Self-regulation and Learning Strategies of Beginner and Advanced University Students

Autorregulación y estrategias de aprendizajes de estudiantes universitarios principiantes y avanzados

Autorregulação e estratégias de aprendizagem de estudantes universitários iniciantes e avançados

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Abstract

The authors analyze the self-regulation learning processes of university students from a degree in the area of computer systems in a private University in Uruguay. An analysis is made of the main features that characterize self-regulation processes drawn from a quant-qual investigation based on a pre-existing questionnaire adapted to this particular context. Such is the Motivated Strategies for Learning Questionnaire (MSLQ), which was administered to 187 students; semi-structured interviews were also carried out to 10 students. Among the most important results of the study, it is worth emphasizing the high level of intrinsic and extrinsic motivation and the diversity in the self-regulation learning strategies used by beginner and advanced students. Concerning the cognitive strategies, students mainly use deep information-processing strategies. Some of the self-regulation processes are developed in keeping with the beginner and advanced students' academic progress.

Keywords: self-regulated-learning, motivation, learning strategies, higher education.

Resumen

Las autoras analizan los procesos de autorregulación de los aprendizajes de estudiantes universitarios que cursan carreras en el área de sistemas informáticos en una universidad privada en Uruguay. Parten de una descripción y análisis de los principales rasgos que caracterizan los procesos de autorregulación a partir de una investigación de carácter cuanti-cuali, basada en un cuestionario preexistente adaptado al contexto particular. Se trata del Motivated Strategies for Learning Questionnaire (MSLQ) aplicado a 187 estudiantes; además se realizaron entrevistas semiestructuradas a 10 estudiantes. Entre los principales resultados del estudio se destaca el alto nivel de motivación intrínseca y extrínseca, y el uso de diversas estrategias de aprendizaje autorregulado por parte de los estudiantes principiantes y avanzados. Con respecto a las estrategias cognitivas, los estudiantes usan mayormente estrategias de procesamiento profundo de la información. El artículo concluye que algunos de los procesos autorregulatorios se desarrollan conforme al avance en la formación académica de estudiantes principiantes y avanzados. Otros aspectos, como el pensamiento crítico y los procesos de autorregulación metacognitiva no presentan diferencias significativas.

Palabras clave: aprendizaje autorregulado, motivación, estrategias de aprendizaje, educación universitaria.

Resumo

Os autores analisam os processos de autorregulação da aprendizagem de estudantes universitários que estudam carreiras na área de sistemas de computação em uma universidade privada no Uruguai. Partem de uma descrição e análise das principais peculiaridades que caracterizam os processos de autorregulação a partir de uma investigação quantitativa-quali baseada num questionário pré-existente adaptado ao contexto particular. Trata-se do Questionário de Estratégias Motivadas para Aprendizagem (MSLQ) aplicado a 187 alunos; além disso, foram realizadas entrevistas semiestruturadas com 10 alunos. Entre os principais resultados do estudo, destaca-se o alto nível de motivação intrínseca e extrínseca, bem como a utilização de diversas estratégias de aprendizagem autorregulada por alunos iniciantes e avançados. Em relação às estratégias cognitivas, os alunos usam principalmente estratégias de processamento de informações profundas. O artigo conclui que alguns dos processos autorregulatórios são desenvolvidos de acordo com o progresso na formação acadêmica de alunos iniciantes e avançados. Outros aspectos, como pensamento crítico e processos de autorregulação metacognitiva, não apresentam diferenças significativas.

Palavras-chave: aprendizagem autorregulada, motivação, estratégias de aprendizagem, educação universitária.

Introduction

When a student begins university, they must get acquainted with autonomous learning situations and with doing activities that require regulating cognitive processes, motivation, and study habits. They are also required to have a higher level of autonomy than what they are used to from their experience in secondary education, and a lot of them have difficulties in meeting such demands (Zusho, 2017).

The present investigation is underpinned by a model of self-regulated learning (SRL), which allows us to understand the cognitive, motivational, and emotional aspects of learning (Panadero, 2017). To attain self-regulated learning, students must be aware of their cognitive processes, see themselves, and reflect on their emotional and affective situation. It is not only about knowing which strategies are to be used for better learning, but it also implies considering other elements such as motivation, their perceived self-efficacy, values, feelings, and beliefs. That is, self-regulation goes beyond cognitive aspects (Panadero & Alonso-Tapia, 2014).

Different investigations (Pintrich & De Groot, 1990; Rinaudo, et al., 2003, Ventura, et al. 2017, Curione, et al. 2018) address the topic that refers to evaluating and measuring self-regulation learning processes in students. In particular, studies have investigated the cognitive, metacognitive, motivational, and affective components of the learning processes and how these are interrelated.

