R., Witherspoon, A., Siler, E., Cox, M., Chauncey, A., Graesser, A.C., et al. (2009). *The effectiveness of MetaTutor in training college students to deploy key self-regulatory processes during learning with Meta-Tutor*. Paper presented at the 13th Biennial Conference EARLI 2009.

Biemans, H., & Simons, P. (1997). *Computer-assisted instruction and conceptual change*. Paper presented at the annual meeting of the American Educational Research Association.

Boekaerts, M., & Corno, L. (2005). Self-regulation in the classroom: A perspective on assessment and intervention. *Applied Psychology: An International Review, 54*, 199-231.

Brandl, K. (2005). Are you ready to "Moodle"? *Language Learning & Technology, 9*(2), 16-23.

Brophy, J. (2004). *Motivating students to learn*. Mahwah, NJ: Erlbaum.

Cardelle-Elawar, M., & Sanz de Acevedo, M.L. (in press). Looking at teacher identity self-regulation. *Psicothema*.

Cerezo, R. (2009). *Autorregulación del aprendizaje en el ámbito universitario: ¿por qué esto y por qué ahora?* Licentiate thesis. University of Oviedo.

Cerezo, R., Núñez, J.C., González-Pienda, J., Rosário, P., Álvarez, L., González-Castro, P., et al. (2009). Entrenamiento de los procesos de autorregulación del aprendizaje en soporte Moodle. *Internacional Journal of Developmental and Educational Psychology, 4*, 317-324.

Cerezo, R., Núñez, J.C., Rosário, P., González-Pienda, J., Alvarez, D., González-Castro, P., et al. (2009). *Adaptación de un programa de promoción*

de estrategias de autorregulación del aprendizaje a las TIC´s. Paper presented at the VII Jornadas de Redes de Investigación en Docencia Universitaria, Alicante (Spain).

Craig, S., Sullins, J., Witherspoon, A., & Gholson, B. (2006). Deep-level reasoning questions effect: The role of dialog and deep-level reasoning questions during vicarious learning. *Cognition and Instruction, 24*(4), 565-591.

De la Fuente, J., Pichardo, M.C., Justicia, F., & Barbén, A. (2008). Learning approaches, self-regulation and achievement in three European universities. *Psicothema, 20*, 705-711.

Dabbagh, N., & Kitsantas, A. (2005). Using web-based pedagogical tools as scaffolds for self-regulated learning. *Instructional Science, 33*, 513-540.

D'Mello, S., Picard, R., & Graesser, A.C. (2007). Toward an affect-sensitive AutoTutor. *IEEE Intelligent Systems, 22*(4), 53-61.

Elliot, A.J. (2008). *Handbook of approach and avoidance motivation*. Mahwah, NJ: Erlbaum.

Elliot, A.J., & Dweck, C.S. (2007). *Handbook of competence and motivation*. New York: The Guilford Press.

González-Pienda, J.A., Núñez, J.C., Alavarez, L., González-Pumariega, S., Roces, C., González, P., Muñiz, R., & Bernardo, A. (2002). Parental Inducement of self-regulation, self-concept, and academic achievement. *Psicothema, 14*, 853-860.

Graesser, Lu, S., Jackson, G.T., Mitchell, H., Ventura, M., & Olney, A. (2004). AutoTutor: A tutor with dialogue in natural language. *Behavioral Research Methods, Instruments and Computers, 36*, 180-192.

Graesser, A.C., Jeon, R., & Dufty, D. (2008). Agent technologies designed to facilitate interactive knowledge construction. *Discourse Processes, 45*, 298-322.

Graesser, McNamara, D.S., & VanLehn, K. (2005). Scaffolding deep comprehension strategies through Point&Query, AutoTutor, and iSTART. *Educational Psychologist, 40*(4), 225-234.

Green, B., & Land, S. (2000). A qualitative analysis of scaffolding use in a resource-based learning environment involving the World Wide Web. *Journal of Educational Computing Research, 23*(2), 151-179.

Hadwin, A.F., & Winne, P.H. (2001). CoNoteS2: A software tool for promoting self-regulation. *Educational Research & Evaluation, 7*(2-3), 313-334.

Jeon, R., O'Reilly, T., McDaniel, B., Graesser, A.C., Goldman, S., & Wiley, J. (2005). *Scaffolding Critical Thinking on SEEK*. Paper presented at the World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education.

Jonassen, D., Howland, J., Moore, J., & Marra, R. (2003). *Learning to solve problems with technology: A constructivist perspective*. Columbus, OH: Merrill Prentice Hall.

Kao, M., & Lehman, J. (1997). *Scaffolding in a computer-constructi-*

vist environment for teaching statistics to college learners. Paper presented at the annual meeting of the American Educational Research Association.

