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Learning Strategies and Reasoning Skills of University Students☆

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ABSTRACT

The present study examined the learning strategies of university students and the differences in their use as a function of their performance on a fluid intelligence test, a scientific reasoning task, and a divergent thinking or creativity task — all of which are key skills involved in knowledge generation, which is one of the principal aims of the European Higher Education Area. We used 150 participants, divided into two groups according to their performance on the tasks. They completed a questionnaire of learning strategies for university students (CEVEAPEU), which assesses learning strategies organized into six subscales (motivational, affective, metacognitive, context-control strategies, information searching strategies, and information processing strategies). Those students with higher fluid and scientific reasoning skills reported a greater use of strategies aimed at context control (including social interaction and resource management), whereas participants with higher scores on the creativity task reported a significantly greater use of metacognitive, motivational, and purely cognitive strategies (information searching and processing). Overall, these results indicate that the use of learning strategies aimed at supporting and controlling information processing contribute to different reasoning skills, and suggest that the encouragement of social interaction and cooperation among university students would promote the development of basic cognitive skills such as creative thinking and problem-solving abilities.

Estrategias de aprendizaje y habilidades de razonamiento de estudiantes universitarios

Palabras clave:
Estrategias de aprendizaje
Estudiantes universitarios
Razonamiento científico
Inteligencia fluida
Pensamiento divergente
Creatividad

RESUMEN

En este estudio se analizan las estrategias de aprendizaje (EA) de estudiantes universitarios y las diferencias en su uso en función del rendimiento en una prueba de inteligencia fluida, una tarea de razonamiento científico y una tarea de pensamiento divergente o creatividad, por estar estas habilidades implicadas en la generación de conocimiento, una competencia clave en el actual Espacio Europeo de Educación Superior. Los 150 participantes se han dividido en dos grupos dependiendo de su rendimiento en las pruebas y han completado el Cuestionario de Evaluación de Estrategias de Aprendizaje en Estudiantes Universitarios (CEVEAPEU), que mide el uso de estrategias de aprendizaje organizadas en seis subescalas (estrategias motivacionales, afectivas, metacognitivas, de control del contexto, de búsqueda y de procesamiento de la información). Los estudiantes con mayores niveles de razonamiento fluido y científico reportan un mayor uso de estrategias de control del contexto (que incluyen la interacción social y el manejo de recursos), mientras que aquellos estudiantes con mayores niveles de creatividad informan de una utilización superior de estrategias metacognitivas y motivacionales, además de las puramente cognitivas (de búsqueda y procesamiento de información). En conjunto, estos resultados ponen de manifiesto que el empleo de

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diferentes estrategias de apoyo al procesamiento de la información contribuye a distintos tipos de razonamiento y apuntan la necesidad de potenciar la interacción social y la cooperación para la promoción del desarrollo de competencias cognitivas fundamentales, como el pensamiento creativo y la resolución de problemas, entre estudiantes universitarios.

Introduction

In recent years, learning strategies (LS) have been regarded as one of the most fruitful research areas for studying the learning process and the factors that affect this process. The importance of such strategies is evident in the university environment with the introduction of a new concept in which the student is placed at the center of the activities developed in the learning process (Martín, García, Torbay, & Rodríguez, 2008; Marugán, Martín, Catalina, & Román, 2013; Samuelowicz & Bain, 2001). In addition, interest in the scientific analysis of the strategies used by university students also derives from the fact that these strategies promote autonomous, critical, and reflective learning of students (Beltrán, 2003), which are included in the main objectives of the European Higher Education Area (EHEA).

LSs have been given multiple definitions (e.g., Beltrán, 2003; Gargallo, 2006; López-Aguado, 2010; Monereo, 1997). However, as pointed out by Gargallo, Campos, and Almerich (2016), whilst at certain times the emphasis has been placed on the cognitive and metacognitive aspects of the concept, this has been enriched to become more inclusive. Thus, an LS can be defined as "the organized, conscious and intentional set of what the learner does to effectively achieve a learning objective in a given social context and integrating cognitive, meta-cognitive, motivational and behavioral elements" (Gargallo, Suárez-Rodríguez, & Pérez-Pérez, 2009, p. 2). From a theoretical point of view, the LSs are based on the perspective of self-regulated learning ("self-regulated learning", Zimmerman, 1986). This construct is understood as the degree to which individuals participate actively at the cognitive/motivational/behavioral level in their own learning process; that is to say, a self-regulated student or one with a good strategic profile would be able to effectively handle a range of LSs (Gargallo et al., 2016) including: (1) affective-motivational and support elements, which suppose the "will" and therefore willingness and suitable climate for learning, (2) metacognitive, which involve making decisions and evaluating them or "self-regulation" by the student, and (3) cognitive, which involve the "skill" or the management of strategies, skills, and techniques related to information processing (Beltrán, 2003; Gargallo et al., 2009, 2016). In this study we adopted the model developed by Weinstein, Husman, and Dierking (2000), which is composed of the aforementioned "will", "self-regulation" and "skill", and which have been agreed upon by other authors (Gargallo et al., 2016; Monereo, 1997; Yip, 2012).