Pioneer studies about the relationship between motivation and self-regulated learning, such as those of Pintrich and his collaborators (Pintrich & De Groot, 1990; Pintrich, et al. 1993) found moderate to strong correlations between motivation and the use of self-regulated learning strategies. Rinaudo et al. (2003) also found a correlation between self-regulated learning and motivation in university students in Argentina. In their study, they adapted a version of the *Motivated Strategies for Learning Questionnaire* (MSLQ) to the Argentinean context. This same adaptation was later used by Ventura et al (2017) in a project that sought to describe the self-regulation and motivational strategies used by freshmen and senior university students in a Bachelor's program in Education Psychopedagogy, whose results were contrasted with the aforementioned study. The authors also found correlations between learning strategies and motivation. With regards to the contrast between freshmen level and senior-level students, they found that the more advanced students exhibited greater gains in terms of strategies dealing with the review of learning, its organization and metacognitive regulation. In what respects to motivational strategies, students at higher levels demonstrated a keener inclination towards the use of intrinsic orientation goals, whereas lower-level students exhibited an orientation towards extrinsic orientation goals. Additionally, Curione et al. (2018) also found similar correlations between motivation, self-regulated learning, and academic achievement in students of Psychology in a public university in Uruguay. However, while the studies referenced above demonstrate an evident interest in the study of self-regulated learning both at the local and international level in the last decade, this area has not been extensively researched in the field of computer science university education.

Pintrich (2004) defines self-regulated learning as an active and constructive process in which novice students establish goals for their learning and then try to monitor, regulate, and control their cognition, motivation, and actions to achieve those goals. In addition to considering their objectives and achievements, the process is also influenced by the characteristics of the environment. As the same author claims, this definition has similarities with the ones proposed by Zimmerman (2000) and other authors.

Students who self-regulate their learning usually act proactively, set goals, and establish the necessary steps to achieve them by using the available information in the environment and their own minds. Nevertheless, this does not mean that they always do it, since it depends on the context, biological differences, and also individual differences that may interfere with the self-regulation efforts. That is to say, students' motivation and the use of different strategies may vary according to the task, the topic, and the course, among other factors (Pintrich, 2004).

Many authors claim that they are framed in orientations or higher-order objectives that are not delimited by a specific result in a certain period. Orientation represents a more general commitment that may be to learning or performance (Zimmerman, 2000). By the early 1990s, Boekaerts develops her Adaptable Learning Model; there she draws from the premise that individuals self-regulate their behavior according to two basic priorities that co-exist and vie for their place among the goals of the person: on the one hand, they wish to enhance their knowledge and abilities (growing goals), but on the other hand, they also wish to protect themselves, prevent losses, distortions or damage. These types of goals reflect the individual's beliefs and are defined as well-being or self-protection goals, as it is, for instance, protecting one's self-esteem. Most probably, students try to attain different goals simultaneously, and these goals may even not go in the same direction (Boekaerts & Niemivirta, 2000).

On the other hand, the process is cyclic since setting the goals is not enough; to achieve them, a plan must be established, executed, monitored, and adjusted. When evaluating their progress concerning the goals set, the student may adjust and regulate their cognition, if necessary, as well as their motivation, emotions, and behavior (Pintrich, 2000).

Besides responding to the evaluation of their progress regarding the goals, other external feedback elements may need adjustments and changes (Schunk & Greene, 2018). For example, a test score is an external factor that may trigger a student's learning strategy change. Therefore, the duration of each self-regulation cycle may vary according to external and internal factors (Zimmerman, 2000).

The objective of the investigation presented in this article was to describe and analyze the motivational characteristics and the use of self-regulation learning strategies by beginner and advanced university students from a computer systems-related degree at a private University in Uruguay. Furthermore, examining possible relations between the motivational characteristics and the use of self-regulation learning strategies was sought.

Methodological design

The study is descriptive and correlational, non-experimental, and transactional, using a mixed design with convergence triangulation. The data collection techniques were self-administered questionnaires to 187 students, and semi-structured interviews with 10 students of the Bachelor in Informatics and Systems Engineering. In this research, a beginner student is whoever is in their first year, and an advanced student is whoever is in the third year of their degree.

One hundred and eighty seven students from the Bachelor in Informatics and Systems Engineering undergraduate degree participated in the study, 129 of whom were in their first year and 58 in their third one of the degrees mentioned above. The 129 beginner students who answered the questionnaire were 21 year-olds on average, 20% of whom were women, and 77% were men, while 3% did not answer or marked other options. The work-related situation reflects that 31% of them were working while studying. The average age of the 58 advanced students was 24, 22% of whom were women and 76% were men, while 2% did not answer or express a different gender. 71% of advanced students expressed they had a job.

An exploration of the instruments used in previous researches was conducted to collect the data. Finally, the MSLQ self-administrated questionnaire was chosen (Pintrich & De Groot, 1990; Pintrich, Smith, García, & McKeachie, 1991), which evaluates the motivation and learning strategies used by students in a course. The self-reporting questionnaire used is divided into two sections dedicated to motivation and self-regulation learning strategies. Answers are given on a 7-point Likert scale, for which values 1 and 2 represent a low level, 3 and 4 are mid-level, and 5 and 7 represent a high level. Students answer according to their agreement or disagreement with the presented statements; the higher the value, the higher the agreement with the statement.

