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HACIA MEJORES PRÁCTICAS EN EL APRENDIZAJE EN LÍNEA: FOMENTO DE LA AUTORREGULACIÓN DEL ALUMNADO

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Angélica Garzón Umerenkova*

Pedro Organista Díaz**

Abstract

The new needs of the continuous learning society, arising from the use of virtual learning environments before and after COVID-19, are discussed. An updated review of the literature and some of the theories on metacognition and self-regulation was carried out to respond to the new challenges of learners, tutors and designers of online learning. The advantages of fostering self-regulation in online learners and their learning competencies are discussed, and a practical guide for tutors is offered. Evidence indicates that incorporating explicit or implicit training in self-regulation generates better performance and quality of learning in students. Seven guidelines for improving planning are presented, ranging from preliminary assessment of the student's self-regulation skills to fostering metacognition, self-monitoring, and motivation.

Key words: self-regulated learning, virtual learning, metacognition, educational quality, learning to learn.

Resumen

Se plantean las nuevas necesidades de la sociedad del aprendizaje continuo, que surgen a partir del uso de los entornos virtuales de aprendizaje antes y posteriores al COVID-19. Se realizó una revisión actualizada de la literatura y de algunas de las teorías sobre la metacognición y la autorregulación, para dar respuesta a los nuevos retos de los aprendices, tutores y diseñadores del aprendizaje en línea. Se discuten las ventajas que ofrece el fomento de la autorregulación en los aprendices en línea, y sobre sus competencias para aprender, y se ofrece una guía práctica para tutores. La evidencia señala que incorporar un entrenamiento explícito o implícito en autorregulación genera en los estudiantes un mejor rendimiento y calidad del aprendizaje. Se presentan siete pautas para mejorar la planificación, que van desde la evaluación preliminar de la capacidad de autorregulación del estudiante hasta el fomento de la metacognición, el automonitoreo y la motivación.

Palabras clave: aprendizaje autorregulado, aprendizaje virtual, metacognición, calidad de la educación, aprender a aprender.

* Psychologist, Ph.D. , specializing in education and psychometrics. Professor and researcher at the Konrad Lorenz University Foundation, Faculty of Psychology. E-mail: agarzonu@gmail.com , ORCID: https://orcid.org/0000-0002-6813-5521 . Scopus ID: 57193443870.

** Psychologist, Master in virtual learning environments and PhD student in Educational Technology. Professor and researcher at the University of Cartagena. E-mail: pedroorganista@gmail.com , ORCID: https://orcid.org/0000-0002-1280-7165.

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INTRODUCTION

The worldwide proliferation of education through virtual environments is an opportunity to expand access to education, with possible gains in space-time flexibility and in learning processes and experiences for students, making it ever broader and diverse, which in turn leads to the need to generate new pedagogical approaches to meet the different needs of an increasingly heterogeneous student body (Fermín-González, 2019).

Similarly, massive open online courses allow students to develop their learning with little external monitoring from teachers (Wong et al., 2019), or that can be combined with traditional face-to-face teaching. Given its relevance, since the beginning of the century, some authors have affirmed that the central challenge of educational psychology today is to better understand the nature of virtual learning (Bernard et al., 2004).

The COVID-19 pandemic prompted millions of students and teachers around the planet to adapt to a virtual teaching-learning context, giving a new dimension to the challenges of education through virtual education contexts . The global trend, prior to the pandemic, towards the digitalization and datafication of education, seems to have reached another level (Teräs et al., 2020) and is here to stay.

However, despite the exponential increase in online learning, it seems that not all students are successful in this learning modality, a situation that is demonstrated by the high dropout levels, despite the improvements in flexibility and content promoted in the recent years (Coussement et al., 2020).

In this way, this document presents a theoretical review on some relevant topics regarding the improvement of the quality of online learning, particularly, in relation to the implementation of improvements in academic self-regulation in students, its possible effects on metacognition and the skills to learn to learn. Some practical recommendations are also taken into account for the improvement of virtual learning processes, which can be fully or partially incorporated by tutors, educators or designers of online courses.

Online student needs

The antecedents of the literature clearly indicate that, in traditional learning environments, students' academic self-regulation, confidence and self-efficacy predict performance and influence their well-being and quality of life as students (De la Fuente et al., 2021 ; Garzon et al., 2018). On the contrary, procrastination, the lack of skills for time management and planning, not only negatively impact academic performance (Garzón & Gil, 2017), they also generate stress (De la Fuente et al., 2020), psychological vulnerability and health problems in students (Garzón et al., 2018).

