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Effects of self-regulated learning and procrastination on academic stress, subjective well-being, and academic achievement in secondary education

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Abstract
The main objective of this study was to test a structural theoretical model of the effects of self-regulated learning on academic stress, subjective well-being, and academic achievement in Secondary Education, considering academic procrastination as a mediator. An additional aim was to explore whether these relationships were moderated by gender and educational level. Participants were 728 students in compulsory and post-compulsory secondary education in a large city in Eastern Spain. Path analysis results indicated that the proposed model showed satisfactory fit, with the three dimensions of self-regulated learning significantly predicting the educational outcomes considered, and that procrastination mediated these relationships. Overall, the model is able to predict 9.8% of the variance of academic stress, 23.1% of students wellbeing, and 14% of academic achievement. Moreover, the multi-group routine revealed no moderation effects due to gender, but educational level moderated two relationships, between self-efficacy and academic achievement and between metacognitive strategies and procrastination. Additionally, supplementary models were tested for three specific subjects (Spanish Language, Foreign Language and Mathematics), which showed an improvement in explained variance, being respectively: 29%, 28% and 27%. Results are discussed in light of previous research and in terms of their impact on educational practice.

Keywords Self-regulated learning · Procrastination · Academic stress · Subjective well-being · Academic achievement

Introduction

Academic procrastination, defined as "the voluntary delay of action on academic tasks despite expecting to be worse off for that delay" (Gustavson & Miyake, 2017; Steel, 2007), is a highly prevalent phenomenon in educational contexts. A large body of research with university students reveals that between 70–95% of students procrastinate consistently and problematically (e.g., Ozer et al., 2009; Rozental & Carlbring, 2014). In addition, the majority of these students express a strong desire to reduce their procrastination (Grunschel & Schopenhauer, 2015; Koppenborg & Klingsieck, 2022; Solomon & Rothblum, 1984) which shows negative effects on their learning and well-being (Duru & Balkis, 2017; Klingsieck, 2013).

However, fewer studies have analyzed students' procrastination in educational stages prior to the university (Klassen et al., 2009), despite the importance of this problem in secondary education (Klassen & Kuzucu, 2009; Ozer & Ferrari, 2011) and its close relationship with self-regulated learning (Schraw et al., 2007), a basic competence to develop in this educational stage (Albert, 2017; García-Ros et al., 2018a, Klassens, Krawchuk, & Hannok, 2011) that is closely related to students' academic performance (e.g., Dent & Koenka, 2016; Kitsantas et al., 2008; Pintrich & De Groot, 1990) and well-being (e.g., Litalien et al., 2013; Rodríguez et al., 2022). More specifically, Ozer (2011) showed the relevance

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of procrastination in secondary education, pointing out that more than half of the students in this educational stage procrastinate frequently, whereas Klassen and Kuzucu (2009) reveal that 83% procrastinate more than one hour per day, especially on postponing studying for exams (38% of students), performing weekly tasks (30%), and turning in work on time (27%).

Given the relevance of academic procrastination, the scant research on it in the stage of secondary education (Klassen et al., 2009), and the excessively fragmented perspective of the research in this area (Rebetez et al., 2015; Steel, 2007), this study aims to analyze the structural relationships between students' procrastination and self-regulated learning, as well as their effects on students' well-being and academic achievement in this educational stage. There is a general consensus among researchers that the absence or lack of self-regulation skills plays a central role in academic procrastination (Balkis & Duru, 2016). Therefore, understanding the effects of the cognitive, motivational, and affective dimensions of self-regulated learning on procrastination in secondary education is of particular importance in order to improve students' regulation strategies, facilitate the prevention of procrastination and its intervention, and allow students to obtain better academic results and greater well-being in their studies.

Academic procrastination and self-regulated learning

Research with university students highlights the inverse relationship between academic procrastination and self-regulated learning (e.g., Hong et al., 2021; Howell et al., 2006; Senécal et al., 1995; Wolters, 2003), defined as "an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behavior, guided and constrained by their goals and the contextual features in the environment" (Pintrich, 2000, p. 453). More specifically, the failure to engage in self-regulated learning has traditionally been considered an antecedent of academic procrastination (Schraw et al., 2007; Sirois & Pychyl, 2013) and evidenced in several previous studies (e.g., Ergulec et al., 2022; Zarrin et al., 2020). For example, self-efficacy for learning and self-regulation strategies (e.g., Wolters, 2003), as well as self-efficacy in applying these strategies (Tan et al., 2008), are the self-regulated learning dimensions that show the greatest relationships with academic delays in several studies with university students (Klassen et al., 2011). Numerous studies also reveal the positive relationship between academic procrastination and test anxiety, suggesting that anxiety may be one of its triggers (Onwuegbuzie, 2004; Owen & Newbegin, 1997; Rothblum et al., 1986; Tan et al., 2008; Van Eerde, 2003).