The instrument mentioned above was previously validated in two parts. On the one hand, the abridged version of the MSLQ-UY Motivational Section was validated with Uruguayan university students by Curione, et al. (2017). Furthermore, the full version of the Learning Strategies Section was also validated (Curione, et al. 2019); see Table 1. The authors' authorization to adapt them was obtained to use both sections.

Table 1 *Sections of the MSLQ questionnaire*

Characteristics	Questionnaire used
Motivational Section	
Consists of 22 items distributed into three dimensions: intrinsic value (9), self-efficacy (9), and test anxiety (4). Answers are given on a 7-point Likert scale ranging from "Completely disagree" to "Completely agree".	Uruguayan validation of the abridged MSLQ (MSLQ-UY) Original: Pintrich & De Groot (1990) Validation: Curione et al. (2017)
Learning Strategies Section	
Consists of 50 items distributed into nine dimensions: Repetition or rehearsal (4), elaboration (6), organization (4), critical thinking (5), metacognitive self-regulation (12), management of time and study environment (8), effort regulation (4), peer learning (3) and help seeking (4). Answers are given on a 7-point Likert scale ranging from "Completely disagree" to "Completely agree".	Uruguayan validation of the full MSLQ Original: Pintrich et al (1991) Validation: Curione et al (2019)

On a different note, it is important to highlight that even though this is a tested and validated instrument, it does not cover all affective aspects and their interaction with regulation processes of the motivation (Pintrich, 2004). In this study, the affective dimension is not specifically deeply approached since it is more related to the field of psychology.

Regarding ethical procedures for this study, the official requirements for authorization by the national educational authorities were fulfilled. Once that authorization was obtained, informed consent was sought from participants via a document to be signed by them. The informed consent form informed participants of the aims of the study, stressed the voluntary nature of participation, guaranteed participants' identity and data confidentiality, and provided no information about the institution they belonged to. Additionally, the form clearly described the provisions for the future use of the data gathered and the procedures for its storage.

The questionnaire dissemination took place in November 2018 while students were participating in their courses. Ten groups of beginner students and seven groups of advanced students were visited. During those visits, the investigation objectives were explained, and students were given the option of answering the questionnaire online using a computer or mobile phone. Answering using the printed version of the questionnaire was also offered as an alternative. It took participants between 15 and 20 minutes to complete the questionnaire.

Concerning the quantitative data's preparation and codification, Cronbach's alpha was calculated to verify the reliability of the subscales in the segments of the questionnaire. The coefficient obtained for the motivational section was 0.84, while the result for the self-regulation learning strategies section was 0.91. The results for each section as well as for each of the subscales are acceptable and similar to the results presented in the validation of the original instrument and the Uruguayan validation.

Next, statistical analysis was conducted. In addition to calculating the mean and standard deviation, to compare the samples of the different educational stages (beginners and advanced) and other comparisons by age and gender, the Student's t-test was used. Additionally, association tests between variables were done with the Pearson correlation coefficient. The values, which may range from -1.00 to +1.00, were interpreted according to the classification offered by Hernández-Sampieri, et al. (2014), who make a distinction between very strong, considerable, medium and weak –being -1.00 a perfect negative correlation and +1.00 a perfect positive correlation.

In a second qualitative phase of the investigation, 10 individual semi-structured interviews were conducted by one of the authors of the study, which involved six beginner students and four advanced ones. The length of the interviews was approximately 30 minutes. Care was taken in ascertaining that the provisions -in terms of physical space- were conducive to the proper development of the interviews' privacy and comfort. Interviews were audio-recorded with the consent of participants. Participants were assured of the confidentiality of all data provided in the questionnaires and interviews.

The content of the interviews targeted the experience and perceptions of participants. Interviews consisted of scripted questions and prompts organized around the topic of motivation (goal orientation, valuing and assessment of learning tasks, self-efficacy and self-control). Additional questions focused on identifying cognitive strategies used by participants (used both inside and outside of class and in terms of individual and collaborative settings) were included. Other questions sought to disclose strategies oriented at the elaboration, organization and management of resources for learning and assessment, as well as emotional and affective components of self-regulation processes. A final set of questions sought to disclose whether there had been any changes in motivation and how participants accounted for those changes, thus addressing self-regulation.

Results

In the following paragraphs, some of the investigation results are presented related to the motivational characteristics of the beginner and advanced students as well as the use of cognitive, metacognitive, and resource strategies.