Taking into account the antecedents that indicate the importance of self-regulation, confidence, self-efficacy or planning skills in face-to-face mode, in virtual learning environments, it is

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pertinent to ask if these variables have equal or greater predictive capacity on academic performance and health. of the students.

Some of the contextual variables that influence the permanence of students online have been identified, such as difficulties in contacting the tutor or little pedagogical experience, which generates in students the feeling of being alone in their learning process (Yang & Cornellius, 2004). Similarly, the permanence in this learning modality, feedback and messages or emails decrease. A significant part of online training consists of poorly designed courses, with inexperienced instructors (Frankola, 2001), with difficulties not only in the didactic aspects, but also in the cognitive and emotional ones (Lovos & Aballay, 2020).

As learners' personal variables, virtual learning environments require students to have greater autonomy and responsibility in their own education, that is, they require high levels of academic self-regulation (Dabbagh & Kitsantas, 2004). Some students enroll in an excessive number of online courses, indicating a weakness in counseling services, as well as when students do not understand their role as virtual students.

On the contrary, those who mainly benefit from virtual learning environments are those who have greater autonomy, adequately plan their study time and have an adequate level of concentration, self-efficacy and digital literacy (Barbour & Reeves, 2009; Booker & Rebman, 2005). Thus, self-regulation and self-efficacy skills are predictors of academic success in learners in virtual mode (Bernal et al., 2020).

Thanks to the identification of these and other contextual and personal variables related to the success of virtual learning, through previous studies, the reference framework of self-regulated learning has been justified, to understand, modify and successfully train aspects that affect performance. of online learners (Banihashem et al., 2021; Heller, 2020; Stephen & Rockinson-Szapkiw, 2021; Winters et al., 2008).

According to the results of the systematic review carried out by Wong et al. (2019), due to the diversity of students who are linked to massive learning environments, it is important to support students' self-regulated learning strategies. After analyzing 35 published studies on the effect of self-regulation in massive virtual courses, the authors found that there are strategies for self-regulation to effectively help online learning (for example, indicators, notifications, feedback or integrated support systems), despite of the fact that there are individual differences as to what benefits one student more than another.

However, despite the potential benefit of promoting self-regulation in online learners, it has not been fully implemented in practice . Lai & Hwang (2021) analyzed the results of publications made in the decade from 2010 to 2020, with the implementation of self-regulation in online learning and found that in 58% of the studies the previous stages were not taken into

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account. and basic aspects of self-regulation (planning, information search, revision, memorization) and that in 40% of the studies it was not made explicit how the results could have practical implications.

Although there is probably a long way to go, perhaps the starting point is to ask how to promote self-regulatory skills through virtual courses, as a means of increasing both the permanence of students and the quality of virtual learning. From this perspective, the teaching and learning process through virtual environments offers a double challenge; On the one hand, it requires learners to improve their self-regulation and metacognition skills, due to the demands of the nature of this teaching modality previously exposed; on the other hand, it forces designers and pedagogues to incorporate innovative instructional elements from the extensive body of research on self-regulation and metacognition to improve the quality of instruction, offering students options to enhance their ability to learn to learn.

DEVELOPING

The context of the learning society

Cultural changes, communication and information technologies, the change in economic relations around the privilege of knowledge and learning over physical resources as an index of competitive advantage among nations (Porter, 1991) and the development of Learning theories, among many other aspects, have led to what some authors call the continuous learning society (Pozo & Monereo, 1999), a context that has defined new forms of relationship between students, teachers and knowledge, substantially modifying the principles of the educational organization and even its objectives.

In this environment, constructivism tends to be spoken of as the epistemological, conceptual and methodological framework currently most accepted to guide educational processes (Serrano & Pons, 2011), even in virtual environments (Barbera, 2004), which implies that the diverse group of approaches, models and proposals that are in tune with this way of understanding and acting in the learning and teaching processes , have in common, according to Díaz & Hernández (2010), the emphasis on the role of students as teachers. knowing and active subjects in the process of knowledge construction.

Although there is relative agreement on the adequacy of this approach to convey learning and teaching processes, it is not yet clear enough how these postulates satisfy training in virtual environments. It is clear that the objective continues to be the formation of critical thinking, comprehensive training, the joint construction of knowledge and the development of learning strategies, among other aspects, but it is not equally clear how to favor such principles through digital tools, without the conventional spaces and times.

This circumstance generates conflicts for designers and teachers of virtual training pro-

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grams, because control is no longer derived from conduct in a classroom, nor from the transmission of a master speech; On the contrary, there is a greater weight in the expectations, in the beliefs, in the motivations and in the previous conceptions of the students, that is, in the intrinsic motivation (Rodríguez, 2009) and teachers are required to incorporate new teaching practices. through the use of information and communication technologies (Alonso-García et al., 2019). The new ways of understanding learning necessarily lead us to self-regulation as a basic objective of higher education.