There are a number of studies that have demonstrated the usefulness of LSs in university students (e.g., Aizpurua, 2017; Gargallo, Almerich, Suárez-Rodríguez, & García-Félix, 2012; Jiménez, García, López-Cepero, & Saavedra, 2018; Ossa & Aedo, 2014), which has a positive effect on academic performance (Castejón, Gilar, & Pérez, 2006; Diseth & Martinsen, 2003; Gargallo et al., 2009; Gil, Bernaras, Elizalde, & Arrieta, 2009; Soares, Guisande, Almeida, & Páramo, 2009; Yip, 2009), particularly when using metacognitive strategies (e.g., Camarero, Martín, & Herrero, 2000; Cano & Justicia, 1993; Gargallo et al., 2012). Similarly, university students employ more strategies to support learning such as context control, metacognitive, or motivational strategies in addition to purely cognitive strategies such as information searching and processing (Aizpurua, 2017; Gargallo et al., 2012, 2016).

Analyzing the use of the LS is important because in addition to assisting in the learning of specific content, it can provide ways for developing intelligence (Carbonero, Román, & Ferrer, 2013). For example, it has been observed that high-skill students (non-university students) report a greater use of LSs than students without high abilities (Marugán, Carbonero, León, & Galán, 2013). However, the relationship between LSs and individual differences in reasoning, intellectual, or creative skills has been scarcely examined in university students. This fact is surprising because, although the educational objective in Higher Education is to acquire the necessary conceptual, procedural, and attitudinal knowledge and expertise to apply this knowledge in different situations, creativity is also fundamental to generate transformation, innovation, and social development (Gutierrez-Braojos, Salmeron-Vilchez, Martin-Romera, & Salmerón, 2013), this being one of the basic skills set out by the EHEA (Martínez & Poveda, 2015). Therefore, the main objective of this work is to analyze the relationship between the use of LSs and cognitive skills related to reasoning and creative thinking. A further objective was to determine the strategic profile of university students by analyzing the LSs they report using.

The skills examined in this study are scientific reasoning, fluid reasoning, and creative thinking. With respect to the latter, we agree with Guilford (1967) who identified several characteristics of creative thinking (fluency, sensitivity to problems, originality, flexibility, and capacity for redefinition) and distinguishes between divergent thinking, which is necessary to generate ideas through the exploration of different possible solutions, and convergent thinking, which is involved in the search for the "correct" or optimal response. Both types of thinking represent different components of human creativity (Guilford, 1967) and correspond to other constructs. Thus, the two-factorial theory of Cattell (1971) relates divergent thinking to fluid intelligence (which includes, among others, processing speed, inductive reasoning, fluency of ideas, and capacity for visual representation). Likewise, divergent thinking coincides with "lateral thinking", implied in the stimulation and creation of new ideas through insight, creativity, and ingenuity (De Bono, 1986). Divergent thinking, therefore, is a necessary component for creativity (Clapham & King, 2010; Elisondo & Donolo, 2016; Hommel, 2012) and is often used to estimate creative potential (Runco, 2014; Runco & Acar, 2012). Moreover, fluid intelligence appears to be a skill closely related to creativity, as seen, for example, in the generation of metaphors (Silvia & Beaty, 2012).

The relationship between cognitive variables such as creativity, scientific thinking, and intelligence appears to be undeniable (Sternberg & O'Hara, 2005). However, the main objective of the present study is to determine the relationship between LSs and these skills. Marugán, Carbonero, et al. (2013) found no connection between intellectual capacity and the use of recall strategies in high ability non-university students, although high-ability students have a higher score in all LSs compared with those of lower ability, whilst Gutierrez-Braojos et al. (2013) observed a positive direct effect of metacognitive strategies on the creativity of university students. Thus, regarding the first objective, students with higher levels of cognitive performance are expected to report a more frequent use of LSs in general (Marugán, Carbonero, et al., 2013) and, in particular, students with a greater capacity for creative thinking should report a greater use of metacognitive strategies (Gutierrez-Braojos et al., 2013). As a further complementary objective, we aimed to identify the strategic profile of the university students analyzed, and, in line with previous findings (Aizpurua, 2017; Gargallo et al., 2012, 2016), we hypothesize that these students will present a strong profile, that is, a frequent and varied management of LSs. In addition, it is anticipated that they will report a greater use of strategies to support information processing as opposed to purely cognitive strategies of information processing.

Method

Participants

The participants were 150 students of the Faculty of Psychology of the University of the Basque Country/Euskal Herriko Unibertsitatea (UPV/EHU). A non-probabilistic sampling technique was employing for convenience, using the first and second year students enrolled in the Psychology degree course of 2015/2016. The number of students enrolled per course in Psychology is 250, so the sample of this study represents 30% of the reference population. The first study involved 68 women and 23 men (M_{age} = 19.91, range = 18–30 years, *SD* = 2.71). In the second study 46 women and 14 men participated (M_{age} = 20.03, range = 18–31 years, *SD* = 3.84).

