Revista de Psicodidáctica, 2019, 24 (1), 1–8

Revista de Psicodidáctica

www.elsevier.es/psicod

Original

# Mediating Role of Self-efficacy and Usefulness Between Self-regulated Learning Strategy Knowledge and its Use☆

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ARTICLE INFO

*Article history:*
Received 5 April 2018
Accepted 4 August 2018
Available online 24 September 2018

*Keywords:*
Self-regulated learning
Usefulness
Self-efficacy
Higher education

ABSTRACT

Interventions designed to improve academic self-regulation must consider the importance of motivational variables and the relationship between them to improve the self-regulatory strategies use. The main aim of this study is to analyze how training in self-regulated learning strategies is related to improvements in knowledge of those strategies, self-efficacy in using those strategies, their perceived usefulness, and their effective use in academic learning tasks. In addition to direct effects, we explore how those multiple determinants interact directly and indirectly with each other. We used a quasi-experimental pretest–posttest design with a control group ($n = 206$) and an experimental group ($n = 167$), of university students. Control group students followed their usual instructional processes. Students from the experimental group received training in self-regulated learning in addition to their usual instruction. The intervention produced a statistically significant improvement in knowledge of self-regulated learning strategies, which was associated with a significant improvement in self-efficacy in using those strategies. However, increases in knowledge and perceived competence in use were not associated with an improvement in perceived usefulness of the strategies. There were no previous studies that have examined the mediating role played by both student self-efficacy and perceived value for strategy use. Significant implications for teaching and intervention planning were extracted. Competent behavior largely depends on acquiring knowledge and skills, but knowing, training, and be motivated is not enough in self-regulating learning.



## El papel mediador de la autoeficacia y la utilidad entre el conocimiento y el uso de estrategias de autorregulación del aprendizaje

*Palabras clave:*
Autorregulación del aprendizaje
Utilidad percibida
Autoeficacia
Educación superior

RESUMEN

Las intervenciones diseñadas para mejorar la autorregulación académica deben considerar la importancia de las variables motivacionales, y la relación entre ellas, para mejorar el uso de estrategias de autorregulación del aprendizaje. El objetivo fundamental del estudio se ha centrado en analizar cómo el entrenamiento en estrategias de autorregulación del aprendizaje está relacionado con el incremento en el conocimiento de estas estrategias, con la autoeficacia percibida para su uso, la utilidad percibida de las mismas y el uso efectivo de estas estrategias en las tareas de aprendizaje. Para ello, se ha utilizado un diseño cuasi-experimental pretest-postest, con un grupo control ($n = 206$) y un grupo experimental ($n = 167$) de estudiantes universitarios. Los estudiantes del grupo experimental han recibido, además de participar en la instrucción habitual como el grupo control, un entrenamiento extra en el uso de estrategias de autorregulación del aprendizaje. La intervención ha favorecido una mejora estadísticamente significativa del conocimiento de estrategias de autorregulación del aprendizaje, asociada a una

PII of original article:S1136-1034(18)30091-1.
☆ Please cite this article as: Cerezo R, Fernández E, Amieiro N, Valle A, Rosário P, Núñez JC. El papel mediador de la autoeficacia y la utilidad entre el conocimiento y el uso de estrategias de autorregulación del aprendizaje. Rev Psicodidáct. 2019;24:1–8. https://doi.org/10.1016/j.psicod.2018.08.001
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mejora significativa en la percepción de autoeficacia para el uso de esas estrategias. Sin embargo, el incremento en conocimiento de estrategias de autorregulación del aprendizaje y de la competencia percibida para ponerlas en práctica no ha favorecido una mejora en la utilidad percibida del uso de las mismas. No hay estudios previos que hayan examinado el papel mediador desempeñado por la autoeficacia del estudiante y la utilidad percibida en el uso de las estrategias, por lo que se han extraído implicaciones significativas para la enseñanza y la planificación de la intervención. El comportamiento competente depende, en gran medida, de la adquisición de conocimientos y habilidades, pero el conocimiento, la capacitación y la motivación no son suficientes en el aprendizaje autorregulado.


## Introduction

According to many theoretical approaches, the use of self-regulation learning, SRL from here on out, should result in improved learning and academic achievement (Zimmerman, 2013a). Traditionally successful university students are usually described as "self-regulated students", generating a series of thoughts, feelings, and actions by themselves and systematically orienting them toward the achievement of their goals (Zimmerman, 2013b). Nevertheless, students at every educational level have deficits in this sense even when they reach higher educational levels such as university (Bjork, Dunlosky, & Kornell, 2013). SRL has been identified as fundamental in preventing academic failure and prior research has shown that students who receive training in self-regulated learning strategies, SRLS from here on out (e.g., goal setting, time management and seeking help) are more deeply engaged in academic tasks and demonstrate better academic achievement (Broadbent & Poon, 2015; Zimmerman & Schunk, 2013). The importance of such strategies is evident in the university environment with the advent of the European Higher Education Area (EHEA) in which the student is placed at the center of the activities developed in the learning process (Aizpurua, Lizaso, & Iturbe, 2018).

### *Self-regulated learning and motivation*

Initial research on SRL focused on the study of cognitive and metacognitive strategies (Zimmerman, 2008). Today, a large body of research focuses on motivational variables which are related to the student's involvement in academic tasks and in the use of SRLS such as outcome expectancies, causal attributions, self-efficacy, task value, etc. (Zimmerman, 2013b). These variables may also facilitate learning processes and influence academic performance (Rosário et al., 2012).

Accordingly, program assessment must encompass the different dimensions of SRL such as cognition, metacognition and behavior, but also volition and motivation (Efklides, 2011; Wang, Chen, Lin, & Hong, 2016) because knowing is not enough in SRL. It seems that students must also believe that strategies are useful and that they can use them effectively.

As Cleary and Kitsantas (2017) explain, motivation constructs and SRL behaviors are malleable in that they can be changed and improved. Many intervention programs have been designed and implemented to ease the lack of SRLS in higher education (Cerezo et al., 2010; Zheng, 2016), but their efficacy has not been always assessed, particularly in relation to the motivational variables involved in the self-regulated learning process (Dörrenbächer & Perels, 2016; Pellas, 2014).