Framework on self-regulated learning and metacognition

The concept of self-regulation has its antecedents in the theoretical construct of consciousness, one of the central axes in the history of psychology, since it has guided the definition of approaches from Wundt himself, who is said to have founded psychology as a science in 1879 (Boring, 1999), and for whom consciousness was his object of study. This same path was followed by Vygotsky's historical-cultural psychology, from which it seeks to understand the socio-genetic process, through which individuals at the end of childhood internalize knowledge and build their consciousness through social mediation. (Vygotsky, 1987; 1989).

Piaget, another of the great managers of the current visions of learning, was no stranger to this orientation and postulated the appearance of consciousness as part of cognitive development (Piaget, 1980), linked to the conceptual and the representational, and whose main characteristic is to formalize through reflective action, what in lower stages of development operates as a practical activity (Piaget, 1970), which would result in the elimination of cognitive conflict.

In this way, cognitive and behavioral regulation, planning capacity and reflection capacity, among other aspects of self-regulation, are previous in educational history and theories.

More recently, Flavell (1985) is recognized as the first theorist to define metacognition. Although there is not total agreement, most researchers distinguish between two large components: one of a declarative order, called metaknowledge and divided by Flavell into knowledge of person, task and strategy, and another with a procedural emphasis, called metacognitive strategies and that we can organize in planning, control and evaluation (Brown, 1987).

In addition to the type of knowledge (declarative or procedural), metacognition influences the learning process according to the level of cognitive demand -from automatic processes to processes that require awareness- and the level of explanation or awareness of knowledge: from the implicit to explicit knowledge (Organista, 2005).

Although metacognition has been configured as a robust body of research, based on the explanation of academic learning, current models have involved metaknowledge and metacognitive

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strategies within multidimensional models, the axis being self-regulation, as examined below. .

Self-regulation of learning is defined as the ability of students to actively plan their process from a metacognitive point of view, being aware of their cognitive, motivational and behavioral characteristics (Schunk & Zimmerman, 1989; Zimmerman, 1996).

Following up on the argumentative axis of this document, it is pertinent to continue the analysis of self-regulation as a determining aspect of technology-mediated education. Virtual learning environments require greater metacognitive tools in terms of topics such as autonomy (Henao, 2002), clarity in the definition and monitoring of goals; the choice of programs, means and learning strategies; decision making about work organization, time management, evaluation and knowledge of techniques, strategies and procedures to study and learn (Hernández & Rodríguez, 2002). That is, students require greater skills to analyze their own thinking, to plan, monitor, self-regulate and modify their learning process (Laskey & Hetzel ,2010). Along with this, online learning demands attitudinal and procedural skills to interact and collaborate in group work environments, correctly using available resources and distributing tasks (Sanhueza, 2006).

For massive virtual courses, a series of self-regulatory characteristics that favor learning have been identified, including self-efficacy and regulation of motivation. As regulatory behavioral strategies, help-seeking, time management, and students' regulatory effort are counted (Lee et al., 2019).

In recent decades, different theoretical models have tried to identify the processes involved in self-regulation of learning. Pintrich's (2000) model, based on sociocognitive aspects, offers the broadest, most synthetic and accepted vision. The model contains four phases: planning, self-monitoring, self-control, and evaluation. The four phases are a general pattern, although they do not constitute a linear pattern. Each phase includes, in turn, cognitive, motivational/affective, behavioral and contextual aspects. In the following pages of the text, this model will be taken up again to exemplify the use of online activities to promote self-regulation.

Advantages of online learning for the promotion of self-regulation

The aforementioned research indicates that self-regulation favors learning in virtual environments. This contribution is bidirectional, insofar as virtual learning environments also offer some advantages for the promotion of self-regulation compared to traditional environments, since they offer a series of resources, forms of interaction and potentially beneficial means for the development of self-regulatory competencies. in students, and for pedagogical innovation in general. For example, if we talk specifically about the complex and dynamic relationship between self-regulated learning and m-learning (mobile learning), there is evidence that m-learning pro-

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motes self-regulated learning and that self-regulation favors m-learning (Palalas & Wark, 2020).

Some of these advantages are mentioned below, based on Coll (2008) and *Joint Information Systems Committee* (JISC, 2010; 2007), a body specialized in the development of policies for higher education in the United Kingdom.