Students' motivation

The beginner and advanced students' motivational characteristics were analyzed based on the answers to the questionnaire's Motivational Section and the input from the interviews. The Motivational Section seeks to understand the students' beliefs regarding their motivation and attitude towards a course. In addition, the student's perception of the learning tasks' usefulness, importance, and interestingness was explored. Their beliefs were also analyzed regarding their success in performing their learning tasks and their abilities to do so.

Table 2 presents the statistical descriptors for the subscales of the Motivational Section of the MSLQ questionnaire, for the first and third years. If one observes the values of the Intrinsic Value and Self-efficacy subscales, in general terms, a high level of motivation can be appreciated. Both first and third-year students present a high level of task value or intrinsic value (M1 = 5.80 and M3 = 5.99) and of self-efficacy beliefs (M_1 = 5.55 and M_3 = 5.46).

Table 2 *Mean, standard deviation, and median for the Motivational Section subscales of the MSLQ for first and third-year students*

Subscale	First year (N=129)			Third year (N=58)		
	M_1	SD_1	Mdn_1	M_3	SD_3	Mdn_3
Intrinsic Value	5.80	.87	6.00	5.99	.88	6.22
Self-efficacy	5.55	.83	5.56	5.46	.71	5.61
Test anxiety	4.21	1.29	4.00	4.22	1.24	4.25

Both first and third-year students' interviewed mentioned elements that indicate intrinsic motivation, such as orientation towards intrinsic goals and value towards learning tasks. They expressed interest and joy in the degree, engineering, particularly software, and in the courses and tasks. It was also found that students report an orientation toward extrinsic goals, which means they commit to learning tasks with varied aims. To a lesser extent, some students expressed an extrinsic interest related to employability or wage increase. In some cases, this was a decisive factor when choosing the degree, added to their intrinsic motivation. To a lesser extent as well, the initial motivation of the student towards the degree is extrinsic, but they later develop intrinsic motivation.

Based on the testimonies, it is observed that intrinsic and extrinsic motivation coexist and complement each other. On the one hand, students set general goals with intrinsic orientation and value the tasks "..I like it and I enjoy it", and at the same time, they are driven by extrinsic goals "I have reached this point already, and I need to finish my degree".

The analysis reveals that students present a high level of perceived self-efficacy. The former relates to their beliefs about having control over their learning, that is, the beliefs of obtaining positive results from their efforts. Students who consider themselves responsible and sedulous relate their achievements with their invested effort.

Concerning the affective component represented in the questionnaire by the subscale that refers to Test Anxiety, the results show an intermediate to a high level. The mean is very similar between first and third-year students (M_1 = 4.21 and M_3 = 4.22) with a standard deviation of 1.92 and 1.24, respectively.

Significant differences were not found between first and third-year students' means when applying the Student's t-test to the different subscales. However, when the test was applied to the subscales referring to Test Anxiety by gender, it was found that for first-year students, women (M_1 = 4.83) presented a higher level of anxiety than men (M_1 = 4.02) with t=-2.428, p=0.021. This difference was also found by Curione et al. (2018) in their study on Psychology students.

In summary, the students who participated in the study presented high motivation levels, both for the first and third years. In particular, they express high levels of intrinsic motivation (value and interest in learning tasks) and self-efficacy. Evidence of extrinsic motivation is also found, related to oriented goals towards academic achievement and the labor market. In the case of test anxiety, in the first-year students, it is worth highlighting that women present higher anxiety levels than men. Results coincide with previous national and regional studies on university students (Curione et al., 2018; Ventura et al., 2017; Rinaudo et al., 2003; Pintrich et al., 1993).

Students' use of self-regulation learning strategies

In order to analyze the characteristics of the self-regulation learning strategies of first (beginners) and third-year (advanced) students, answers were taken from the self-regulation learning Strategies Section of the questionnaire and the contribution of the interviews. It is important to remember that the answers obtained from this section's items serve to understand the students' beliefs about the use of cognitive, metacognitive, and resource control strategies in the context of self-regulated learning. As it was mentioned before, the items are grouped into nine dimensions. To have a general view, Table 3 presents the statistical descriptors for all the MSLQ questionnaire Strategies Section of Self-regulated Learning subscales for the first and third years.

Table 3 *Mean, standard deviation and, median for the self-regulation Learning Strategies Section of the MSLQ for first and third-year students*

Subscale	First year (N-129)			Third year (N-58)		
	M_1	SD_1	Mdn_1	M_3	SD_3	Mdn_3
Cognitive strategies						
Repetition	3.80	1.36	4.00	4.29	1.22	4.38
Elaboration	4.88	1.06	5.00	5.43	.92	5.58
Organization	4.34	1.40	4.25	4.87	1.38	5.00
Critical Thinking	4.48	1.12	4.40	4.78	1.28	4.90
Metacognitive strategies						
Metacognitive self-regulation	4.61	.91	4.75	4.61	.88	4.54
Resource control strategies						
Management of time and study environment	4.64	1.03	4.75	4.99	.90	5.00
Effort regulation	5.09	1.25	5.25	5.39	.91	5.50
Peer-to-peer learning	4.58	1.29	4.67	4.55	1.40	4.67
Seeking support	4.93	1.16	4.92	4.84	1.18	4.75

When considering the subscales altogether, it is observed that students presented medium to high-level use of self-regulation learning strategies, both for first and third years. In the following sections, the different subscales grouped into cognitive, metacognitive, and resource control strategies are considered separately.