Instruments

Questionnaire to assess the Learning Strategies of University Students (CEVEAPEU, Gargallo et al., 2009). This questionnaire adopts a self-report format, consisting of 88 items with 5-point Likert-type responses (1 = strongly disagree, 5 = strongly agree) and is divided into two scales, six subscales, and 25 LSs (see Appendix). In this investigation the scores in the subscales were analyzed, and in a complementary manner the use of the strategies grouped into the two main scales (affective and information processing) is compared in the total sample. The theoretical structure of the questionnaire has previously been established (Gargallo et al., 2009, see also Bustos, Oliver, Galiana, & Sancho, 2017). There is good reliability of the whole questionnaire calculated in the sample (Cronbach's alpha $\alpha = .725$, composite reliability = .816, McDonald $\Omega = .867$, and average variance extracted = .546).

Scientific reasoning task. This task is based on the model of scientific discovery as a dual search (Klahr & Dunbar, 1988), according to which there are three main components involved in this process: hypothesis search, hypothesis testing, and evidence evaluation. The task has two phases. In the first, the participant reads the following text: "Imagine that you are a high school teacher. One of your students sees a red ball ascend 2 and a half meters in the air after it first bounces off the ground, and the ball stops after 6 bounces. A few minutes later he sees a blue ball ascend 1 and a quarter meters after its first bounce off the ground, and the ball stops after 12 bounces. On the same page, the following instructions are given:" Please, tell us why the phenomenon described above is possible. That is, formulate all the hypotheses you can to explain the phenomenon. In the second phase, after 5 minutes of performing a distractor task (solving synonyms) the participant is given another page that reads: "After carrying out various experiments, you and your students come to the following two conclusions: (1) The soil and weather conditions have played no role in the phenomenon described previously. (2) Except for the color, the balls are exactly identical. Please, formulate all the hypotheses that you can to explain the phenomenon. That is, you are asked to generate explanations for the problem taking into account the limitations provided. Two independent judges assess the possibility or not of the hypotheses formulated by each participant; for example, the hypothesis "the red ball has been thrown more strongly" is considered possible, while "the blue ball weighed more than the red one" is considered impossible. Each participant obtains two scores, one for possible and the other for impossible hypotheses. An independent judge assesses the responses of all the participants, while a second independent judge assesses the responses of 80% of the participants. The inter-judge agreement calculated with Pearson's correlation analysis could be considered to be high (possible hypotheses $r = .96$, impossible hypotheses $r = .99$).

Fluid reasoning task (Cattell & Cattell, 2001). This task includes visual tests that require the participant to perceive relationships between shapes and figures. In the present study, Form A of Scale 2 was used, which consists of 4 subtests with a duration of 3, 4, 3, and 2.5 minutes, respectively: series, classification, matrices and conditions. For example, in the classification subtest, 14 problems are presented with five abstract figures in each and the participant must select the figure that differs from the other four. The participant's score is calculated by adding all of their correct answers.

Alternative uses task (Guilford, 1967). This task is used to evaluate divergent thinking and has the following instructions: "We are going to ask you to think about some objects, each of which has a common use. You have to try to write as many possible uses as you can think of for the object or parts of it. For example, if we present you a newspaper as an object, which is normally used for reading, you could say that it can be used to: (1) Make fire, (2) Collect garbage, (3) Kill mosquitoes, (4) Line drawers or shelves, (5) Construct an anonymous note. The presented objects are a pencil, chair, and a sheet, with 4 min provided per object. The test manual is used to determine the correctness of the answers. The measure of divergent thinking is calculated by adding all the correct answers produced in the time available. An independent judge assesses the responses of the participants, while a second independent judge assesses the responses of 80% of the participants. The inter-judge agreement on the number of correct answers produced is high ($r = .97$).

Procedure

The procedure followed in this study has the approval of the Ethics Committee of the UPV/EHU. All the participants were evaluated individually during the second semester in their first or second Psychology course. They first fill out the informed consent document and the personal information sheet (age, sex, years of studies, etc.). Then, the participants in Study 1 performed the scientific reasoning task followed by the fluid intelligence test, whilst the participants in Study 2 completed the task of divergent thinking.[1] Finally, participants completed the learning strategies questionnaire and received financial compensation for their collaboration.

Data analysis

The statistical package SPSS, version 23.0 was used. Complying with the assumptions required by parametric tests, homoscedasticity was confirmed using with the Levene test (in all cases $F < 3.978$ and $p > .05$) and the normality of the sample was confirmed in all cases with the Shapiro–Wilk test ($W < .99$ and $p > .05$).

Group was analyzed as an independent variable, the high and low categories of which were established according to the performance of the participants on the cognitive tests. In Study 1, these tests were the scientific and fluid reasoning tasks, and in Study 2 the divergent thinking task was employed. Thus, depending on the number of possible hypotheses produced in the scientific reasoning task, the participants were assigned to the high scientific reasoning group (2 or more possible hypotheses) or the low group

[1] This study is part of a wider research.