Immediacy and ease of feedback. Through virtual learning environments, the results of an activity can be delivered immediately. Various online tools allow students to participate synchronously (for example, via mobile devices or online quizzes), which can facilitate micro-assessment and self-monitoring. Quick feedback facilitates learning and encourages self-regulation (JISC, 2010).

Diversity of interactions. The variety of online communication channels and tools can facilitate interaction and feedback during the learning process. On the other hand, the precision in the use of language (all the more so when the non-verbal gestural, prosodic and body language cues are not available), with the possibility of permanently returning to the observations, which no longer obey only one situation asynchronous, it makes teachers' comments more assertive, in terms of offering clear, precise, objective and operationalized information, indicating the positive aspects and those that need to be improved.

Ecological validity. When the online learning platform uses simulations, virtual reality, augmented reality or holography, these can support the transfer of learning to the real world.

Scaffolding and self-regulated learning. Virtual tutors, online resources or virtual agents created to support learning can serve as scaffolding for learning , a concept introduced by Wood et al. (1976), based on Vygotsky 's postulates .

Scaffolding is a metaphor about the use of "scaffolding" by the teacher or tutor to facilitate the construction of knowledge in the student; As knowledge is built, external support (scaffolding or external regulation) is withdrawn. In an experiment carried out by Song & Kim (2020), it was found that the experimental group subjected to a dialogue with an intelligent virtual agent that served as scaffolding showed a greater increase in self-regulation compared to the control group, which was only given information about what it is self-regulation, but it was not provided with scaffolding.

Fostering self-regulation and metacognition through online learning

Technology-mediated education, despite being a diverse and complex area of research, has focused on three areas of study: design, cognition, and context (Dillon & Jobst , 2005). The design refers to the studies that address the various forms of platform and information structure used in the implementation of virtual learning environments. Cognition studies the psychological variables and the individual differences of the learners and, fina-

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lly, in the context area , learning situations and the impact of the use of virtual media on learning are examined.

Although research on self-regulation of learning and metacognition in virtual environments has been partially covered in some of these exposed areas, or in a combination of them (Azevedo, 2020), there are, as Azevedo & Witherspoon (2009) point out, a series of crucial problems that are the constant object of educational research, such as the way in which the student regulates his learning in a virtual environment through an interaction between the demands of the task, the characteristics of the learner and the cyclical cognitive and metacognitive processes, in the different phases of the self-regulation process.

In the wake of the COVID-19 pandemic, the implementation of strategies to improve online learning has accelerated. In an exploratory investigation carried out by Infante et al. (2021) The use of digital applications in university teaching to promote self-regulation of online learning was investigated. The authors identified 27 apps used by teachers that were relevant to facilitating self-regulation of learning. However, it should be noted that most of these applications were not designed to promote self-regulation, being effective only due to the active participation of the teacher, the way in which they were incorporated into the programmed academic activities and their didactic proposal (Infante et al. ., 2021).

In that order of ideas, tools that have not been originally created to promote self-regulation can fulfill this purpose as long as the teacher incorporates them into their pedagogical activity.

Following the classification proposed by Winters et al. (2008), the supports or conditions offered by virtual environments and that facilitate the improvement of the quality of students' self-regulation can be divided into three general categories: a) tools within the virtual environment that allow students to manipulate resources and ideas such as taking notes, highlighting text, creation and communication tools; b) conceptual supports inside or outside the virtual environment that guide the student to understand content, static or adaptive scaffolding for conceptual understanding, and c) metacognitive supports that guide the student in ways of thinking and reflecting on their task, for example , in training in signs or warnings for self-monitoring and reflection.

Based on this classification, and with the intention of providing greater clarity, Table 1 selects some concrete representative examples of successful experiences that have been investigated in learning through virtual environments, to increase or create academic self-regulation competence.

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Table 1.

Some uses of virtual tools to improve self-regulation and metacognition.