### *Self-efficacy and strategy value*

Leading SRL models have paid special attention to self-efficacy and usefulness of SRL as interrelated and indispensable motivational variables for the correct use of SRLS (Panadero, 2017; Winne & Hadwin, 2008). In general, many researchers place primary importance on self-efficacy beliefs which are theorized to be the central determinant of a student's agency and substantial predictors of academic success (Cleary & Kitsantas, 2017). It is considered an essential variable in the processes of self-regulation (Rosário et al., 2012) to the point that altering low self-efficacy for SRL may be the key to ensuring success and adaptation to the academic context, and it is definitely an important variable affecting students' motivation and learning (Van Dinther, Dochy, & Segers, 2011).

The value students place on the material they are learning is also a key form of motivation within many models of SRL (Pintrich & Zusho, 2007; Wigfield & Cambria, 2010). This value includes students' perceptions of the classroom and learning environment. Individuals learn from their experience that there is some instrumental knowledge (like that gained during studying) that helps them to earn rewards such as academic achievement, and avoid punishment such as failure or low marks (Lens & Tsuzuky, 2005). That is the sense of perceived usefulness that connects the usefulness of strategies to some present or future goal, enhancing motivation for the learning task. In general, students who see the materials or skills they are learning as useful are more likely to engage the regulatory strategies necessary for SRL and exhibit higher academic achievement (Vick & Packard, 2008; Wigfield & Cambria, 2010). However, students may not use SRLS if the cost of doing so is too high and the reward is low. In this study we consider perceived usefulness to be another key motivational variable to be considered.

This study used a training program to promote the use of SRLS in college students. The program has already demonstrated efficacy in modifying cognitive variables in students from four different countries (Rosário et al., 2015), producing a significant improvement in declarative knowledge of SRLS (Núñez et al., 2011; Rosário et al., 2007). However, as previously noted, knowledge is a necessary condition but not necessarily sufficient to give value and make students feel confident enough to use SRLS in real academic contexts (Zimmerman, 2011).

The aim of this study is to contrast how the training program influences knowledge of SRLS, self-efficacy, perceived usefulness, and the use of SRLS, and how those variables are associated with each other through structural equation modeling (SEM) analysis (see Figure 1).

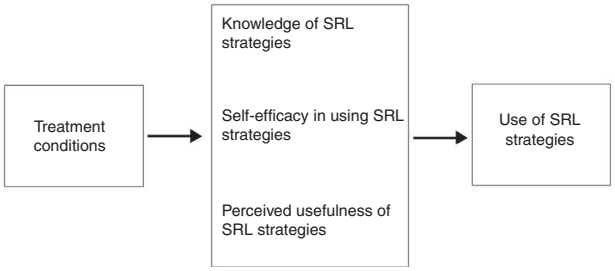


**Figure 1.** Representation of hypothesized effects of intervention. Treatment conditions: comparison and e-TRAL condition.

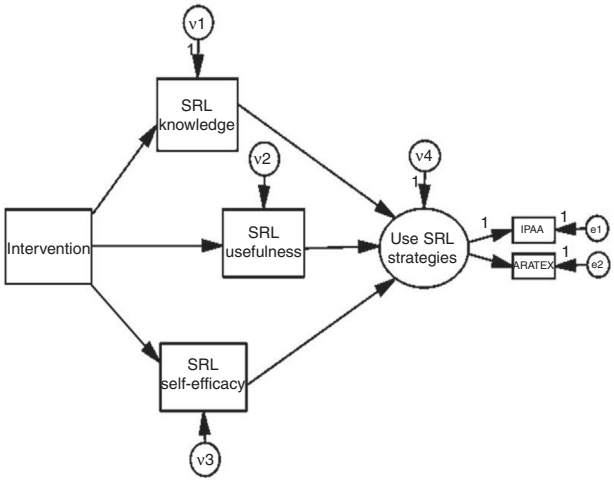


**Figure 2.** Graphic representation of Model A.

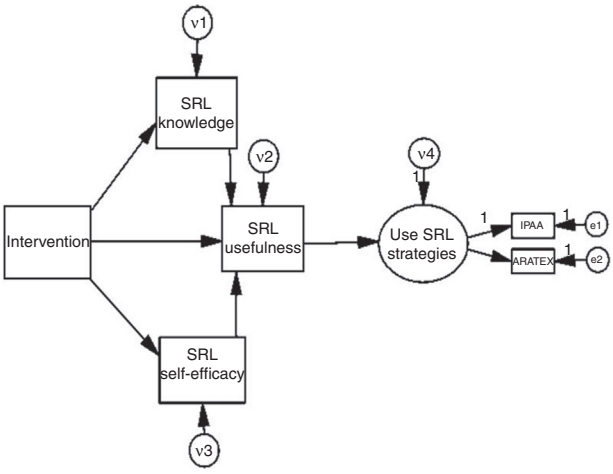


**Figure 3.** Graphic representation of Model B.

Previously, many studies have employed SEM procedures to examine the effects of motivation and SRL processes on student achievement (Cleary & Kitsantas, 2017; Fantuzzo, LeBoeuf, Rouse, & Chen, 2012; Sakiz, Pape, & Hoy, 2012) or the effects of training on motivation (Wang et al., 2016). However, there are no previous studies that have concurrently examined a comprehensive set of SRL variables and strategy use, nor have studies examined the mediating role played by both student self-efficacy and perceived strategy value.

Based on the theoretical background of socio-cognitive theory, this study was proposed as an analysis of alternative models (which compete to explain the existing relationships in the matrix of empirical data). Thus, two models were formulated under the wide umbrella of variables that influence SRLS use. Model A is based on the early models of SRL (Zimmerman, 1989), interacting person, behavior and environment, where individuals acquire cognitive models by training and social interaction, and become experts in different tasks; Model B is based on later models like Pintrich (2003) where the role of motivation is emphasized. Both of them, the most relevant and cited models about SRL (Panadero, 2017).