(1 or 0 possible hypotheses). Compared with participants with a low level of scientific reasoning ($n = 52$), participants with a high level ($n = 38$) generate more possible hypotheses ($M = 2.26$, $SD = .70$ vs. $M = .73$, $SD = .45$, $t(88) = 13.86$, $p < .001$, $d = 2.95$) and less impossible hypotheses ($M = .26$, $SD = .80$ vs. $M = .67$, $SD = .84$, $t(88) = 2.35$, $p = .021$, $d = 0.50$). On the fluid reasoning task, the answers of three participants are missing for technical reasons, and so the sample is composed of 87 participants, who, depending on their score on the test, are assigned to high or low level. Compared with the mean of the total sample ($M = 34.16$, $SD = 4.77$), the high group has a higher score ($n = 47$, $M = 37.57$, $SD = 2.24$), $t(46) = 10.44$, $p < .001$, $d = 3.09$, and the low group has a lower score ($n = 40$, $M = 30.15$, $SD = 3.70$), $t(39) = 6.86$, $p < .001$, $d = 2.20$. Likewise, in the divergent thinking test, the participants are assigned to the high or low group according to the number of uses generated in the task; the high group ($n = 30$, $M = 24.27$, $SD = 5.19$) has a score higher than the mean of the total sample ($M = 19.20$, $SD = 6.74$), $t(14) = 3.78$, $p = .002$, $d = 2.02$, and the low group ($n = 30$, $M = 14.13$, $SD = 3.48$) has a lower score than the mean of the total sample, $t(14) = 5.64$, $p < .001$, $d = 3.01$.

The effect of the group factor on the dependent variables, which are the scores obtained by the participants on the six subscales measured by the CEVEAPEU questionnaire, is examined with the corresponding analysis of variance (ANOVA). The descriptive statistics of the LSs are also calculated in the total sample. The partial squared Eta ($\eta p2$) for the analysis of variance and Cohen's d for the Student t tests of differences between the means of the groups are presented as measures of effect size. Bonferroni post hoc tests were used to further analyze the effects of significant interactions.

Results

First, the results are presented according to the two groups of participants, i.e., the high and low groups for performance on scientific reasoning, fluid reasoning, and divergent thinking (without distinguishing between Study 1 and 2). For the interpretation of the effect sizes, the guidelines of Cohen (1988) were followed, considering that an effect is small when $\eta p2 = .01$, $d = 0.2$, medium when $\eta p2 = .059$, $d = 0.5$ and large when $\eta p2 = .138$, $d = 0.8$. Secondly, the results of the analyses related to the use of LSs of all participants are presented, that is, independently of their cognitive performance.

Learning strategies and scientific reasoning

Table 1 displays the means and standard deviations of the scores on the total scale, in the scales and in the subscales according to the high and low scientific reasoning groups. To analyze the group differences according to the strategies used (grouped into the subscales), an ANOVA 2 (Group) × 6 (Subscale) was conducted.

Table 1
Scores (Mean and SD) on the total scale, scales, and subscales according to whether participants belonged to the high or low scientific reasoning group

	High		Low	
	M	*SD*	*M*	*SD*
Total scale	3.59	.26	3.51	.31
1. Affective scale	3.63	.25	3.52	.27
1.1. Motivation subscale	3.95	.31	3.89	.26
1.2. Affective subscale	3.18	.54	3.19	.62
1.3. Metacognitive subscale	3.51	.41	3.36	.14
1.4. Context control subscale	3.91	.50	3.65	.43
2. Processing scale	3.54	.38	3.49	.44
2.1. Searching sub-scale	3.39	.45	3.32	.56
2.2. Processing sub-scale	3.70	.43	3.67	.43

The Group factor was not significant, but the significant effects of the interaction Group × Subscale, $F(5, 425) = 4.14$, $p = .001$, $MCe = .16$, $\eta p2 = .046$, indicating that the high scientific reasoning group presents a higher score than the low group on the subscales strategies of *context control, social interaction, and resource management*, $t(88) = 2.59$, $p = .011$, $d = 0.55$, whilst there were no differences on the remaining subscales (see Table 1 and Figure 1). The size of the effects of Group can be regarded as medium.

Learning strategies and fluid reasoning

Table 2 shows the means and standard deviations of the scores on the total scale, the scales and on the subscales according to the high and low fluid reasoning groups. An ANOVA 2 (Group) × 6 (Subscale) was conducted on the differences in the use of LSs between high and low score participants.

There were no significant effects of Group. However, the interaction Group x Subscale reached significance, $F(1, 87) = 4.69$, $p = .033$, $MCe = .16$, $\eta p2 = .052$. In this case differences are observed between the groups on the two subscales; the high group had higher

Table 2
Scores (Mean and SD) on the total scale, the scales, and the subscales according to whether participants belonged to the high or low fluid reasoning groups

	High		Low	
	M	*SD*	*M*	*SD*
Total scale	3.59	.26	3.51	.31
1. Affective scale	3.63	.25	3.52	.27
1.1. Motivation sub-scale	3.93	.29	3.93	.30
1.2. Affective sub-scale	3.03	.46	3.29	.64
1.3. Meta-cognitive sub-scale	3.51	.40	3.38	.43
1.4. Context control sub-scale	3.94	.40	3.68	.53
2. Processing scale	3.54	.38	3.49	.44
2.1. Searching sub-scale	3.43	.48	3.31	.49
2.2. Processing sub-scale	3.71	.40	3.67	.44