Category	Results of its application in virtual learning environments
Support tools: Virtual elements that allow students to manipulate resources and ideas.	- Collaborative and communication tools improve goal setting, planning, time management and help seeking. Administrative tools help with self-monitoring, self-assessment, planning, and time management (Dabbagh & Kitsantas , 2008). - The administrative-collaborative tools that can be used by teachers so that students have dates, activities and notes available, also serve as reminders or to organize information, favoring the planning and monitoring of activities, for example, WhatsApp and Google Calendar (Infante et al., 2021). - The structuring and self-assessment of learning objectives generate different self-regulation patterns, while improving the direction and regulation of online learning (Moos & Azevedo, 2006; Stephen & Rockinson-Szapkiw, 2021). - The use of note-taking and monitoring tools correlates significantly with the number of correctly completed tasks (Proske et al., 2007).
Concept support: Aids inside or outside the virtual environment that guide the student to understand content.	- Students who receive scaffolding (tutorial and adaptive support) advance further in their learning and use more and better elements of self-regulation (Azevedo & Cromley , 2004; Song & Kinm , 2020). - Adaptive scaffolding facilitates changes in students' mental models and greater use of self- regulation strategies, compared to a fixed scaffolding or a non-scaffolding condition (Azevedo et al., 2004). - Adaptive scaffolding is effective in facilitating learning, it allows students to change their mental models, benefits their declarative knowledge and self-regulation patterns (Azevedo and Cromley, 2004).
Metacognitive support: Guide the student in their way of thinking and reflecting on the task.	- The training in metacognitive questions helps in the development of skills for learning mathematics (Kramarski & Gutman, 2006). - Previous training in the different phases of self-regulation makes students obtain greater conceptual advances in their learning (Azevedo & Cromley , 2004). - Tutoring through a personalized system that promotes self-regulation increases the performance and satisfaction of learners (Chen, 2009). - Those who are supported to ask metacognitive questions perform tasks significantly better (Kramarski & Gutman, 2006). - It is better that the tutor offers feedback on the cognitive, metacognitive and motivational aspects, rather than focusing exclusively on the acquisition of knowledge (Barak, 2010).

Source: Own elaboration (2021).

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Educational conditions for the promotion of self-regulation

Based on the evidence that has just been presented and the review by Artino & Ioannou (2008), whose work is the result of an exhaustive reading of the literature on self-regulation studies applied to online learning between the years 1995 and 2007, they can identify some successful experiences that can serve as a basis for the instructional process based on self-regulation.

First. Those with more adaptive profiles are more successful in virtual learning. In this sense, in the planning of a virtual course it is important to evaluate the components of self-regulated learning of students, for this, questionnaires can be used, offering individualized feedback. The results of the questionnaires can also be used by the virtual tutor to send reflective messages to students to promote their self-monitoring, as well as to create tasks and rubrics to support goal setting and self-assessment.

Second. According to the evidence, the motivational beliefs of the students are relevant within the pedagogical process (self-efficacy, intrinsic motivation and value of the task, among others). In this line, for example, the value of the task can be increased by discussing at the beginning of an activity the importance of this, designing online activities that are based on authentic problems, reflecting with the students on what type of specific learning tasks can contribute to the realization of their personal goals, interests and values, or using dynamic and synchronous systems (mobile devices and social networks, for example).

Third. Despite the widespread use of online discussion forums, it has been found that students rarely use their critical thinking skills during these discussions, opting instead for a rather superficial treatment of topics. Providing appropriate scaffolding for online discussions can increase the use of metacognitive tools. In this sense, the tutor can, through explicit comments and clarification of the argumentative criteria, model and exemplify appropriate discussions that focus on the specific topics and concepts of debate. Luis et al. (2006) report an activity in which students could freely express their ideas in a reflective manner in combination with peer feedback and support. In this activity, a group of first-year software engineering students was asked to write a reflective blog in response to questions from the tutor and other students. Blogs, therefore, were used to share knowledge and as a space for work and information.

Quarter. Students who seek help from others and collaborate with others have been shown to be more successful in virtual environments. Consistent with this finding, it is important to encourage collaboration and co-regulation, for example, by using peers as models for appropriate discussions, explicitly acknowledging well-written student comments, offering model assignment examples from outstanding students, or use group projects that encourage students to work together toward the same goal. English & Duncan (2008) promoted the use of Facebook

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in a group of student teachers during their teaching practice, to facilitate the sharing of stories and anecdotes. Results indicate that self-direction of their own learning was promoted as practitioners created, shared, and commented on each other's contributions, allowing various forms of peer support to be created.

Specifically, in virtual *blended learning environments,* the literature indicates that some characteristics can be taken into account, since they favor the development of self-regulation skills by students, among them: authenticity, personalization, learning control, scaffolding, interaction and signals for reflection (Van & Elen, 2016).

Other thematic nodes related to online learning

Both self-regulation and metacognition are central issues in the educational context, which is why they have been addressed in research on other major topics of interest in virtual learning and teaching. In this section we will examine the links between the two topics that have been examined and other research topics that are supporting the expansion of knowledge in the area.

epistemic beliefs. According to Winters et al. (2008) and Martinez et al. (2009), in virtual training it is necessary to analyze epistemic beliefs due to their implication in motivation, learning and self-regulation. The learning that occurs with the intervention of self-regulation strategies is not limited to information or a specific domain, but must be reflected in the skills for learning. Virtual learning can facilitate the elaboration of a personal epistemology by making the search for information, decision-making and communication more reflective, probably as a consequence of the monitoring and metacognitive evaluation that these environments imply (Muis, 2007).