*Model A*. We predicted that the intervention would significantly modify the levels of SRLS knowledge, self-efficacy in using SRLS, and perceived usefulness of SRLS, and that this would lead to an increased use of SRLS. That is, the treatment conditions modify knowledge of SRLS, self-efficacy in using SRLS, and perceived usefulness of SRLS. These three variables directly explain the use of SRLS (see Figure 2).

*Model B*. The treatment conditions modify knowledge of SRLS and self-efficacy of using SRLS. Knowledge of SRLS and self-efficacy of using SRLS significantly affect the perceived usefulness of SRLS. Finally, the perceived usefulness of SRLS influences the use of SRLS (see Figure 3).

In models A and B the variables SRL knowledge, SRL usefulness, and SRL self-efficacy are observed, while use of SRL strategies is a latent variable (from the measurements of two variables: IPAA and ARATEX, see section of instruments).

The contribution of this work is to go beyond the assumption of direct effects, and observe how those multiple determinants interact directly and indirectly between each other. This knowledge is likely to have significant implications for instructional and intervention planning (Cleary & Kitsantas, 2017).

## Method

### *Participants*

The sample was made of 373 students from a university in the north of Spain who were in their third years in two different degrees (Psychology and Education), from various classes (whole groups). The students were assigned to two conditions: control and experimental. There were no statistically significant differences in the age of the students between the two groups, $M_{GC} = 19.96$, $M_{GE} = 20.53$, $F(1, 370) = 3.311$, $p > .05$. The control group (CG), who followed the usual subject syllabus, was made up of 206 students from both subjects, 158 were women (76.7%). The experimental group (EG) was also from both subjects and was made up of 167 students, of whom 143 (85.6%) were women.

### *Instruments*

We assessed variables related to cognitive (declarative *knowledge of SRLS*), motivational (*self-efficacy* and *usefulness* of SRLS), and behavioral (*use of SRLS*) dimensions of SRL.

*Learning Strategies Knowledge Questionnaire* [*Cuestionario de Conocimiento de Estrategias de Aprendizaje-CEA]* (Rosário et al., 2007). This questionnaire comprises ten items, with three response alternatives (only one is correct). It measures the declarative knowledge of the main SRLS that are covered in SRL intervention program (cognitive, metacognitive, and learning management). Cronbach's alpha for the overall scale is .89 and the composite reliability (CR) = .67 (Rosário et al., 2018). The results of the confirmatory factor analysis are satisfactory: $\chi^2(35) = 118.39$, $p < .001$, $\chi^2/df = 3.38$, GFI = .97, AGFI = .96, CFI = .90, SRMR = .01, RMSEA = .05 (.04–.06), thus obtaining evidence of the construct validity of the inventory (Rosário et al., 2018).

*Self-efficacy* in using SRLS and perceived *usefulness* of SRLS. Both were assessed with ten equivalent items (total of 20) referring to the student's competence in using, and perceived usefulness of SRLS in the academic context (Rosário et al., 2007). The items were rated on a 5-point Likert-type scale, ranging from 1 (not capable at all/not at all useful) to 5 (completely capable/very useful). Students score to what extent they feel able to use the SRLS presented in each item and to what extent they consider it useful for their studies and academic learning. Cronbach's alpha for the *self-efficacy* subscale is

.91 and CR = .76, while for the subscale of *perceived usefulness* it is .89 and CR = .82. The results contributed by the two factor confirmatory factor analysis are highly satisfactory: $\chi^2(35) = 119.6$, $p < .001$, $\chi^2/df = 3.15$, GFI = .97, AGFI = .95, CFI = .97, RMSEA = .05 (.04–.07), thus obtaining evidence of the construct validity of the inventory.

The *SRLS Inventory-IPPA* (Rosário et al., 2007) and the *Self-Regulated Learning from Text Assessment Scale-ARATEX-R* (Núñez, Amierio, Álvarez, García, & Dobarro, 2015) were used to assess the *use of SRLS*.

The *Self-Regulation Learning Strategies Inventory-IPPA* provides information about the use of a macro-SRL strategy made up of the three phases described by Zimmerman's Model (Zimmerman, 2011): plan, practice and evaluation. The IPAA is made up of 12 items which are rated on a 5-point Likert-type scale (1 = never to 5 = always). In this study, the reliability of the global scale is acceptable ($\alpha = .78$, CR = .79), although somewhat lower is the spatial of each of the three factors (*planning*: $\alpha = .47$, CR = .48; *evaluation*: $\alpha = .56$, CR = .58; *execution*: $\alpha = .62$, CR = .62), something logical if we take into account that each of the factors has only four items. These reliability data are somewhat lower than those provided by Rosário et al. (2012), although these were with Secondary students. The results of the three factor confirmatory factor analysis in this study are satisfactory: $\chi^2(51) = 441.44$, $p < .001$, $\chi^2/df = 8.65$, GFI = .91, AGFI = .86, CFI = .89, SRMR = .05; RMSEA = .08 (.07–.89), since some correlations have not been included among the errors of measurements of some items (especially among the specific ones of each factor).

The *ARATEX-R* provides information about the use of specific SRLS when students are learning from texts (most common in academic contexts). The ARATEX-R has five dimensions (first order factors): *planning, cognition, motivation, evaluation* and *environment management*, and 20 items rated on a 5-point Likert-type scale, ranging from 1 = never to 5 = always. In this study, the reliability of the global scale is good ($\alpha = .89$, CR = .92), and logically somewhat lower for the five factors mentioned (*motivation*: $\alpha = .78$, CR = .78; *planning*: $\alpha = .84$, CR = .82; *environment management*: $\alpha = .45$, CR = .45; *cognition*: $\alpha = .88$, CR = .89; *evaluation*: $\alpha = .70$, CR = .71), especially in the *environment management* factor since it only has two items. The results of the three factor confirmatory factor analysis in this study are satisfactory: $\chi^2(160) = 739.29$, $p < .001$, $\chi^2/df = 4.62$, GFI = .90, AGFI = .86, CFI = .97, SRMR = .04; RMSEA = .06 (.06–.67), since some correlations have not been included among the errors of measurements of some items (especially among the specific ones of each factor).