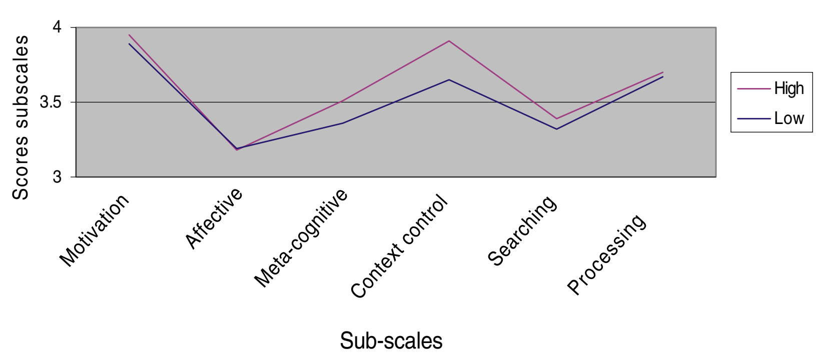

Figure 1. Scores on the subscales according to whether participants belonged to the high or low scientific reasoning groups.

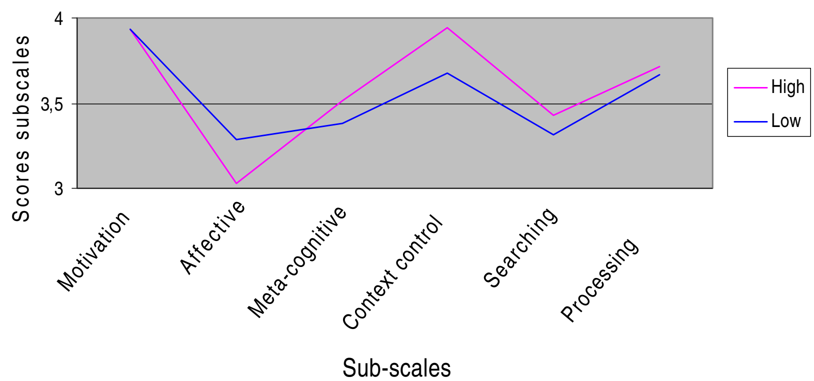

Figure 2. Scores on the subscales as a function of whether participants belonged to the high and low fluid reasoning groups.

Table 3
Scores (Mean and SD) on the total scale, the scales, and the sub-scales as a function of whether participants belonged to the high or low divergent thinking groups

	High		low	
	M	*SD*	*M*	*SD*
Total	3.86	.25	3.54	.19
1. Affective scale	3.93	.28	3.66	.17
1.1. Motivation sub-scale	4.29	.19	3.92	.27
1.2. Affective sub-scale	3.74	.63	3.58	.54
1.3. Meta-cognition sub-scale	3.86	.31	3.41	.19
1.4. Context control sub-scale	3.83	.56	3.73	.22
2. Processing scale	3.79	.34	3.42	.28
2.1. Searching sub-scale	3.70	.42	3.35	.39
2.2. Processing sub-scale	3.88	.32	3.50	.34

Table 4
Scores (Mean and SD) on the total scale, scales, and subscales for the total sample

	M	*DT*
Total scale	3.58	.29
1. Affective scale	3.62	.28
1.1. Motivation sub-scale	3.96	.61
1.2. Affective sub-scale	3.30	.41
1.3. Meta-cognitive sub-scale	3.46	.47
1.4. Context control sub-scale	3.78	.49
2. Processing scale	3.53	.40
2.1. Searching sub-scale	3.38	.49
2.2. Processing sub-scale	3.68	.42

scores than the low group on the subscales of *context control strategies, social interaction, and resource management*, $t(85) = 2.44$, $p = .017$, $d = 0.53$, and lower on the subscale of *affective components*, $t(85) = 2.17$, $p = .033$, $d = 0.47$ (see Table 2 and Figure 2); differences which are considered to be medium in size.

Learning strategies and divergent thinking

Table 3 shows the means and standard deviations of the scores on the total scale, the scales, and the subscales according to the high and low divergent thinking groups. An AVAR 2 (Group) × 6 (Subscale) was carried out on the differences in the use of the LSs between high and low scoring participants.

No main effects of group were found to be significant, $F(1, 59) = 15.64$, $p < .001$, $MCe = .05$, $\eta p2 = 1.49$, with higher scores in the participants of the high than low group of divergent thinking. The Group × Subscale interaction is not significant, indicating that the high group scores are higher than the low group scores on all subscales. However, the results of the post hoc tests show that these differences are statistically significant for the subscales of *motivation*, $t(28) = 4.41$, $p < .001$, $d = 1.67$, *metacognition*, $t(28) = 4.86$, $p < .001$, $d = 1.84$, *search and selection*, $t(28) = 2.36$, $p = .026$, $d = 0.89$, and *processing*, $t(28) = 3.24$, $p = .003$, $d = 1.22$. In all of these cases the size of the observed effects can be considered large.