Cognitive and metacognitive strategies

The cognitive strategies in the questionnaire were evaluated based on four subscales that cover the lowest levels of cognition, such as mechanical memorization and comprehension, and other deep-processing strategies that imply analysis, construction, and application. The repetition subscale refers to strategies used by the learner to carry out simple tasks and to activate information in the working memory. The elaboration strategies are those which help the learner to store information in their long-term memory on the bases of the construction of internal connections between the elements to be learned. They help to integrate and connect new information with previous knowledge. At the same time, organizational strategies are useful to select the appropriate information and involve an active effort to learn. The critical thinking subscale refers to the application of previous knowledge to new situations (Pintrich et al., 1991).

The least valued cognitive strategy for self-regulation learning was repetition (M_1 = 3.80 and M_3 = 4.29). This subscale does not refer exclusively to mechanical memorization strategies but also covers strategies to review what has already been learned. According to the students' testimonies, the lowest level of cognition development happens outside the classroom context. Concerning critical thinking, it is observed that there are no statistically significant differences between the mean values reported by first and third-year students. The subscale presented medium to high levels in the questionnaire (M_1 = 4.48 and M_3 = 4.78).

It was sought to evaluate self-regulatory and control aspects of metacognition in the context of planning, monitoring, and regulation processes. It can be appreciated that students reported a medium to a high level for metacognitive self-regulation strategies. When applying the Student's t-test, no differences were found between the means of the subscale (M_1 = 4.61 and M_3 = 4.61 with a deviation of .91 and .88, respectively) for first and third-year students (p>0.9).

In summary, students showed medium to high-level use of cognitive and metacognitive strategies. When contrasting the different educational stages, evidence shows that third-year students express a higher use of cognitive strategies (shallow processing and deep processing of information), with the exception of critical thinking. It is also observed in the first year that women report higher use of repetition (M_1 = 4.52) than men (M_1 = 3.62) with a deviation of 1.38 and 1.30, respectively (t=-3.105, p=0.002). Women also report a higher use of organizational strategies (M_1 = 5.27) than men (M_1 = 4.10) with a deviation of 1.34 and 1.31 respectively (t=-4.046, p=0.000). In general terms, these findings are aligned with the results from previous investigations involving university students.

Resources control strategies

The MSLQ questionnaire evaluates the resources control strategies according to four subscales that involve management of time and study environment, effort regulation, peer learning, and seeking support from classmates, teachers, or other relevant stakeholders.

The subscale related to time management and study environment presented a medium to a high level (M_1 = 4.64 and M_3 = 4.99). When applying the Student's t-test to independent samples, it was observed that there is a significant difference between the levels reported for the first and third year (t=-2.214, p=0.028). Third-year students score higher in this type of resource control strategy than first years. As they move forward in their degrees, students gain experience in managing better and making effective use of their study time, generally to meet the requirements of the assessment timetable.

The Effort regulation subscale refers to the abilities a student has to regulate their effort and attention when distractors are presented or when task interest is lost. It seeks to evaluate the Student's level of commitment toward their own goals in a non-favorable scenario. Students reported a high level for the subscale (M_1 = 5.09 and M_3 = 5.39). Many students expressed to be aware of the fact that they sometimes get distracted or have a hard time concentrating. Some of the students who mentioned distractions or lack of concentration also described how they mitigate this (the regulation activities that involve the continuous adjustment of cognitive activities).

Concerning peer learning, the subscale presents a high level both for first and third-year students (M_1 = 4.58 and M_3 = 4.55). In general, students expressed that work organized in teams or groups is beneficial. Nevertheless, students differentiated group work in class from work outside the class and mentioned that sometimes, they perceive group work in class as a distraction factor or of low productivity. Students mostly reported that when faced with diverse difficulties, they are willing to seek support from classmates and teachers (M_1 = 4.93 and M_3 = 4.84).

In summary, students presented medium to high levels of use of resource control strategies. Results indicate that third-year students report greater use of management of time and study environment strategies than first-year students. The findings are consistent with previous investigations with university students, such as the study carried out by Curione et al. (2018).

Relationships between motivation and the use of self-regulation learning strategies

To analyze the relationships between the different subscales of the Motivational and self-regulation learning Strategies section three correlational analyses were conducted. The first analysis accounted for all the first and third-year students that participated, and in the other ones, students from each year were analyzed separately. This work presents a general analysis. The Pearson's R correlation coefficient results for the total sample are presented in Table 4. It is observed that there is no strong or considerable correlation between the different subscales.