Almost all the research conducted in secondary education shows a significant relationship between self-regulated learning and procrastination (e.g., Klassen & Kuzucu, 2009). For example, Orpen (1998) highlights a significant inverse relationship between the two constructs ($r = -.23$, $p < .01$). Klassen and Kuzucu (2009) highlight the significant inverse relationship between self-regulated learning and procrastination, whereas different studies find a positive relationship with a low magnitude between test anxiety and procrastination (e.g., Klassen & Kuzucu; Owen & Newbegin, 1997; Rosário et al., 2009). Klassen et al. (2009), in a study with Canadian and Singaporean adolescents, analyzed and compared the contributions of self-esteem, self-efficacy for self-regulation, and test anxiety to procrastination, finding similar patterns in both cultural contexts. The variables considered in the study jointly explained a high percentage of variance in procrastination (51% in the Canadian group, 40% in the Singaporean group), with self-efficacy for self-regulation being its best predictor ($\beta = -.63$ for Canadians, $\beta = -.54$ for Singaporean adolescents, $p < .001$ in each group), whereas test anxiety also showed a significant but smaller effect ($\beta = .10$, $p < .05$ for Canadians, and $\beta = .19$, $p < .001$ for Singaporeans).

García-Ros et al. (2016), in a study with Spanish compulsory secondary students, showed that metacognitive strategies ($\beta = -.14$, $p < .05$), self-efficacy for learning ($\beta = -.26$, $p < .01$), and intrinsic motivation ($\beta = -.21$, $p < .05$) significantly predict academic procrastination, jointly explaining 35% of its variance. Ziegler and Opdenakker (2018), in a study with first-year secondary students, found significant effects of effort regulation ($\beta = -.59$ $p < .001$), metacognitive strategies ($\beta = -.08$ $p < .001$), and self-efficacy for learning ($\beta = -.05$, $p < .05$) on academic procrastination.

In summary, previous research has found a significant inverse relationship between self-regulated learning and procrastination. However, studies conducted in secondary education are still quite scarce, and they tend to focus on analyzing the relationship and/or the effects of specific dimensions of self-regulated learning on procrastination, without simultaneously considering the cognitive, affective, and motivational dimensions highlighted in the reference models on self-regulated learning (e.g., Park & Sperling, 2012; Pintrich, 2004). Additionally, some of these dimensions are incorporated in a very limited way in previous research, even though their strong relationship with procrastination has been evidenced in some studies (e.g., effort regulation, Ziegler & Opdenakker, 2018). This study attempts to address these gaps in previous research by focusing on secondary education and simultaneously analyzing the effects of the cognitive, affective, and motivational dimensions of self-regulated learning on procrastination (Pintrich, 2004).

Procrastination and academic achievement

A meta-analytic study carried out to determine the nomological network for procrastination (Van Eerde, 2003) showed a significant average effect size of procrastination on academic performance -assessed both through students' GPA (r = -.28, $p < .001$) and course grades (r = -.17, $p < .001$)-, although most of the research included was conducted with university students. Another recent meta-analysis (Kim & Seo, 2015) showed an inverse relationship between students' procrastination and academic achievement, with higher levels of this association found in secondary education (r = -.32, $p < .001$) than in the university (r = -.16, $p < .001$), and it highlighted the few studies carried out in secondary education (only five studies out of the thirty-three included in the meta-analysis).