In the use of the Internet, Braten & Stromso (2009) and Stromso and Braten (2010) found that people with favorable epistemic beliefs towards the usefulness of this tool as a source of knowledge, towards seeking help and about self-regulation in learning (specifically in planning, monitoring and regulation), obtain better results, while those who tend to believe that computer-based learning requires less planning and organization, show greater difficulties in adapting to these learning environments.

Teaching metacognitive skills. DeStefano & Lefevre (2007) found that the interactivity of virtual learning, specifically in hypertexts, does not necessarily improve learning, especially in the case of students with low skills, while the structuring of the material did improve results. Thus, metacognitive strategies that promote reflection and ordering of the material, such as metacognitive questionnaires prior to the task, anticipation exercises and results planning, favor learning (Núñez et al., 2011). Some examples of metacognitive questions are: Do you think you know the topic? Are you clear about the meaning of…? Think about how you can relate the information

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to…? Do you reflect on what steps you should follow…? Think about what kind of difficulties you have to…? Think about how you can solve them? Reflect on what you are systematic? Think about how much interest you have in the task?

Tesouro (2004) offers an example of how metacognition can be fostered through assessment in virtual environments. In this approach, assessment is an integral part of the instructional process and fosters cognitive and metacognitive processes. He suggests starting by activating students' previous learning, referring to examples of previous activities. Likewise, to activate students' metacognition, it is recommended to make a reflexive correction of the possible interpretation errors of the developed exercise. On the other hand, to promote metacognitive capacity, it is important to self-assess, co-assess and discuss the questions of the exams after their qualification, as a complementary cognitive feedback to the grade obtained.

Problem Based Learning (PBL). Research with experiences in promoting self-regulation in face-to-face environments shows the usefulness of explicit discussion of learning objectives, the nature of the task and the problem-solving strategies used with students (Barak, 2010). Precisely, starting from problem situations is a strategy that implies the activation of processes of metacognition, planning, control and metacognitive evaluation. The so-called Problem-Based Learning (PBL) strategy has been used in both face-to-face and virtual environments. From this route, the active participation of students is promoted in each of the phases of the learning process, including the definition of problems, objectives, content, forms of evaluation and, in general, of the entire process. knowledge construction process.

Another way of approaching virtual learning through strategies that involve problem solving are research tasks such as those involved in webquests and similar strategies. For example, Quaresma & Oliveira (2009) included a webquest as an activity in an educational informatics course, emphasizing planning and monitoring, as well as the evaluation of process difficulties, which contributed to the understanding of the subject.

Self-monitoring and planning. Through monitoring, the learner compares the learning products with the criteria or standards to determine if in that phase of learning a task, the objectives have been achieved, or if more work is necessary to achieve them. Studies by Azevedo and Witherspoon (2009), specifically in virtual environments, point out that there are at least eight types of monitoring that students display and that if all or some of them are supported during the learning process, execution and comprehension of students improves significantly. They are presented below:

1. Sense of knowledge: the student realizes whether or not he has any previous familiarity with the material.

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2. Judgment of learning: the learner realizes whether or not he is understanding what he is reading.

3. Use of strategies: in which the student realizes if the strategy he is using is useful or not for learning.

4. Self-test: the student asks himself some question to determine if he is understanding and determines if he should readjust his learning process.

5. Towards the goal: the student assesses whether he has managed to advance by completing the previous stages of learning.

6. Time monitoring: the student is aware of the time he has dedicated to the learning task.

7. Content evaluation: the student monitors the appropriateness or inappropriateness of the content being studied at that moment, taking into account the general vision of the pre-existing goals and sub-goals.

8. Adequate content expectation: it is similar to the previously described content evaluation, but in this case the students evaluate a content that they have not yet reached, generating expectations about what they will find.

Collaborative Learning. Some of the most used virtual activities are forums, debates or chats to promote collaborative learning. The proper use of these virtual spaces can favor metacognition and motivation and , with it, self-regulation skills. In a virtual learning environment the feeling of community is important. Fisher & Baird (2005) investigated the social aspects of an online course that support student self-regulation and retention. Among the social technologies used in this study was the platform itself (in this case Tapped In), the Newsgroups, the Web log (Blog), the chat and the Wiki. Some of the projects and activities used in the courses required students to develop collaboration and relationship skills crucial to passing the course. These projects offered a combination of personal and group skills, whereby the individual project was supported by the activities of the group projects.