Learning strategies

Table 4 shows the means and the standard deviations of the scores on the total scale, on the two scales, and on the six subscales for the total sample. All the scores significantly exceed the average value (3) of the scale, indicating a frequent and varied management of strategies. Therefore, we can confirm the presence of a good strategic profile in the student sample analyzed. In addition, it is verified that, as expected, the score of the affective, support, and control scale was higher than the information processing scale, $t(149) = 3.06$, $p = .003$, $d = 0.50$.

Discussion

Although the nature of the cognitive skills shown by those students with a good strategic profile — that is, those who frequently use a variety of strategies in their learning process — is an issue of importance, relevant research is still in its early stages. In this paper we therefore set out to analyze the LSs of university students and how these relate to performance on different tests that measure cognitive abilities. In particular, we focused on scientific reasoning, fluid intelligence, and divergent thinking, since these skills are considered to be critical for creativity and the generation of knowledge, and are key components of the current EHEA (Martínez & Poveda, 2015).

The results obtained reveal that LSs are present in the participating university students and that the latter have, in general, a good strategic profile, that is, they are competent in the management of strategies and are therefore able to implement strategic learning (Gargallo et al., 2012). As observed in the work of other authors (Aizpurua, 2017; Gargallo et al., 2012, 2016), the students reported using more strategies to support learning than purely cognitive strategies. It is precisely the use of learning support strategies that distinguishes students in terms of performance on the cognitive tests, particularly those related to social interaction skills and context control, in addition to motivational and metacognitive strategies. Therefore, favorable differences for students with high cognitive abilities are observed in the "will" and "self-regulation" components of the model proposed by Weinstein et al. (2000), and the size of these differences is considerable.

As the main conclusion of this research, it should be noted that the nature of the LSs reported by the students differ according to the type of reasoning considered. Thus, similar to the high-skill students studied by Marugán and his colleagues (2013), the more competent university students or those with a relatively high level of scientific and fluid reasoning skills claim to use more LSs of context control, social interaction, and resource management. On the other hand, if we consider divergent thinking, high-level students show a greater use of all LSs than students of a low level, with significant differences in metacognitive, motivational, and cognitive strategies (search and information processing). These latter results agree with previous findings indicating that metacognitive strategies predict the level of creative intelligence (Gutierrez-Braojos et al., 2013) and show that motivational strategies and those related to the search, selection, and use of information also contribute in a positive and meaningful way to creative thinking. Motivational strategies have already been associated with high quality learning and good academic performance (Gil et al., 2009; Yip, 2012), and the results of this study allow us to confirm that the benefits of their use extend to divergent thinking skills, which are related to creativity.

In addition to the theoretical importance of our findings, the results of this study also have implications for the educational process. In particular, the results point to the need to encourage social interaction and cooperation among students as a way of boosting scientific and fluid reasoning skills, whilst motivational, metacognitive, and purely cognitive LSs should be implemented to enhance divergent thinking and creative intelligence. The effectiveness of these practices should be investigated in future projects, through the application of specific programs involving the design of subjects and/or the insertion of self-regulated learning in the curriculum of the subjects (Gargallo et al., 2016). In this regard, several authors have found that teaching and promoting the application of LSs has a positive impact on both the ability to learn and subsequent academic performance (Marugán, Martín, et al., 2013; Núñez et al., 2011; Rosário et al., 2007). For example, Gargallo et al. (2016) have recently observed significant benefits of learning strategies when evaluating the effects of a course that was specifically designed to teach the management of such strategies to university students.

Finally, in terms of the limitations of this research, it is worth mentioning that there are aspects of the teaching-learning process that have not been considered in this study, such as the difference between perceived use and actual use of strategies (Marugán, Carbonero, et al., 2013) or the characteristics of the student sample (e.g., the academic year, Aizpurua, 2017). In addition, the size of the observed effects raises the need to conduct more in-depth studies in this field using wider samples of university students studying a range of subjects, and of different ages. These future investigations will help to understand and promote the development of fundamental cognitive skills such as creative thinking, along with learning processes that are key in the EHEA, and will also contribute to improving the training of students who, subsequently, will become creative, reflective, transformative, and independent professionals.

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Appendix. Scales, subscales, and strategies of the questionnaire

Scales	Subscales	Strategies	Items
Scale I Affective strategies of support and control (or self-management) α = .714	Subscales 1.1 Motivational strategies α = .693	Intrinsic motivation	1,2,3
		Extrinsic motivation	4,5
		Value of the task	6,7,8,9
		Internal attributions	10,11,14
		External attributions	12,13
		Self-efficacy and expectations	15,16,17,18
		Conception of intelligence as modifiable	19,20
	Subscale 1.2 Affective components α = .736	Physical and emotional state	21,22,23,24
		Anxiety	25,26,27,28
	Subscale 1.3 Metacognitive strategies α = .718	Knowledge of objectives and evaluation criteria	30,31
		Planning	32,33,34,35
		Self-evaluation	29,36,39
		Control, self-regulation	37,38,40,41,42,43
	Subscale 1.4 Strategies of context control, social interaction, and resource management α = .734	Context control	44,45,46,47
		Social interaction and peer learning skills	48,49,50,51,52,53
Scale II Strategies related to information processing α = .721	Subscale 2.1 Strategies of searching and information selection α = .716	Knowledge of sources and information search	54,55,56,57
		Selection of information	58,59,60,61
	Subscale 2.2 Strategies of processing and information use α = .719	Acquisition of information	62,63,64,65
		Development	66,67,68
		Organization	69,70,71,72,81
		Personalization and creativity, critical thinking	73,74,75,76,77
		Storage. Memorization. Use of mnemonic resourcess	80,82,83
		Storage. Simple repetition	78,79
		Transference. Use of information	86,87,88
		Resource management for using acquired information	84,85