### *Procedure*

The study used a quasi-experimental pretest–posttest design where the students' subsamples were assigned to two conditions: control and experimental. The procedure consisted of randomly assigning the classes to the conditions (not the subjects within each class). The students in the experimental group actively participated in the intervention program in addition to their normal syllabus. The experimental and control groups completed the evaluation instruments before and after the intervention period, both implementations were supervised by a researcher. The procedures followed in the study were in accordance with the ethical standards of the Research Ethics Committee of the University of Oviedo and the Helsinki Declaration.

### *Intervention program*

The intervention program used in this study, eTRAL, is a tool designed to promote the use of SRLS in university students through virtual platforms (Núñez et al., 2011). The program has 12 units where the objective was analyzing a fictional student's behavior and feelings (see Table 1).

**Table 1**
Strategies trained and their distribution in the eTRAL program

| Unit | Trained strategies | |
|---|---|---|
| | Macro-strategies | Micro-strategies |
| nr. 1 | Understanding the learning process. | Student's role in the learning process. |
| nr. 2 | Establishing goals. | Goal characteristics.<br>Long-term and short-term goals.<br>Goals oriented toward learning and oriented toward results. |
| nr. 3 | Information managing and study strategies. | Summaries and concept maps.<br>Taking notes.<br>Cornell technique.<br>Mirror questioning, inferences.<br>Controlling distractors. |
| nr. 4 | Procrastination. | Time management.<br>TTD (Things to do) Lists.<br>Structuring the environment.<br>Relaxation techniques. |
| nr. 5 | Information processing. | Short-term memory.<br>Long-term memory.<br>Forgetting.<br>Instrumentality of learning. |
| nr. 6 | Self-regulated learning. | Cyclical model of SRL.<br>Establishing goals.<br>Monitoring.<br>Assessing learning results. |
| nr. 7, 8, 9 | Problem solving.<br>Help seeking. | Steps in the process of problem solving.<br>Exercises in logic.<br>Help seeking. |
| nr. 10 | Preparing and coping with exams. | Establishing goals.<br>Time management.<br>Organization of information.<br>Reviewing and revising.<br>Self-assessment.<br>Doing previous exams.<br>Types of questions (short answers, tests, and long answers).<br>Working in groups. |
| nr. 11 | Regulating anxiety. | Dimensions of anxiety.<br>Internal and external distracters.<br>Plagiarizing and copying.<br>Relaxation techniques. |
| nr. 12 | Reflecting on the learning process. | Assessment of the learning process and reflecting about the experience. |

The program was applied as part of a Learning Management System (LMS), Moodle, although there were also three in-person sessions to explain to the students what they had to do, and how to use the Moodle platform before beginning the intervention. Learning and guided practice during the intervention were made as contextualized as possible, emphasizing its potential applicability.

A new unit was made available to students each week, comprising a note by the fictional student and associated activities for the students to work on autonomously outside the classroom. These materials, in addition to the texts or notes, were accompanied by summaries of the main strategies employed in them, certain practical activities, and audio-visual materials for the students to practice what they had learned; in addition, students were asked to participate into a forum in which they could discuss the most important topics in each unit and how they might be applied outside the program. In order to complete each unit, students had to closely study the notes and analyze the SRLS covered; they had to hand in completed practical tasks; and they had to participate in the forum, sharing their own experiences and application of strategies in their normal degree subjects. The students had two weeks to complete each unit.

**Table 2**
Descriptive statistics of the variables in de SEM model for the two moments of measurement (pretest and posttest)

| | Control group | | Experimental group | |
|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* |
| *Knowledge of SRLS* | | | | |
| Pretest | 7.89 | 1.57 | 8.30 | 1.02 |
| Postest | 7.75 | 1.88 | 9.41 | 1.16 |
| *Self-efficacy for use SRLS* | | | | |
| Pretest | 3.84 | .51 | 3.88 | .49 |
| Postest | 3.86 | .51 | 4.05 | .45 |
| *Usefulness of use of SRLS* | | | | |
| Pretest | 3.87 | .42 | 3.91 | .34 |
| Postest | 3.87 | .41 | 3.92 | .34 |
| *Use of SRLS* | | | | |
| Pretest | 3.67 | .48 | 3.70 | .49 |
| Postest | 3.75 | .51 | 3.93 | .40 |
| *Use of SRL text strategies* | | | | |
| Prestest | 3.62 | .50 | 3.71 | .50 |
| Postest | 3.72 | .55 | 3.89 | .48 |

*Note.* Minimum and maximum scores for the variable *knowledge of SRLS* are 0 and 10; Minimum and maximum scores for the variables *self-efficacy* for use SRLS, *usefulness* of use SRLS, *use of SRLS*, and *use of SRL text strategies* are 0 and 5.

### *Data analysis*

The data contributed by the two samples of university students were analyzed to verify that there were no values outside of the scale or missing values, and to examine the linearity and normality of the data. Three students were eliminated from the initial control group because they had a large amount of missing data or presented outlier values. No significant amount of missing data was found in any of the variables (in all cases less than .9%). The missing values were treated through the multiple imputation procedure. Therefore, the final sample comprised 373 students.

The structural equation models were analyzed in two stages using the AMOS.22 program (Arbuckle, 2013). First, we proceeded to the selection of the best model based on statistics such as SRMR, AIC or BIC. The AIC and BIC indices were also used to inform about the probabilities that the selected model can be confirmed in other independent samples of subjects. The smaller the SRMR, AIC, BIC, and ECVI are, the better. Secondly, the hypotheses that make up the selected model were evaluated, taking as criteria the most commonly used statistical measures and indexes: in addition to chi-square ($\chi^2$) and its associated probability ($p$), we also used information provided by the SRMR, GFI and the AGFI (Jöreskog & Sörbom, 1983); the CFI (Bentler, 1990); and the RMSEA (Browne & Cudeck, 1993). According to these authors, the model has a good fit when GFI and AGFI > .90, CFI > .95, and RMSEA ≤ .05.

## Results

### *Preliminary analysis*

Table 2 shows the descriptive statistics in the study at pretest and posttest, and Table 3 shows the intercorrelations, the means, standard deviations, asymmetry and kurtosis for the variables in the model in the posttest (the model is adjusted in the posttest data).