Subscale	Motivational (MOT)			Self-Regulation Learning Strategies (LS)								
	IV	SE	TA	R	E	O	CT	MR	TS	ER	PL	HS
Intrinsic Value (IV)	1	.64**	-.02	.06	.52**	.33*	.45**	.48**	.37**	.57**	.29**	.20**
Self-efficacy (SE)	.64**	1	-.26**	-.11	.40**	.12	.47**	.45**	.38**	.55**	.18*	.20**
Test Anxiety (TA)	-.02	-.26**	1	.28**	-.04	.17*	-.14	-.04	-.09	-.14	.10	.04
Repetition (R)	.06	-.11	.28**	1	.31**	.50**	.02	.25**	.24**	.13	.12	.02
Elaboration (E)	.52**	.40**	-.04	.31**	1	.56**	.53**	.58**	.37**	.46**	.28**	.22**
Organization (O)	.33**	.12	.17*	.50**	.56**	1	.24**	.43**	.41**	.26**	.18*	.14
Critical Thinking (CT)	.45**	.47**	-.14	.02	.53**	.24**	1	.50**	.22**	.39**	.30**	.21**
Metacognitive self-regulation (MR)	.48**	.45**	-.04	.25**	.58**	.43**	.50**	1	.49**	.61**	.33**	.27**
Time and Study Environment (TS)	.37**	.38**	-.09	.24**	.37**	.41**	.22**	.49**	1	.56**	.25**	.22**
Effort Regulation (ER)	.57**	.55**	-.14	.13	.46**	.26**	.39**	.61**	.56**	1	.21**	.23**
Peer Learning (PL)	.29**	.18*	.10	.12	.28**	.18*	.30**	.33**	.25**	.21**	1	.55**
Help Seeking (HS)	.20**	.20**	.04	.02	.22**	.14	.21**	.27**	.22**	.23**	.55**	1

** The correlation is significant at the 0.01 level (bilateral)

* The correlation is significant at the 0.05 level (bilateral)

In summary, the analysis of the relationship between motivational components and self-regulation learning strategies provides consistent results with findings reported in previous studies. Self-efficacy is positively related to intrinsic value and negatively and weakly related to testing anxiety. It is also related to self-regulation learning strategies, especially with elaboration, critical thinking, metacognitive self-regulation, time and environment management, and effort regulation strategies. Intrinsic value relates positively to almost all the self-regulation learning strategies, with weak to moderated levels. Cognitive strategies relate to metacognitive and resource control strategies, which were previously reported by Curione et al. (2018) and by Pintrich et al. (1993). In this study, the strongest correlation is the one observed between Repetition and Organization within the cognitive strategies. Elaboration is linked to Organization, Critical thinking, Metacognitive self-regulation, and Effort regulation. Other strong correlations found are those between Metacognitive self-regulation with Management of time and environment and with Effort regulation. Peer-to-peer learning and Seeking support are also positively related.

Discussion

One of the investigation objectives presented in this article was to examine relationships between motivation and self-regulation learning strategies, underpinned by the social cognitive learning theory. Evidence shows a connection between the students' motivations and the use of cognitive, metacognitive, and resource control strategies. In general terms, the results are coherent with the findings of Pintrich and De Groot (1990) and other regional studies involving Uruguayan and Argentinian university students (Curione, 2017; Curione, 2018; Rinaudo et al., 2003).

The findings drawn from the correlational analysis and the testimonies indicate that self-efficacy and control beliefs are factors that influence the activation of learning strategies, in keeping with the literature consulted (Zimmerman, 2013; Panadero, 2017). In particular, high levels of perceived self-efficacy relate to deep information-processing strategies, critical thinking, metacognitive self-regulation, and effort regulation. Intrinsic motivation influences how the student commits to the learning task in the attempt to use varied cognitive strategies. The results show an association between intrinsic motivation and cognitive strategies for deep processing of information, metacognitive self-regulation, and resource control strategies such as time management and effort regulation, which confirms findings from previous studies.

Students that report high intrinsic values display high levels of self-efficacy. The intrinsic value also relates to the use of self-regulation learning strategies, especially to elaboration and critical thinking strategies, to metacognitive self-regulation, and to effort regulation.

On the other hand, self-efficacy negatively albeit weakly relates to test anxiety. That is students reporting high levels of self-efficacy show lower levels of test anxiety. In beginner students, test anxiety relates positively but weakly with cognitive strategies. This correlation for beginner students goes in the same direction as the one indicated by Curione et al. (2018) for Uruguayan university students in their first year of a Psychology degree, but it is not accounted for by the creators of the MSLQ instrument (Pintrich et al., 1993). According to these studies, the differences may lie in the cultural differences of the target population (the original instrument was conceived in the context of university students from the United States of America). Another element to consider may be the educational stages, given that the Pintrich et al. (1993) study included students from all levels, with 7% being from the first year. This association was not found for advanced students in the current investigation, either.