References

Aizpurua, A. (2017). Estrategias de aprendizaje: Diferencias por curso académico en estudiantes universitarios de Psicología y Máster. *Cultura y Educación*, *29*(1), 31–61. http://dx.doi.org/10.1080/11356405.2016.1269500

Beltrán, J. (2003). Estrategias de aprendizaje. *Revista de Educación*, *332*, 55–73.

Bustos, V., Oliver, A., Galiana, L., & Sancho, P. (2017). Propiedades psicométricas del CEVEAPEU: Validación en población peruana. *Educación XXI*, *20*, 299–318. http://dx.doi.org/10.5944/educXX1.11546

Camarero, F., Martín, F., & Herrero, J. (2000). Estilos y estrategias de aprendizaje en estudiantes universitarios. *Psicothema*, *12*, 615–622.

Cano, F., & Justicia, F. (1993). Factores académicos, estrategias y estilos de aprendizaje. *Revista de Psicología General y Aplicada*, *46*, 89–99.

Carbonero, M. A., Román, J. M., & Ferrer, M. (2013). Programa para "aprender estratégicamente" con estudiantes universitarios: diseño y validación experimental. *Anales de Psicología*, *29*(3), 876–885. http://dx.doi.org/10.6018/analesps.29.3.165671

Castejón, J. L., Gilar, R., & Pérez, A. M. (2006). Aprendizaje complejo: el papel del conocimiento, la inteligencia, motivación y estrategias de aprendizaje. *Psicothema*, *18*, 679–685.

Cattell, R. B. (1971). *Abilities: Their structure, growth and action*. Boston: Houghton-Mifflin.

Cattell, R. B., & Cattell, A. K. S. (2001). *Tests de Factor «g» Escalas 2 y 3*. Madrid: TEA.

Clapham, M. M., & King, W. R. (2010). Psychometric characteristics of the CREA in an English speaking population. *Anales de Psicología*, *26*(2), 206–221.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). New Jersey: Lawrence Erlbaum.

De Bono, E. (1986). *El pensamiento lateral*. Barcelona: Ediciones Paidós.

Diseth, A., & Martinsen, O. (2003). Approaches to learning, cognitive style, and motives as predictors of academic achievement. *Educational Psychology*, *23*(2), 195–207. http://dx.doi.org/10.1080/01443410303225

Elisondo, R., & Donolo, D. (2016). Construcción y análisis de las propiedades psicométricas del Cuestionario de Acciones Creativas en población argentina PSIENCIA. *Revista Latinoamericana de Ciencia Psicológica*, *8*(1), 1–21.

Gargallo, B. (2006). Estrategias de aprendizaje, rendimiento y otras variables relevantes en estudiantes universitarios. *Revista de Psicología General y Aplicada*, *59*(1–2), 109–130.

Gargallo, B., Almerich, G., Suárez-Rodríguez, J. M., & García-Félix, E. (2012). Estrategias de aprendizaje en estudiantes universitarios excelentes y medios Su evolución a lo largo del primer año de carrera. *RELIEVE*, *18*, 1–22. http://dx.doi.org/10.7203/relieve.18.2.2000

Gargallo, B., Campos, C., & Almerich, G. (2016). Aprender a aprender en la universidad Efectos de una materia instrumental sobre las estrategias de aprendizaje y el rendimiento académico. *Cultura y Educación*, *28*(4), 790–809. http://dx.doi.org/10.1080/11356405.2016.1230293

Gargallo, B., Suárez-Rodríguez, J. M., & Pérez-Pérez, C. (2009). El cuestionario CEVEAPEU: Un instrumento para la evaluación de las estrategias de aprendizaje de los estudiantes universitarios. *RELIEVE*, *15*(2), 1–31. http://dx.doi.org/10.7203/relieve.15.2.4156

Gil, P., Bernaras, E., Elizalde, L. M., & Arrieta, M. (2009). Estrategias de aprendizaje y patrones de motivación del alumnado de cuatro titulaciones del Campus de Gipuzkoa. *Infancia y Aprendizaje*, *32*(3), 329–341. http://dx.doi.org/10.1174/021037009788964132

Guilford, J. P. (1967). *The nature of human intelligence*. New York: McGraw-Hill.