Following this methodology, the researchers found that the elements that motivated students' self-regulation were: the projects, since they are based on their intrinsic needs; the relevance of the projects and readings, due to the need to alleviate knowledge deficits; offer opportunities for autonomy and creativity; the use of social networks and collaborative tools on the Web; and peer support and feedback.

Seven practical guidelines to start implementing self-regulation in online learning

The results of the systematic review carried out by Rodrigues et al. (2019) on the literature published between 2010 and 2018 regarding online learning, indicate that educational innovation is one of the most recurrent contents in this area

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of knowledge. The implementation of innovation in online learning shows that it is a dynamic area of knowledge in which there is a growing interest in finding new strategies for students to learn under the different modalities offered by virtual learning environments.

Taking into account the aforementioned review of research in the area and Pintrich's model (2000) on the components of self-regulated learning, a roadmap of seven practical considerations or guidelines to follow in order to promote self-regulated learning is proposed below. self-regulation and the improvement of virtual learning and teaching environments. These seven guidelines can be partially or totally taken into account in the design or improvement of virtual courses according to availability and available resources.

Guideline 1: *Initial assessment of students' self-regulatory skills and epistemic beliefs.* This can be done through surveys, questionnaires or polls that should be made known to students through individualized and assertive feedback that increases their awareness of these topics, at the same time that they are referred to resources on the Web or to readings about what is the academic self-regulation and the erroneous beliefs that many students tend to have about the learning process in virtual environments.

The rule would be that the evaluation of the initial learning conditions allows the tutor to improve his orientation and helps the students to gain awareness and ownership of their pedagogical process.

Guideline 2: *Promotion of planning.* Promoting in students the setting of goals and sub-goals through a clear initial definition of the task, generates greater skills for learning. In the cognitive area, planning occurs through the establishment of specific objectives, the activation of previous knowledge, the recognition of the difficulty of the different tasks, the identification of the knowledge and skills necessary to face them or the knowledge about the sources and strategies that may be useful in the treatment of the task, among others. In the motivational area, it is useful to activate motivational beliefs (including self-efficacy, goals and value assigned to the task) and emotions. In the behavioral area, the planning of time and effort to be used in the tasks result in gains in the task. Finally, in the contextual area, the activation of perceptions about the task and its environment support learning (Pintrich, 2000).

To generate this movement of students towards planning, the virtual course designer or tutor can take advantage of the multiple forms of communication in virtual learning environments (for example, through forums, blogs, emails, calendars and activity logs) and can help establish initial clarity in the student regarding learning goals.
students' prior knowledge .

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Guideline 3: *Promotion of self-monitoring.* As previously presented, in this phase the student monitors and pays attention to the behaviors he/she performs to solve the activity, while supervising his/her own results. Self-monitoring can be encouraged in students, for example, by means of the following reflective questions in the different phases of their learning process: a) Do I know something about the subject? b) Do I understand or not what I am reading?; c) Is my strategy useful to learn this content?; d) Am I making progress in my learning? e) How much time have I dedicated to the task? f) Am I achieving the goals and sub-goals outlined? and g) How do I see the content that I have not studied based on what I have previously advanced?

The rule would be to constantly encourage students to actively review their own learning process throughout the course.

Guideline 4: *Promotion of self-control.* The student, based on monitoring, tries to control his cognitions, behaviors or his learning environment to improve his performance. For example, the student may be aware that the level of comprehension of the reading he is doing is low and, therefore, he must implement remedial strategies such as repeating aloud, rereading or making a graph or a graph. conceptual representation. On the other hand, at a motivational level, the student may be aware of their ability to tackle a task and its importance or their behavior, seeking help or making more effort to understand the reading. Finally, it is important that the online student takes into account corrective measures that help the assimilation and retention of knowledge, such as taking notes online or on paper and making graphs or summaries , restricting the possibilities of copying and pasting. .

The rule would be to lead students' self- monitoring to include cognitive, behavioral, motivational and/or contextual corrections that improve their learning.

Guideline 5: *Promotion of self-assessment.* Pintrich (2000) describes the evaluation or reflection phase that includes judgments, attributions and general self-evaluations (at the motivational, behavioral and contextual level) that the student makes about their results and execution. For example, at the behavioral level a student may reflexively consider that he or she did not use the time appropriately to achieve a learning goal.

Formative assessment is a key part of the success of virtual learning environments, understanding that the most complete and impressive for the student is that this assessment is based on its three modalities: hetero-assessment, self-assessment and co-assessment.

The rule would be that a course should not be completed without the student making a conscious reflection on its process and on the cognitive, behavioral, motivational and/or contextual results.