Focusing on secondary education, Owen and Newbegin (1997) showed negative correlations between procrastination and academic achievement in Mathematics (r = -.34, $p < .001$) and English language (r = -.26, $p < .001$). Orpen (1998) also showed a significant negative correlation between procrastination and academic achievement (r = -.24, $p < .001$). Howell et al. (2006) analyzed the relationship between different measures of procrastination and grades in an introductory psychology course. They found a significant relationship between the latter and the students' self-reported procrastination on course assignments (r = -.25, $p < .05$), but not with their scores on the Procrastination Assessment Scale-Students (Solomon & Rothblum, 1984). Lubbers et al. (2010), in a study with Dutch adolescents, concluded that academic procrastination partially mediates the relationship between different personality dimensions and Mathematics and Dutch-language outcomes, with a significant weak inverse relationship found between students' procrastination and grades in both subjects (Mathematics, r = -.04, $p < .05$; Dutch language = -.08, $p < .05$). Lastly, in a study conducted with Spanish students, a significant correlation was found between procrastination and academic performance in post-compulsory secondary education (r = -.22, $p < .01$) (García-Ros et al., 2011).

In contrast, there are very few studies that simultaneously analyze the effects of self-regulated learning on procrastination and of both constructs on students' academic performance. A previously mentioned study (García-Ros et al., 2016) analyzed the effects of several dimensions of self-regulated learning on procrastination and of both constructs on academic performance and students' well-being. Self-efficacy for learning showed direct effects on academic performance ($\beta = -.46$, $p < .001$), metacognitive strategies showed direct effects on academic stress ($\beta = .14$, $p < .05$), and procrastination showed negative effects on academic performance ($\beta = -.18$, $p < .05$), but not on academic stress ($\beta = .08$, $p > .05$), explaining 31% of the variance in academic performance and only 6% of the variance in academic stress. Grunschel et al. (2016), in two studies with university students, also analyzed the effects of students' motivational regulation strategies and procrastination on their academic performance and well-being. The results highlighted that regulation strategies had a weak-moderate inverse relationship with procrastination and a weak direct relationship with academic performance, whereas procrastination was inversely related to academic performance (r = -.25, $p < .01$). Additionally, through path analysis techniques, the authors found significant effects of motivational regulation strategies on procrastination (Study 1, $\beta = -.33$, $p < .01$; Study 2, $\beta = -.27$, $p < .01$) and academic performance (Study 1, $\beta = .13$, $p < .01$; Study 2, $\beta = .05$, $p > .05$), and of procrastination on academic performance (Studies 1 and 2, $\beta = -.20$, $p < .01$), showing that procrastination mediates the effects of motivational regulation strategies on academic performance. These results are congruent with the perspective that views procrastination as a deficit in self-regulation processes and strategies, supporting the idea that it stems from a motivational deficit (Klingsieck, 2013).

In summary, previous studies have shown the relationship between self-regulated learning and procrastination and their significant effects on academic performance, although most of the studies have been carried out with university students. In addition, these relationships have been analyzed in a fragmented way, that is, determining the effects of self-regulated learning and/or procrastination on academic performance separately, without considering the relationships between the two constructs (e.g., García-Ros et al., 2016; Grunschel et al., 2016; Yang, 2021). This study attempts to address both aspects by analyzing the potential mediating role of procrastination in the effect of self-regulated learning on academic performance.

Procrastination, academic stress, and students' well-being

The meta-analysis carried out by Van Eerde (2003) showed a moderate and significant relationship between procrastination and state anxiety (r = .28, $p < .001$) and depression (r = .30, $p < .001$). Studies conducted with undergraduates also indicate that procrastination is a significant predictor of students' well-being (e.g., Balkis, 2013), showing its direct relationship with academic anxiety and stress (e.g., Balkis & Duru, 2016; Sirois et al., 2013, 2016; Solomon & Rothblum, 1984; Stead et al., 2010; Tice & Baumeister, 1997). The few studies conducted in secondary education yield similar results (e.g., García-Ros et al., 2016; Yaseminejadm et al., 2013), pointing out that the consequences of procrastination are mainly psychological (e.g., anxiety, depressive symptomatology, and learning problems), although they can also be somatic (e.g., physical complaints, skin alterations, intestinal problems), mediated by adolescents' coping strategies and emotional self-regulation (Boekaerts, 2011; Pintrich, 2000).