Gutierrez-Braojos, C., Salmeron-Vilchez, P., Martin-Romera, A., & Salmerón, H. (2013). Efectos directos e indirectos entre estilos de pensamiento, estrategias metacognitivas y creatividad en estudiantes universitarios. *Anales de Psicología*, *29*(1), 159–170. http://dx.doi.org/10.6018/analesps.29.1.124651

Hommel, B. (2012). Convergent and divergent operations in cognitive search. In P. M. Todd, T. T. Hills, & T. W. Robbins (Eds.), *Cognitive search: Evolution, algorithms, and the brain* (pp. 215–230). Cambridge, MA: MIT Press.

Jiménez, L., García, A. J., López-Cepero, J., & Saavedra, F. J. (2018). Evaluación de estrategias de aprendizaje mediante la escala ACRA abreviada para estudiantes universitarios. *Revista de Psicodidáctica*, *23*(1), 63–69. http://dx.doi.org/10.1016/j.psicod.2017.03.001

Klahr, D., & Dunbar, K. (1988). Dual space search during scientific reasoning. *Cognitive Science*, *12*(1), 1–48. http://dx.doi.org/10.1207/s15516709cog1201_1

López-Aguado, M. (2010). Design and analysis of the Individual Learning Strategies Questionnaire for University Students. *Revista de Psicodidáctica*, *15*(1), 77–99.

Martín, E., García, L. A., Torbay, A., & Rodríguez, T. (2008). Estrategias de aprendizaje y rendimiento académico en estudiantes universitarios. *International Journal of Psychology and Psychological Therapy*, *8*(3), 401–412.

Martínez, C., & Poveda, B. (2015). Creativity as a competency in Bologna: A critical analysis. In *Proceedings of EDULEARN15 conference*.

Marugán, M., Carbonero, M., León, B., & Galán, M. (2013). Análisis del uso de estrategias de recuperación de la información por alumnos con alta capacidad intelectual (9-14 años) en función del género, edad, nivel educativo y creatividad. *Revista de Investigación Educativa*, *31*, 185–198. http://dx.doi.org/10.6018/rie.31.1.147361

Marugán, M., Martín, L. J., Catalina, J., & Román, J. M. (2013). Estrategias cognitivas de elaboración y naturaleza de los contenidos en estudiantes universitarios. *Psicología Educativa*, *19*(3), 13–20. http://dx.doi.org/10.5093/ed2013a3

Monereo, C. (1997). La construcción del conocimiento en el aula. In M. L. Pérez Cabaní (Ed.), *La enseñanza y el aprendizaje de estrategias desde el curriculum* (pp. 21–34). Gerona: Horsori.

Núñez, J. C., Cerezo, R., Bernardo, 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*(2), 274–281.

Ossa, C., & Aedo, J. (2014). Enfoques de aprendizaje, autodeterminación y estrategias meta-cognitivas en estudiantes de pedagogía de una universidad chilena. *Ciencias Psicológicas*, *8*, 79–88.

Rosário, P., Mourão, R., Núñez, J. C., González-Pienda, J., Solano, P., & Valle, A. (2007). Eficacia de un programa instruccional para la mejora de procesos y estrategias de aprendizaje en la enseñanza superior. *Psicothema*, *19*(3), 422–427.

Runco, M. A. (2014). *Creativity: Theories and themes: Research, development and practice*. London: Elsevier.

Runco, M. A., & Acar, S. (2012). Divergent thinking as an indicator of creative potential. *Creativity Research Journal*, *24*(1), 66–75. http://dx.doi.org/10.1080/10400419.2012.652929

Samuelowicz, K., & Bain, J. D. (2001). Revisiting academics' beliefs about teaching and learning. *Higher Education*, *41*(3), 299–325. http://dx.doi.org/10.1023/a:1004130031247

Silvia, P. J., & Beaty, R. E. (2012). Making creative metaphors: The importance of fluid intelligence for creative thought. *Intelligence*, *40*(4), 343–351. http://dx.doi.org/10.1016/j.intell.2012.02.005

Soares, A. P., Guisande, M. A., Almeida, L. S., & Páramo, M. (2009). Academic achievement in first-year Portuguese college students: The role of academic preparation and learning strategies. *International Journal of Psychology*, *44*(3), 204–212. http://dx.doi.org/10.1080/00207590701700545

Sternberg, R. J., & O' Hara, L. (2005). Creatividad e inteligencia. *Cuadernos de Información y Comunicación*, *10*, 113–149.

Weinstein, C. E., Husman, J., & Dierking, D. R. (2000). Self-regulation interventions with a focus on learning strategies. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 727–747). San Diego: Academic Press.

Yip, M. C. W. (2009). Differences between high and low academic achieving university students in learning and study strategies: A further investigation. *Educational Research and Evaluation*, *15*(6), 561–567. http://dx.doi.org/10.1080/13803610903354718

Yip, M. C. W. (2012). Learning strategies and self-efficacy as predictors of academic performance: A preliminary study. *Quality in Higher Education*, *18*(1), 23–34. http://dx.doi.org/10.1080/13538322.2012.667263

Zimmerman, B. J. (1986). Becoming a self-regulated learner: Which are the key sub-processes? *Contemporary Educational Psychology*, *11*(4), 307–313. http://dx.doi.org/10.1016/0361-476x(86)90027-5