Since the two groups of subjects were formed by randomly assigning the classes to the experimental and control groups, but not those subject to the classes, it is convenient to check if there are differences between the groups before the intervention (pretest) in the dependent variables. The data derived from the MANOVA indicate that, taking conjointly the five dependent variables, there were statistically significant pretest differences between the two groups of students, Wilks' Lambda = .97, $F(5, 363) = 2.39$, $p < .05$, $d = 0.36$. Paying attention to the differences for each variable individually, it is found that the differences previously mentioned were only obtained in one of the dependent variables, *knowledge of SRLS* $F(1, 368) = 8.25$, $p < .01$, $d = 0.30$. Likewise, no statistically significant differences were found between both groups, Lambda de Wilks = .98, $F(3, 369) = 2.447$, $p > .05$ in terms of other variables that could interact with the intervention, such as *prior academic achievement* (from the previous year), *motivation toward learning* (learning goals) or *study time* (hours per week).

**Table 3**
Pearson correlation matrix of the total posttest sample

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1. Knowledge of SRL strategies | – | | | | |
| 2. Self-Efficacy for use SRL strategies | .29** | – | | | |
| 3. Usefulness of SRL strategies | .01* | .06* | – | | |
| 4. Use of SRL strategies | .30** | .57** | .07* | – | |
| 5. Use of SRL text strategies | .34** | .61** | .08* | .71** | – |
| *M* | 8.5 | 3.94 | 3.89 | 3.83 | 3.80 |
| *SD* | 1.79 | .50 | .38 | .47 | .53 |
| Skewness | −1.63 | −.73 | −1.37 | −.34 | −.62 |
| Kurtosis | 2.91 | 1.59 | 3.66 | .21 | .66 |

*Note.* * $p > .05$. ** $p < .001$; minimum and maximum scores for each of the variables can be seen in the note of Table 1.

For the adjustment of the SEM model, taking the criteria established by Finney and DiStefano (2006), who give 2 and 7 as the maximum allowable values for skewness and kurtosis respectively, none of the variables in either sample (in posttest moment) had values approaching these criteria (see Table 3). Evaluation of multivariate normality showed a somewhat significant kurtosis (multivariate kurtosis = 8.23). However, the ML method is robust and can deal with this slight deviation.

### *Selection of the best model*

The data of the adjustment of the models is given in Table 4. Initially the two competing models (Models A and B) were adjusted. The results obtained showed that Model A is better than Model B (AIC, BIC and ECVI of Model A are smaller than those of Model B). Therefore, Model A was selected as the best.

Although the indices for Model A are almost acceptable (SRMR less than .05; GFI and AGFI greater than .90; CFI greater than .95; but RMSEA is greater than .05), analysis of the modification indexes suggested that we should include an effect in the selected model (Model A) that had not been taken as significant initially (*knowledge of SRLS → self-efficacy* in using SRLS). The inclusion of this effect was statistically and theoretically justified. Subsequently we reformulated and recalculated the model A (now Model A'), finding a

**Table 4**
Criteria for the adjustment of the SEM models

| | Model A | Model B | Model A' |
|---|---|---|---|
| $\chi^2$ | 22.59 | 239.45 | 3.48 |
| *df* | 7 | 7 | 6 |
| *p* | .002 | .000 | .747 |
| $\chi^2/df$ | 3.23 | 34.21 | .58 |
| SRMR | .05 | .11 | .01 |
| GFI | .98 | .84 | 1.00 |
| AGFI | .94 | .53 | .99 |
| CFI | .97 | .61 | 1.00 |
| RMSEA (LO90-HI90) | .08 (.04–.11) | .30 (.27–.33) | .00 (.00–.05) |
| AIC | 50.59 | 267.45 | 33.48 |
| BIC | 105.49 | 322.35 | 92.30 |
| ECVI | .14 | .72 | .09 |

*Note.* Model A' is the Model A re-specified.

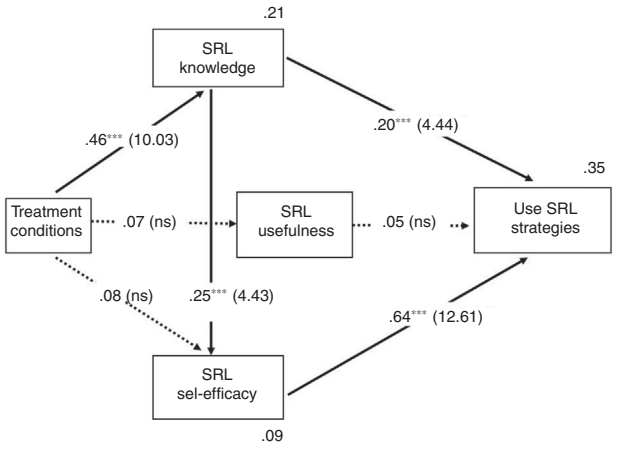


**Figure 4.** Final path diagram with regression coefficients (Model A'). The statistically significant relationships were: intervention on *SRL knowledge*, *knowledge of SRLS* on SRL *self-efficacy*, *knowledge of SRLS* on *use of SRLS*, and SRL *self-efficacy* on *use of SRLS*.

significant improvement in the model fit index, $\Delta\chi^2_{(1)} = 19.110$; $p < .001$, and final optimum fit indexes (see Table 4). Then, Model A' is the final model.

*Evaluation of Model A'*

Figure 4 provides the data related to the standardized regression coefficients as well as their degree of significance (values *t* and their associated probability). The data show that the intervention results in a statistically significant improvement in *knowledge of SRLS* ($b = .46$, $p < .001$), and that this improvement is associated with a significant improvement in *self-efficacy* in using those strategies ($b = .25$, $p < .001$). This boost in perceived competence in turn has a notable positive impact on the effective *use of SRLS* ($b = .64$, $p < .001$). However, the improvements in *knowledge of SRLS* and SRL *self-efficacy* in their use are not associated with an improvement in perceived *usefulness* of those strategies. Finally, the *use of SRLS* is not seen to be dependent on perceived use, but rather on the perceived individual competence in using them effectively (independent of their perceived *usefulness*), and the *knowledge of SRLS* ($b = .20$, $p < .001$).