Guideline 6: *Promotion of motivation.* For the success of the online learner, maintaining motivation towards learning activities becomes essential. To do this, tutors are recommended

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to use collaborative learning and seek help from peers, in order to create a sense of community, support and feedback that peers can offer through social networks and forums that generate an environment of regulation and collaboration.

For the increase of intrinsic motivation, it is recommended to increase the value of homework through the use of projects and relevant readings, the use of authentic problems of real life, the relationship of the projects or topics of the course with the personal goals of the student. student or with its relevance in the professional future. To maintain motivation, the use of a sense of humor, periodic questions that activate judgments and feelings, and integration with prior knowledge are suggested. At the design level, for the maintenance of motivation, the use of simulations and sound and image resources that maintain the interest of students by exploiting the different forms of information representation that virtual environments allow is recommended.

The rule would be that the motivation of the students should not be taken for granted: it should be generated and maintained throughout the course.

Guideline 7: *Promotion of metacognition.* The most complete strategy for increasing metacognition is Problem-Based Learning (PBL), since it activates problem-solving strategies in the student, generates opportunities to activate planning, self-monitoring, creativity and appropriation of knowledge. For these reasons, its use is recommended whenever possible in the design of virtual learning courses.

The rule would be that active learning strategies, such as PBL, are preferable to passive learning strategies.

Conclusions

To conceive of online learning as an extension of traditional/face-to-face learning would be a mistake. Although the pedagogical models derived from the educational sciences can be useful to improve the quality of any learning environment, online education presents some singularities that must be studied in a particular way.

Virtual learning environments involve a complex set of interactions of cognitive, metacognitive, motivational and affective processes in learners (Azevedo and Witherspoon, 2009). Currently, the social cognitive model of self-regulated learning provides important evidence and explanations about the interrelation between students' metacognitive processes (awareness of their own knowledge and self-regulation of their own thinking) and their motivational beliefs (such as the intrinsic value of task, success expectations, self-assessment, and self-efficacy) (Pintrich, 2000; Zimmerman & Moylan , 2009).

From the evidence presented, it is clear that virtual environments, regardless of the thematic content, can incorporate explicit or implicit training in self-regulation to favor the development of these skills (Azevedo et al., 2006). However, one of the most important current challenges in this area is to achieve a real incorporation of empirical findings and theoretical developments

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into virtual instructional designs, through the appropriation of these by teachers and tutors (Garrido et al., 2013).

Although there are highly refined personalized systems (such as tutors or automated virtual platforms) designed with the aim of increasing students' self-regulation skills, the virtual tutor can be and continues to be the fundamental scaffolding available to the virtual student to improve their performance. ability to learn to learn. For this reason, the orientation of the virtual tutor in the choice of tasks, the evaluation and the follow-up of his course, based on the incorporation of the results of educational research on self-regulation, can make a difference in daily educational practice. . In these circumstances, the tutor offers an adaptive scaffolding and is an external regulator that can be key to increasing the quality of virtual teaching.

Azevedo et al. (2008) compared the results of adolescent students who received external regulation (a human tutor who facilitated their self-regulated learning) versus students in a self-regulated condition (responsible for regulating their own learning) in the teaching of science topics. The students who received the help of the tutor present greater declarative knowledge, more complex mental models, activate their prior knowledge, are involved in more monitoring activities, use effective study strategies and know how to seek help when they need it; while students responsible for their own learning process without help, use ineffective strategies and make insufficient use of monitoring activities on their own learning.

The incorporation of pedagogical strategies that promote learning to learn among students should not necessarily be difficult and complex. Authors such as Muis (2007) and Muis & Franco (2009) indicate that self-regulation can be facilitated if a simple four-point guideline is followed: 1) define the task; 2) plan and define goals; 3) execute the strategy and 4) evaluate it.

Finally, it is useful to reflect on some of the challenges for the future of this area of study. First, the improvement of the quality of online courses. It would be convenient for the institutions that bet on virtual training to take into account the quality of the pedagogical training that they offer both to their tutors and to the designers of online courses.

The research results and the high levels of desertion of virtual learning lead us to think that tutors and designers of virtual courses should have a higher pedagogical training, even higher than the trainers who work in traditional learning environments.

Second, it is highly recommended that these improvements focus on strengthening the competence to learn to learn in the students who join this learning modality throughout the process, as a protective element against desertion.

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Third, it is necessary to bring the advances in educational research closer to daily pedagogical practice, and this will only be achieved from the recognition of the particular demands presented by virtual learning environments.

Fourth, research on the self-regulation of learning must take into account both the process and the product of learning, so that there is increasingly more evidence on the micro-processes that students follow online during their educational interaction.

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