On the other hand, different studies with university students have analyzed the mediation or moderation roles of third variables in the relationship between procrastination and personal well-being. For example, the intensity of the relationship between procrastination and academic stress seems to be related to the urgency of the response to the stressors (e.g., Schraw et al., 2007). Thus, Tice and Baumeister (1997) showed that procrastinators present lower levels of stress and physical and psychological symptomatology than non-procrastinators at the beginning of academic semesters, whereas in their final phases -close to the time to turn in papers and take exams-, they show greater stress and physical symptomatology, more doctor visits, and worse results. In other words, academic procrastination can produce short-term benefits, but it also has important medium- and long-term costs related to producing low quality work at the last minute, higher levels of stress and fear of failure, and worse academic outcomes, which can lead to physical and mental health problems (Natividad, 2014). Recent studies have shown an inverse relationship between procrastination and student well-being in college students ($r = -.34$, $p < .01$). However, at the same time, given that students with lower well-being (e.g., low self-confidence and efficacy beliefs) perceive the school environment as more discouraging (Habelrih & Hicks, 2015), their tendency to procrastinate may also increase, which, in turn, could further reduce their well-being (Fernie & Spada, 2008).

Grunschel et al. (2016) also point out the relationship between motivational regulation strategies and procrastination and their significant effects on the well-being of university students, showing that procrastination partially mediates the effects of motivational self-regulation on affective well-being (positive and negative emotions) and fully mediates its effects on cognitive well-being (satisfaction with studies). Balkis and Duru (2016) also found that both self-regulated learning and procrastination are related to students' well-being, given that self-regulated learning shows direct effects on positive affect and procrastination shows direct effects on negative affect (negative emotions toward studies), whereas procrastination partially mediates the effects of self-regulated learning on academic life satisfaction. Finally, a recent study with university students from two different cultural contexts (China and Europe) showed that self-regulation moderates the relationship between procrastination and life satisfaction in Asian students, but not in European students (Yang, 2021). Thus, this author found significant relationships between self-regulation, procrastination, and life satisfaction in both countries, but he also found that self-regulation moderates the effects of procrastination on life satisfaction only in the Asian context, where procrastination significantly and inversely predicts life satisfaction in students with low self-regulation, but not in students with high self-regulation. Thus, the results further suggest the moderating role of the cultural context of reference in the relationships between the variables considered in the study.

In summary, previous research has also shown the significant relationship between self-regulated learning and procrastination and its effects on student well-being. As previously highlighted, the close relationship between the two constructs suggests considering them simultaneously when studying their effects on this educational outcome (e.g., Cobo-Rendón et al., 2020), a question this study seeks to address. Moreover, the lack of studies of this type in secondary education and the divergences with those carried out with university students also point to the importance of delving deeper into this issue, especially if we consider the close relationship between students' well-being and their academic success and mental health (e.g., Langford et al., 2014; Wörfel et al., 2016).

Academic procrastination, gender, and age of the students

Procrastination in daily life decreases with age (Steel, 2007; Van Eerde, 2003), which means that effective strategies are developed to overcome it and they improve with repeated practice. However, the results for academic procrastination are not conclusive because some studies show an increase between secondary education and the university (Ozer, 2011). Advancing through the educational system requires higher levels of self-regulation and dealing with increasingly complex tasks, aspects related to higher levels of student procrastination (Steel, 2007).

Studies that analyze the possible differences based on gender mainly highlight that women procrastinate less than men (Steel, 2007; Van Eerde, 2003). However, various studies with adolescents point to the existence of significant differences in academic procrastination between boys and girls, whereas others indicate that the gender variable moderates the effects of self-regulated learning on academic procrastination (Klassen & Kuzucu, 2009). More specifically, this latter study showed that self-regulated learning is a relevant predictor of procrastination in both boys and girls ($R^2 = .40$, $p < .001$), and that Self-efficacy for self-regulation ($\beta = -.59$, $p < .001$ for boys, and $\beta = -.47$, $p < .001$ for girls) and self-esteem ($\beta = -.15$, $p < .001$ for boys, and $\beta = -.13$, $p < .001$ for girls) are significantly associated with procrastination in both groups. However, self-efficacy for learning only showed significant effects on procrastination in girls ($\beta = -.21$, $p < .001$), but not in boys ($\beta = -.02$, $p < .001$).

Therefore, these results emphasize the relevance of analyzing the possible effects of the educational level and gender of the students on academic procrastination in secondary education, as well as their possible moderation role in the relationships between students' self-regulated learning, procrastination, personal well-being, and academic

achievement, a question that has not been sufficiently addressed in previous studies.