## Discussion

From the starting approaching and a traditional perspective, we expected the intervention to lead to increased *knowledge of SRLS*, *self-efficacy* in using SRLS, and perceived *usefulness* of SRLS, and that this would have an impact on the *use of SRLS*. However, our data suggests that only *knowledge of SRLS* and *self-efficacy* in using SRLS have a significant, positive impact on the *use of SRLS*, *self-efficacy* being predominant. These significant results are important because it is reinforced that it is possible to influence students' self-efficacy within higher educational programs. In this particular case, the program improves students' self-efficacy through improving their knowledge of SRL. It is not a remarkable finding. How students become self-regulated as learners has attracted researchers for decades and although academic emotions and motivation undoubtedly count, in practice it seems as though remedial or empowering actions should ideally be based on strategy instruction (Van Dinther et al., 2011).

Nevertheless, the not significant results and the underlying effect of intervention through SRL strategy knowledge rather than being direct, are the most challenging findings.

It was in the middle of the last century when Sterling discussed about the publication bias and how statistically significant results capture all the attention (Sterling, 1959). In our study, the perceived *usefulness* of SRLS was unaffected by the intervention, nor did it significantly affect the level of *use of SRLS*. Hattie, Biggs, and Purdie (1996) already advised as a result of their meta-analysis that learning skills training should be in context and use tasks within the same domain as the target content, as was followed in the current study. However, our results, although unexpected, may indicate that the value students place on the material they are learning during interventions is mediated by their own needs as students in a wider context. It could be their routine academic assignments and assessment rather than the hypothetical and theoretical usefulness of SRLS given by the training program. This is despite the learning and practice during the intervention, as with many other interventions, being as contextualized as possible, emphasizing its potential applicability. In this regard, knowing or being motivated is not enough.

As noted in the introduction, the effects of strategy training do not always transfer well to non-experimental contexts. Incentivizing SRL in students goes beyond intervention environments, involving what is taught and how it is taught in real contexts. It is crucial, but not sufficient in itself, for training programs to create authentic learning environments that are conductive to self-regulated learning. Students may not apply a strategy personally, even one they know to be effective, because they do not feel the gains are worth the effort (Zimmerman, 2011). According to Boekaerts and Niermivirta (2000), the students interpret the learning task but also the context, and then activate (or not) a regulatory learning path. On this subject, one of the participants posted in the forum "I have found the experience great but if I did what I've learnt, I would not survive as student in real life".

Although Boekaerts (1997) inspiringly predicted massive school reform at the turn of this century from policy makers to teachers and students, the current day-to-day experience of students is still outcome-based practices that do not usually reward SRL, especially in higher education. This particular aspect is connected to the absence of direct influence of the intervention on the two motivational variables. *Self-efficacy* in SRLS use was indirectly influenced by increased *knowledge of SRLS* but the same influence did not extend to the perceived *usefulness* of SRLS. Perceived value connects the usefulness of strategies to some present or future learning goal and the context. It is hard to convince a student to personally use and transfer SRLS to their own work when those strategies are not applicable to their immediate learning environment. Another student post on the forum stated "(...) I think that using it successfully not only depends on the students but on the teachers and the system too". Related to this, all of the SRL main models include context as a significant piece on self-regulation, however, not much research has been conducted the task context affect SRL (Panadero, 2017).

These results support the idea that the expected change in students' self-regulated behavior is not domain-specific but transcends domains and learning agents. Surprisingly, little is empirically known about the role of SRL with respect to the teaching profession or academic policies, and although different institutions and researchers have called for increased efforts to enhance teachers' SRL competence (Steinbach & Stoeger, 2016), some with great success (Kramarski & Kohen, 2017), various influences still prevent teachers from fully promoting SRL (Peeters et al., 2014). For an intervention to succeed it is essential for students to be provided with opportunities to apply and practice their newly acquired strategies, which is where the role of the instructor and institutions come into play. This study reinforces the fact that teachers need to receive training on SRL to understand how they can maximize their students' learning otherwise we could be wasting interventional efforts and effects. Teachers play a significant role in the promotion of SRL and they are in charge

of essential decisions (e.g. learning assessment) that make the difference in terms of strategies value. Academic learning takes place within an indivisible teaching-learning process; it must be taken into account, otherwise it is unlikely to achieve real-world, generalized change toward self-regulated learning.

The limitations of the study are at the same time an enriching opportunity to discuss the results. The usefulness variable was very high before the intervention, so it is possible that the intervention produced no statistically significant effects because the margin of improvement was small. However, the pretest levels of the other variables were relatively high too. In this respect, we suggest that one of the limitations of using self-reporting is overestimating the initial perceptions of both *usefulness* and *self-efficacy*. The importance of scales for measuring learning strategies (Jiménez, García, López-Cepero, & Saavedra, 2018) and self-report methodology in SRL research is undeniable (Zimmerman, 2011), but so too are the associated problems of validity (Pike & Kuh, 2005) and incongruence with other innovative methods of assessment (Winne & Perry, 2000). As illustrated by Roth, Ogrin, and Schmitz (2016) there is a lack of emotional and motivational regulation scales. This issue seems to be inconsistent with gains obtained in the level of *knowledge of SRLS* assessed with self-reporting methodology, but only if the motivational construct is assumed to be conscious and accessible to the individual. Motivational functions are often treated as a trait and relatively stable over time and across situations (Fulmer & Frijters, 2009); however, Schunk in 1991 already considered motivation as fluid and situationally dependent. In this regard, perhaps the self-report methodology was not sensitive enough to the intervention's motivational gains. In line with that, we propose a move toward integrative and multichannel measurement (Azevedo et al., 2017). Furthermore, considering the importance of the instructional environment, future studies should not only measure improvement in learners, but also changes in assessments by instructors, and assessments of the instructional process. We must also consider as a limitation of the current conclusions that the sample may not be representative of the university population, as it is of convenience and, in addition, pertaining to the third year of a degree in psychology and education degrees only. It would be interesting to replicate this study in subjects of other years and grades.

Current SRL models are beneficial for interventions (Panadero, 2017) but the effects observed at this study need to be further considered by researchers and practitioners. It should promote changes in our understanding of SRL interventions. Competent behavior largely depends on acquiring knowledge and skills, but knowing, training, and be motivated is not enough in self-regulating learning.