When investigating how cognitive and metacognitive aspects relate to the contextual dimensions that influence the learning process, it was found that this relationship was positive concerning self-regulation learning strategies. These findings corroborate the ones presented by the creators of the MSLQ instrument, as well as those by Curione et al. (2018).

A relevant finding concerns the use of cognitive strategies; a strong correlation was identified between deep information processing strategies and elaboration using organizational strategies and critical thinking. In contrast, cognitive strategies of elaboration correlate with metacognitive self-regulation strategies. The latter, which involve planning and self-assessment of the learning process, also correlate with resource management strategies such as regulating learning efforts. These resource management strategies were found to correlate with one another, particularly those of time and space management with those of regulation of learning effort and peer-assisted learning. Regarding advanced students, the connection increases between cognitive strategies for deep processing of information and resource control strategies, such as time management and the study environment, and their commitment to the learning task, despite distractions or difficulties.

Another objective of this study was to examine the motivation and self-regulated learning in beginner and advanced students. Among the investigation results, it can be highlighted that some students' self-regulation processes are developed in keeping with their academic progress, while other aspects, such as critical thinking and metacognitive self-regulation processes do not present significant differences.

From the analysis, it can be concluded that both beginners and advanced students report high motivation levels that respond to intrinsic and extrinsic factors that co-exist and complement each other. As an intrinsic factor, it is found that students find interest, value, and usefulness in tasks, which, according to Pintrich et al. (1991), relates to a greater commitment to their own learning. These findings are aligned with the results of previous national and international studies. The reason for the higher values from a quantitative perspective may lie in the nature of the learning tasks of the courses covered by the investigation. Concerning extrinsic factors, they relate to the achievement of academic goals and a lesser extent, to the labor market.

Students reported high levels of perceived self-efficacy; they positively value their dedication and responsibility and understand that their academic results depend largely on their personal effort. This control belief goes hand in hand with the possibility of changing their course, provided an improvement is needed to achieve their established goals (Pintrich, 2004).

In general terms, the anxiety level is reported from medium to high, both for beginner and advanced students. According to Pintrich (2000), test anxiety may influence the learning process and requires student to adapt their cognitive and behavioral strategies. The previously said involves a reactive and adaptive behavior, of which not enough evidence was found within the testimonies. It is noteworthy the weight evaluations have for female beginner students and the influence this factor has on their performance. However, for advanced students, the gender difference is dissipated. It is not clear that this is due to better anxiety management as they move forward in their degree since the weight this factor has on academic lags and abandonment in women remains unknown.

Regarding self-regulation learning strategies, we conclude that the reported use of cognitive strategies covers a medium to high range. Results show that advanced students report greater use of deep information-processing strategies and that among beginners, women report more significant use of strategies related to comprehension and transformation of new knowledge when integrating it to previous knowledge, characteristics that Zimmerman (2013) confers to proactive students, from the perspective of self-regulated learning.

Results that refer to self-regulated learning go in the same direction as findings from previous studies, which indicate that advanced students show higher levels of self-regulation learning strategies than beginners (Hernández & Camargo, 2017). This does not imply that students do not use shallow information-processing strategies; indeed, evidence indicates that the use of shallow information-processing strategies increases in advanced students compared to beginners. It is worth wondering how students interpreted the questions from the questionnaire related to this dimension: whether they associated them more with mechanical repetition or memorization, or they interpreted them as a revision to understanding the concepts, that is, as a way to approach understanding. At this point, it should be highlighted that, in the data gathered, no qualitative elements were found regarding this interpretation. On the other hand, the question remains as to whether the increase in advance students (regardless of their interpretation) is related to the selected subjects for the study, or if the cause is a different one, such as an increase in the demand, a change in the labor situation, etc.

About critical thinking, which can be located in the self-regulation level of Zimmerman's (2000) multi-level model, students reported a medium to high level. Differences were not found between the different years (first and third), except for an increase in the questioning of what was seen in the course by the advanced students. There were no qualitative elements within the collected data about the questioning or contrast of what they see in the courses and their own ideas, nor about putting into practice what was learned in other contexts. It is worth wondering to what extent the courses propose challenges that consider critical thinking. The level of self-regulation is connected to the nature of the learning tasks and their context, and when greater challenges from a cognitive perspective are offered may positively influence motivation and the other self-regulation processes, such as prioritizing strategies that involve deeper processing of information as opposed to shallow processing strategies (Pintrich, 2004; Zimmerman & Schunk, 2012).

Students reported a medium to high-level use of metacognitive strategies, and differences were not found between beginners and advanced. According to the results, planning, monitoring, and regulation are influenced by contextual factors, such as the subject type or the teacher. On the other hand, this is what we can conclude on the students that did reach this educational stage; we do not know what happened with those who did not continue with their degree or those who fell behind in the second year, or with first-year subjects.