Kitsantas, A., & Dabbagh, N. (2004). Promoting self-regulation in distributed learning environments with web-based pedagogical tools: An exploratory study. *Journal on Excellence in College Teaching, 15*(1-2), 119-142.

Liu, E., Lin, S., & Yuan, S. (2001). Design of a networked portfolio system. *British Journal of Educational Technology, 32*(4), 492-494.

Lozano, A., & De la Fuente (in press). Assessing self-regulated learning in early childhood education: Difficulties, needs, and prospects for the future. *Psicothema*.

McLoughlin, C., & Hollingworth, R. (2001, 9-12 December). *The weakest link: Is web-based learning capable of supporting problem-solving and metacognition?* Paper presented at the ASCILITE 2001, Melbourne (Australia).

McMahon, M. (2002, 7-10 July). *Designing an on-line environment to scaffold cognitive self-regulation*. Paper presented at the 25th HERDSA Annual Conference, Perth (Western Australia).

McNamara, D.S., Levenstein, I.B., & Boonthum, C. (2004). iSTART: Interactive strategy trainer for active reading and thinking. *Behavioral Research Methods, Instruments and Computers, 36*, 222-233.

Midgley, C. (2002). *Goals, goal structures, and patterns of adaptive learning*. Mahwah, N J: Erlbaum.

Moskowitz, G.B., & Grant, H. (2009). *The psychology of goals*. New York: Guilford Press

Narciss, S. (2004). The impact of informative tutoring feedback and self-efficacy on motivation and achievement in concept learning. *Experimental Psychology, 51*, 214-228.

Narciss, S., Proske, A., & Koerndle, H. (2007). Promoting self-regulated learning in web-based learning environments. *Computers in Human Behavior, 23*, 1126-1144.

Núñez, J.C., Solano, P., González-Pienda, J.A., & Rosário, P. (2006a). Self regulation processes measurement through self-report methodology. *Psicothema, 18*, 353-358.

Núñez, J.C., Solano, P., González-Pienda, J.A., & Rosário, P., (2006b). Self-regulated learning as a resource and a goal of education. *Papeles del Psicólogo, 27*, 141-148.

Núñez, J.C., Valle, A., Cabanach, R.G., González-Pienda, J.A., Rodríguez, S., Rodríguez, N., & Rosário, P. (in press). Perfiles motivacionales en estudiantes universitarios. *Revista de Psicología y Educación*.

Perkins, D., & Salomon, G. (1989). Are cognitive skills context-bound? *Educational Research 18*, 16-25.

Perry, N.E., Hutchinson, L., & Thauberger, C. (2008). Talking about teaching self-regulated learning: Scaffolding student teachers' development and use of practices that promote self-regulated learning. *International Journal of Educational Research, 47*, 97-108.

Phan, H.P. (in press). Critical thinking as a self-regulatory process component in teaching and learning: Theoretical overview and implications. *Psicothema*.

Riggs, E.G., & Gholar, C.R. (2009). *Strategies that promote student engagement. Unleashing the desire to learn*. Thousand Oaks, CA: Sage.

Rosário, P. (2004). *Estudar o Estudar: As (Des)venturas do Testas*. Porto, Portugal: Porto Editora.

Rosário, P., Mourão, R., Baldaque, M., Núñez, J.C., González-Pienda, J.A., Cerezo, R., & Valle, A. (2009). Tareas para casa, auto-regulación del aprendizaje y rendimiento en matemáticas. *Revista de Psicodidáctica, 14*(2), 179-192.

Rosário, P., Mourão, R., Núñez, J.C., Pienda, J., Solano, P., & Valle, A. (2007). Evaluating the efficacy of a program to enhance college students' self-regulation learning processes and learning strategies. *Psicothema, 19*(3), 422-427.

Rosário, P., Mourão, R., Núñez, J.C., González-Pienda, J.A., & Solano, P. (2006). School-family: Is a reciprocal and positive relationship possible? *Papeles del Psicólogo, 27*(3), 174-182.

Rosário, P., Mourão, R., Soares, S., Chaleta, E., Grácio, L., Núñez, J.C., & González-Pienda, J. (2005). Trabalho de casa, tarefas escolares, auto-regulação e envolvimento parental. *Psicologia em Estudo, 10*(3), 343-351.

Rosario, P., Núñez, J.C., & González-Pienda, J.A. (2006). *Cartas do Gervásio ao seu umbigo*. Coimbra, Portugal: Almedina.

Rosário, P., Núñez, J.C., González-Pienda, J.A., Valle, A., Trigo, L., & Guimarães, C. (in press). Enhancing self-regulation and approaches to learning in first-year college students: A narrative-based program assessed in the Iberian Peninsula. *European Journal of Psychology of Education*.