## Acknowledgements

This work was supported by the Spanish Ministry of Science and Innovation [EDU2010-16231] and the Spanish Ministry of Economy, Industry and Competitiveness - Dirección General de Investigación Científica y Técnica [EDU2014-57571-P].

## References

Aizpurua, A., Lizaso, I., & Iturbe, I. (2018). Learning strategies and reasoning skills of university students. *Revista de Psicodidáctica*, *23*(2), 110–116. http://dx.doi.org/10.1016/j.psicoe.2018.02.002

Arbuckle, J. L. (2013). *Amos 22.0 user's guide*. Crawfordville: Amos Development Corporation.

Azevedo, R., Millar, G. C., Taub, M., Mudrick, N. V., Bradbury, A. E., & Price, M. J. (2017). *Using data visualizations to foster emotion regulation during self-regulated learning with advanced learning technologies: A conceptual framework*. pp. 444–448. Canada: Proceedings of the seventh international learning analytics & knowledge conference. Recovered from https://dl.acm.org/citation.cfm?id=3027440&dl=ACM&coll=DL

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*, 238–246.

Bjork, R. A., Dunlosky, J., & Kornell, N. (2013). Self-regulated learning: Beliefs, techniques, and illusions. *Annual Review of Psychology*, *64*, 417–444. http://dx.doi.org/10.1146/annurev-psych-113011-143823

Boekaerts, M. (1997). Self-regulated learning: A new concept embraced by researchers, policy makers, educators, teachers, and students. *Learning and Instruction*, *7*(2), 161–186.

Boekaerts, M., & Niemivirta, M. (2000). Self-regulated learning: Finding a balance between learning goals and ego-protective goals. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 417–450). San Diego, CA, US: Academic Press.

Broadbent, J., & Poon, W. L. (2015). Self-regulated learning strategies and academic achievement in online higher education learning environments: A systematic review. *The Internet and Higher Education*, *27*, 1–13. http://dx.doi.org/10.1016/j.iheduc.2015.04.007

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. Bollen, & J. Long (Eds.), *Testing structural equation models* (pp. 136–162). Newbury Park, CA: Sage.

Cerezo, R., Núñez, J. C., Rosário, P., Valle, A., Rodríguez, S., & Bernardo, A. (2010). New media for the promotion of self-regulated learning in higher education. *Psicothema*, *23*, 306–315.

Cleary, T. J., & Kitsantas, A. (2017). Motivation and self-regulated learning influences on middle school mathematics achievement. *School Psychology Review*, *46*, 88–107. http://dx.doi.org/10.17105/SPR46-1.88-107

Dörrenbächer, A., & Perels, F. (2016). More is more? Evaluation of interventions to foster self-regulated learning in college. *International Journal of Educational Research*, *78*, 50–65. http://dx.doi.org/10.1016/j.ijer.2016.05.010

Efklides, A. (2011). Interactions of metacognition with motivation and affect in self-regulated learning: The MASRL model. *Educational Psychologist*, *46*(1), 6–25. http://dx.doi.org/10.1080/00461520.2011.538645

Fantuzzo, J., LeBoeuf, W., Rouse, H., & Chen, C. (2012). Academic achievement of African American boys: A city-wide, community-based investigation of risk and resilience. *Journal of School Psychology*, *50*(5), 559–579. http://dx.doi.org/10.1016/j.jsp.2012.04.004

Finney, S. J., & DiStefano, C. (2006). Non-normal and categorical data in structural equation modelling. In G. R. Hancock, & R. O. Mueller (Eds.), *Structural equation modelling: A second course* (pp. 269–314). Greenwich, CT: Information Age Publishing.

Fulmer, S. M., & Frijters, J. C. (2009). A review of self-report and alternative approaches in the measurement of student motivation. *Educational Psychology Review*, *21*(3), 219–246. http://dx.doi.org/10.1007/s10648-009-9107-x

Hattie, J., Biggs, J., & Pudie, N. (1996). Effects of learning skills interventions on student learning: A meta-analysis. *Review of Educational Research*, *66*(2), 99–136. http://dx.doi.org/10.2307/1170605

Jiménez, L., García, A. J., López-Cepero, J., & Saavedra, F. J. (2018). The brief-ACRA scale on learning strategies for university students. *Revista de Psicodidáctica*, *23*(1), 63–69. http://dx.doi.org/10.1016/j.psicoe.2017.03.001

Jöreskog, K. G., & Sörbom, D. (1983). *LISREL – 6 user's reference guide*. Mooresville, IN: Scientific Software.

Kramarski, B., & Kohen, Z. (2017). Promoting preservice teachers' dual self-regulation roles as learners and as teachers: Effects of generic vs. specific prompts. *Metacognition and Learning*, *12*(2), 157–191. http://dx.doi.org/10.1007/s11409-016-9164-8

Lens, W., & Tsuzuki, M. (2005, September). *The role of motivation and future time perspective in educational and career development*. Lisboa, Portugal: Paper presented at the Conferência Internacional da Associação Internacional de Orientação Escolar e Profissional (AIOSP).

Núñez, J. C., Amieiro, N., Álvarez, D., García, T., & Dobarro, A. (2015). Escala de evaluación de la autorregulación del aprendizaje a partir de textos (ARATEX-R). *European Journal of Education and Psychology*, *8*, 9–22. http://dx.doi.org/10.1016/j.ejeps.2015.10.002

Núñez, J. C., Cerezo, R., González-Pienda, J. A., Rosário, P., Valle, A., Fernández, E., & Suárez, N. (2011). Implementation of training programs in self-regulated learning strategies in Moodle format: Results of an experience in higher education. *Psicothema*, *23*, 274–281.