The present study

As mentioned in previous sections, the studies that have analyzed the relationship between self-regulated learning and procrastination, and the relationship between these two constructs and academic performance and/or student well-being, have mostly been carried out with university students, whereas very few have been conducted in previous educational stages. In addition, most of them have separately analyzed the relationships and effects of self-regulation and procrastination on the two educational outcomes, which has led to excessively fragmented research. This study aims to address these gaps in the previous research by determining the structural relationships between academic procrastination and self-regulated learning in secondary education and their effects on students' well-being and academic achievement, as well as the possible moderator effects of gender and educational level. The competing structural models that relate the variables can be seen in Fig. 1. Based on previous research, the following hypotheses are proposed:

(1) Self-regulated learning will show significant effects on students' procrastination and on the educational outcomes considered in the study: (1.a) Metacognitive strategies and self-efficacy for learning will have negative relationships with students' procrastination and positive relationships with their subjective well-being and academic performance; (1.b) Test anxiety will show positive associations with students' procrastination and academic stress and negative relationships with their subjective well-being and academic achievement.

(2) Academic procrastination will show positive associations with students' academic stress and negative associations with their subjective well-being and academic achievement.

(3) Academic procrastination will partially mediate the relationship between self-regulated learning and students' academic stress, personal well-being, and academic achievement. Several studies conducted with university students support this hypothesis (Balkis & Duru, 2016; Grunschel et al., 2016). Additionally, studies in secondary education point out that self-regulated learning is a relevant antecedent of procrastination, and, in turn, both constructs are good predictors of both academic performance and well-being. Congruent with these results, the hypothesis states that low levels of self-regulation will be related to greater procrastination, worse academic results, and less personal well-being, and greater procrastination will lead to worse academic results and lower levels of well-being, partially mediating the effects of self-regulated learning on both of the educational outcomes considered. In contrast, students who are highly self-regulated will obtain better results and show higher well-being.

Method

Participants

Participants in the study were 728 Spanish Secondary Education students from six Public Secondary Schools in a large city in Eastern Spain. Their mean age was 15.66 years ($SD = 3.7$), ranging from 12 to 21 years; 372 were female (47.8%). In Spain, Secondary Education (12–18 years old) is structured in two stages: Compulsory Secondary Education –CSE- (7th-10th grade, 12–16 years) and Post-Compulsory Education –PSE- (11th-12th grade, 17–18 years).

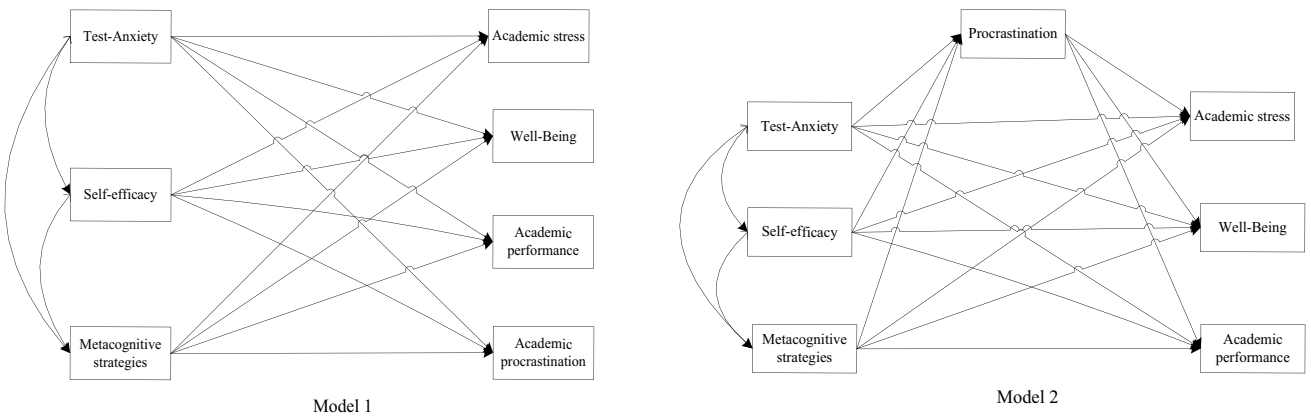

Fig. 1 Competing structural models considered in the study

After passing the CSE stage, students can access two different types of programs in PSE: Upper Secondary Education General Branch or Mid-level Vocational Training. More specifically, the study involves 413 CSE students (56.7% of the sample), with a similar distribution by grade levels (7^{th} grade, $n = 97$; 8^{th}, $n = 103$; 9^{th}, $n = 109$; 10^{th}, $n = 106$), and 315 PSE students (Upper Secondary Educational Branch, $n = 182$, 25% of the sample; Mid-level Vocational Training, $n = 133$, 18.3% of the sample).