Schraw, G., Crippen, K.J., & Hartley, K. (2006). Promoting self-regulation in science education: Metacognition as part of a broader perspective on learning. *Research in Science Education, 36*, 111-139.

Schunk, D.H., & Zimmerman, B.J. (2008). *Motivation and self-regulated learning: Theory, research, and applications*. Mahwah, NJ: Erlbaum.

Simpson, M.L., Hynd, C.R., & Nist, S.L.B., K.I. (1997). College academic assistance programs and practices. *Educational Psychology Review, 9*(1), 39-87.

Solano, P. (2006). *Elaboración y evaluación de un programa de mejora de la competencia en estrategias de autorregulación*. University of Oviedo, Spain.

Steffens, K. (2006). Self-regulated learning in technology-enhanced learning environments: Lessons of a European peer review. *European Journal of Education, 41*(3/4), 353-379.

Symeou, L. (2006). Past and present in the notion of school-family collaboration. *Aula Abierta, 85*, 165-184.

Tallent-Runnel, M.K., Thomas, J.A., Lan, W.Y., Cooper, S., Ahern, T.C., Shaw, S.M., et al. (2006). Teaching courses online: A review of the research. *Review of Educational Research, 76*(1), 93-135.

Tuckman, B.W. (2002). *Academic procrastinators: Their rationalizations and web course performance*. Paper presented at the Annual Meeting of the American Psychological Association.

Tuckman, B.W. (2003). The effect of learning and motivation strategies training on college students' achievement. *Journal of College Student Development, 44*(3), 430-437.

Tuckman, B.W., Abry, A., & Smith, D. (2002). *Learning and motivation strategies: Your guide to success*. Englewood Cliffs, NJ: Prentice-Hall.

Valle, A., Cabanach, R.G., Rodríguez, S., Núñez, J.C., González-Pienda, J.A., & Rosário, P. (2009a). Middle school students' motivational profiles: Analyzing the differences in cognitive strategies, self-regulated strategies and academic achievement. *Revista Mexicana de Psicología, 26*(1), 113-124.

Valle, A., Cabanach, R.G., Rodríguez, S., Núñez, J.C., González-Pienda, J.A., & Rosário, P. (2009b). Academic goals and learning quality in higher education students. *The Spanish Journal of Psychology, 12*(1), 96-105.

Valle, A., Núñez, J.C., Cabanach, R.G., González-Pienda, J.A., Rodríguez, S., Rosário, P., Cerezo, R., & Muñoz-Cadavid, M.A. (2008). Self-regulated profiles and academic achievement. *Psicothema, 20*(4), 724-731.

Valle, A., Núñez, J.C., Rodríguez, S., Cabanach, R.G., González-Pienda, J.A., & Rosário, P. (2010). Motivational profiles and differences in affective, motivational and achievement variables. *Universitas Psychologica, 9,1*, 109-121.

Vovides, Y., Sánchez-Alonso, S., Mitropoulou, V., & Nickmans, G. (2007). The use of e-learning course management systems to support learning strategies and to improve self-regulated learning. *Educational Research Review, 2*, 64-74.

Wang, S., & Lin, S. (2007). The application of social cognitive theory to web-based learning through NetPorts. *British Journal of Educational Technology, 38*(4), 600-612.

Wang, S., & Wu, P. (2008). The role of feedback and self-efficacy on web-based learning: The social cognitive perspective. *Computers & Education, 51*, 1589-1598.

Winne, P.H. (1992). State-of-the-art instructional computing systems that afford instruction and bootstrap research. In M. Jones & P. H. Winne (Eds.): *Adaptive learning environments: Foundations and frontiers* (pp. 349-380). Berlin: Springer-Verlag.

Winne, P.H. (2006). How software technologies can improve research on learning and bolster school reform. *Educational Psychologist, 41*(1), 5-17.

Winne, P.H., Hadwin, A.F., McNamara, D.S., Chu, S.T.L., & Field, D. (1998). CoNoteS2: An electronic notebook with support for self-regulation and learning tactics. Burnaby, British Columbia. Canada: Simon Fraser University.

Winne, P.H., Hadwin, A.F., Nesbit, J.C., Kumar, V., & Beaudoin, L. (2005). gSTUDY: A toolkit for developing computer-supported tutorials and researching learning strategies and instruction (Version 2.0.3). Burnaby, British Columbia. Canada: Simon Fraser University, Faculty of Education.

Zimmerman, B.J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal, 45*, 166-183.

Zimmerman, B.J., & Schunk, D.H. (1989). *Self-regulated learning and academic achievement: Theory, research, and practice*. New York: Springer-Verlag.