Conclusions

To conclude, the findings deemed from the correlational analysis performed and the data gathered from the interviews, point to the beliefs about self-efficacy and control as key factors that influence the deployment of learning strategies. This finding aligns with similar findings reported in the literature (Zimmerman, 2013; Panadero, 2017). Intrinsic motivation impacts how students engage in learning tasks and the deployment of varied cognitive strategies to that avail. The data analysis evidenced a clear association between intrinsic motivation and cognitive strategies oriented towards the deep processing of information. Additional correlations were identified between metacognitive self-regulation and resource management strategies (including time management and learning effort management), thus confirming findings in previous studies on this matter. A corollary of the present study is that those students who apply learning strategies oriented towards self-regulation of learning feel they are capable of fulfilling both the learning tasks at hand, as well as their personal goals. Those students who possess a high level of self-efficacy see their performance enhanced by developing a deeper engagement with the task, and deploying a wider range of strategies to propel their learning process forward.

We conclude that students actively manage their resources for learning. These strategies involve, for instance, organizing and planning their study time, ensuring an appropriate physical space, learning together with other classmates, the commitment to making an effort with a hard task and not abandoning it, and seeking support from classmates and teachers. In particular, advanced students perceive they have greater control over their time and the study environment than beginner students, in many cases driven by goals oriented to fulfill the task timely and in due form. Students show dedication to keeping their learning goals active, which may, at different times, conflict with other goals such as well-being or self-protection. The ability to keep concentration and dedicate to carrying out the learning tasks is also related to the motivational aspects. Concerning peer learning, students recognize better potential and advantageously use it when the group work is not imposed and takes place outside the class context. In short, some of the self-regulation processes develop as they advance in their academic training, while other aspects, such as critical thinking and the processes involved in cognitive self-regulation do not seem to have significant differences.

The present study sought to contribute to the field by providing empirical evidence to support the theoretical elaboration of the process of self-regulation of learning. At the methodological level, it sought to contribute to the field via using the MSLQ instrument in a novel context, that of Uruguayan higher education. It is hoped that the findings of this study on the self-regulation of beginner and advanced university students may contribute to the decision-making process involved in designing learning experiences for undergraduate students of computer systems.

Additionally, it is hoped that this study may inspire some actions to be taken in terms of the professional development of university instructors. In this way, the results of the investigation signpost that it would be possible to create the conditions for critical and reflective learning on the part of the student. In this scenario, the teacher switches to a facilitator role and becomes responsible for creating the conditions that encourage a reflective dialogue. It is, therefore, necessary to promote instances for university teachers to develop abilities that would then allow students the possibility of reflecting upon the processes, strategies, and knowledge by which they learn.

One further point to notice is that this investigation also sought to understand the network of factors that intervene in self-regulation processes in university students from computer systems in a private University in Uruguay. In this sense, the findings are not readily transferable to other realities including different career orientations, other subject matter content, different instructional and/or assessment methods, or other kinds of higher education institutions that may have significantly greater number of students.

The version of the original MSLQ instrument implemented underwent a process of adaptation and validation to make it relevant to the Uruguayan reality and to ascertain its reliability. During the validation process, it became evident that the instrument required revisions and improvements to reflect the sociological and technological changes that occurred after its initial development (Curione & Huertas, 2016).

On the other hand, as mentioned before, self-regulation of learning is the byproduct of individual processes which do not necessarily correspond to the learning cycles imposed by scheduling. At the same time, it is a highly situated process contingent upon contextual affordances, where courses are but one of the many variables impinging upon the process. Because of this, triangulation of questionnaire responses with data emerging from the interviews was a fundamental consideration of the research design. However, it should be noted that the authors specifically developed the interview protocol for this specific research project. As such, it has not been applied to other research projects, thus indicating one potential limitation of the study. On the other side, were it to be used in other similar projects, it has the potential of becoming a valid complementary instrument to the MSLQ.

In what respects further work in this area, and since no significant differences were identified for beginning and advanced students, a possible line of future research could be oriented toward identifying potential differences in students' self-regulation closer to graduation. What is more, such information could inform studies on student retention, student completion rates and rhythms, as well as students dropping out.

One example of those strategies that were identified as not having a strong correlation and/or variation (in terms of students' levels) was the use of critical thinking. Hence, a further area of interest to delve deeper into could be how the critical appraisal of knowledge contrasts with the students' own ideas as a learning stance, given the relevance of critical thinking in the development of a professional identity.

Finally, the findings that relate to how students organize their learning in terms of deadlines and assessments, as well as the nature of the assessments they face and the consequential test anxiety these instances provoke provide a fertile turf for further exploration. It would be interesting to analyze the influence of assessment both on motivation and self-regulation strategies from the vantage point of both instructors and students within the constraints of the structures that the university imposes on them via rules and regulations.

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