Panadero, E. (2017). A review of self-regulated learning: Six models and four directions for research [Monograph]. *Frontiers in Psychology*, *8*, 1–28. http://dx.doi.org/10.3389/fpsyg.2017.00422

Peeters, J., De Backer, F., Reina, V. R., Kindekens, A., Buffel, T., & Lombaerts, K. (2014). The role of teachers' self-regulatory capacities in the implementation of self-regulated learning practices. *Procedia-Social and Behavioral Sciences*, *116*, 1963–1970. http://dx.doi.org/10.1016/j.sbspro.2014.01.504

Pellas, N. (2014). The influence of computer self-efficacy, metacognitive self-regulation and self-esteem on student engagement in online learning programs: Evidence from the virtual world of Second Life. *Computers in Human Behavior*, *35*, 157–170. http://dx.doi.org/10.1016/j.chb.2014.02.048

Pintrich, P. R. (2003). A motivational science perspective on the role of student motivation in learning and teaching contexts. *Journal of Educational Psychology*, *95*(4), 667–686. http://dx.doi.org/10.1037/0022-0663.95.4.667

Pike, G. R., & Kuh, G. D. (2005). A tipology of student engagement for American colleges and universities. *Research in Higher Education*, *46*, 185–209. http://dx.doi.org/10.1007/s11162-004-1599-0

Pintrich, P. R., & Zusho, A. (2007). Student motivation and self-regulated learning in the college classroom. In R. P. Perry, & J. C. Smart (Eds.), *The scholarship of teaching*

*and learning in higher education: An evidence-based perspective* (pp. 731–810). The Netherlands: Springer.

Rosário, P., Lourenço, A., Paiva, M. O., Núñez, J. C., González-Pienda, J. A., & Valle, A. (2012). Self-efficacy and perceived utility as necessary conditions for self-regulated academic learning. *Anales de Psicología*, *28*, 37–44.

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

Rosário, P., Núñez, J. C., Cerezo, R., Fernández, E., Solano, & Amieiro, N. (2018). Propiedades psicométricas del Cuestionario de Evaluación del Conocimiento sobre Estrategias de Autorregulación en universitarios (CEA-U). *Journal of Psychology and Education*.

Rosário, P., Núñez, J. C., Trigo, L., Guimarães, C., Fernández, E., Cerezo, R., . . . Figueiredo, M. (2015). Transcultural analysis of the effectiveness of a program to promote self-regulated learning in Mozambique, Chile, Portugal, and Spain. *Higher Education Research and Development*, *34*, 173–187. http://dx.doi.org/10.1080/07294360.2014.935932

Roth, A., Ogrin, S., & Schmitz, B. (2016). Assessing self-regulated learning in higher education: A systematic literature review of self-report instruments. *Educational Assessment, Evaluation and Accountability*, *28*(3), 225–250. http://dx.doi.org/10.1007/s11092-015-9229-2

Sakiz, G., Pape, S. J., & Hoy, A. W. (2012). Does perceived teacher affective supports matter for middle school students in mathematics classrooms? *Journal of School Psychology*, *50*(2), 235–255. http://dx.doi.org/10.1016/j.jsp.2011.10.005

Schunk, D. H. (1991). Self-efficacy and academic motivation. *Educational Psychologist*, *26*, 207–231. http://dx.doi.org/10.1207/s15326985ep2603&4_2

Sterling, T. D. (1959). Publication decisions and their possible effects on inferences drawn from tests of significance or vice versa. *Journal of the American Statistical Association*, *54*(285), 30–34. http://dx.doi.org/10.1080/01621459.1959.10501497

Steinbach, J., & Stoeger, H. (2016). How primary school teachers' attitudes towards self-regulated learning (SRL) influence instructional behavior and training implementation in classrooms. *Teaching and Teacher Education*, *60*, 256–269. http://dx.doi.org/10.1016/j.tate.2016.08.017

Van Dinther, M., Dochy, F., & Segers, M. (2011). Factors affecting students' self-efficacy in higher education. *Educational Research Review*, *6*(2), 95–108. http://dx.doi.org/10.1016/j.edurev.2010.10.003

Vick, R. M., & Packard, B. W. (2008). Academic success strategy use among community-active urban Hispanic adolescents. *Hispanic Journal of Behavioral Sciences*, *30*, 463–481. http://dx.doi.org/10.1177/0739986308322913

Wang, H. H., Chen, H. T., Lin, H. S., & Hong, Z. R. (2016). The effects of college students' positive thinking, learning motivation and self-regulation through a self-reflection intervention in Taiwan. *Higher Education Research and Development*, *36*, 201–216. http://dx.doi.org/10.1080/07294360.2016.1176999

Wigfield, A., & Cambria, J. (2010). Students' achievement values, goal orientations, and interest: Definitions, development, and relations to achievement outcomes. *Developmental Review*, *30*(1), 1–35. http://dx.doi.org/10.1016/j.dr.2009.12.001

Winne, P., & Hadwin, A. (2008). The weave of motivation and self-regulated learning. In D. Schunk, & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: Theory, research, and applications* (pp. 297–314). New York: Lawrence Erlbaum Associates.

Winne, P., & Perry, N. (2000). Measuring self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 531–566). San Diego: Academic Press.

Zheng, L. (2016). The effectiveness of self-regulated learning scaffolds on academic performance in computer-based learning environments: A meta-analysis. *Asia Pacific Education Review*, *17*(2), 187–202. http://dx.doi.org/10.1007/s12564-016-9426-9

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology*, *81*, 329–339. http://dx.doi.org/10.1037/0022-0663.81.3.329

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal*, *45*, 166–183. http://dx.doi.org/10.3102/0002831207312909

Zimmerman, B. J. (2011). Motivational sources and outcomes of self-regulated learning and performance. In B. J. Zimmerman, & D. H. Schunk (Eds.), *Handbook of self-regulation of learning and performance* (pp. 49–65). NY: Routledge.

Zimmerman, B. J. (2013a). Theories of self-regulated learning and academic achievement: An overview and analysis. In B. J. Zimmerman, & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement* (pp. 10–45). London: Routledge.

Zimmerman, B. J. (2013b). From cognitive modeling to self-regulation: A social cognitive career path. *Educational Psychologist*, *48*, 135–147. http://dx.doi.org/10.1080/00461520.2013.794676

Zimmerman, B. J., & Schunk, D. H. (2013). Reflections on theories of self-regulated learning and academic achievement. In B. J. Zimmerman, & D. H. Schunk (Eds.), *Self-regulated learning and academic achievement* (pp. 282–301). London: Routledge.