The reference population is made up of the 52,488 secondary school students enrolled in the schools in the city mentioned above (CSE, 58.4% of the population; PSE 41.6% of the population -Upper Secondary Education General Branch, 21.8%; Mid-level Vocational Training, 19.8%-) with a similar distribution by gender (CSE, 48.9% female; PSE, 50.5% female). Thus, although the study used a non-probabilistic convenience sampling procedure, the distribution of the sample by educational stages and grades, as well as by the gender of the participants, is aligned with the characteristics of the population (Generalitat Valenciana, 2021a, b). In addition, the study was carried out in public secondary schools, where students from families with medium to low socioeconomic levels are mostly enrolled (Consejo Escolar Valenciano, 2021).

Materials and procedure

The study was reviewed and approved by the Ethics Committee of the University of Valencia (code number H1523870265031). Likewise, it had authorization from the Board of Education of the Valencian Government to access the schools and carry out the study. Questionnaires were administered in groups during regular school hours. Participation was voluntary, and written consent was obtained from participants prior to initiating the study (for those under 18 years old, parents' informed consent was obtained). The questionnaires were administered by experienced school psychologists who were familiar with the different instruments. Because students were surveyed in their own academic settings, missing data were rare. The variable with the largest percentage of missing data had less than 2%. Therefore. missing data were omitted from the analyses.

Self-regulated learning was assessed with the Spanish adaptation of the *Motivated Strategies for Learning Questionnaire* -MSLQ- for secondary education (Albert, 2017; Pintrich & De Groot, 1990). Items are rated on a seven-point scale from 1 (*never*) to 7 (*always*). In this study, three different MSLQ subscales were used:

- *Metacognitive Strategies.* It evaluates the processes of planning, monitoring, and metacognitive regulation in an academic context. It includes six items (e.g., "I try to change the way I study in order to fit the course requirements and the instructor's teaching style"). In previous research ($\alpha = .74$) and in this study, it showed adequate internal consistency ($\alpha = .71$)
- *Self-Efficacy for Learning.* It evaluates the student's confidence about his/her ability to perform the academic tasks. It consists of seven items (e.g., "I'm confident I can understand the most complex material in this course") and showed satisfactory internal consistency in previous research and in this study (in both cases $\alpha = .89$).
- *Test Anxiety.* It evaluates the cognitive and emotional components of test anxiety with three items (e.g., "When I take tests, I think of the consequences of failing"). It showed satisfactory internal consistency in the previous research ($\alpha = .70$), as well as in this study ($\alpha = .74$).

Students' procrastination was assessed by the *Academic Procrastination Scale* (García-Ros et al., 2011, 2016). It has five items (e.g., "I start studying for the exams at the last moment") rated on a five-point scale from 1 (*never/almost never*) to 5 (*always/almost always*). Previous studies have shown its satisfactory internal consistency ($\alpha = .78$), which is slightly higher than the alpha obtained with this sample ($\alpha = .75$).

The *Academic Overload* subscale of the *Questionnaire of Academic Stress in Secondary Education* (QASSE) (García-Ros et al., 2018b) was used to assess the academic stress produced by the perception of lack of time, as well as the feeling of being overwhelmed by the amount of schoolwork and exams. It has nine items (e.g., "taking exams") rated on a five-point scale from 1 (*very low*) to 5 (*very high*). Both previous research and the present study have shown satisfactory internal consistency (.86 and .83, respectively).

Students' well-being was assessed by the Spanish adaptation of the *General Health Questionnaire* (GHQ-12) (Lobo & Muñoz, 1996). The GHQ-12 consists of 12 items that assess mental health problems in the past few weeks using a 4-point Likert scale (0 to 3). In this study, higher scores indicate better health. Its adequate internal consistency has been shown in previous research and in this study (.86 and .79, respectively).

Academic achievement corresponds to the average grade obtained by the students at the end of the school year in which the study is carried out, considering all the subjects taken. The final grades of 273 CSE students are also available for three specific subjects taken at all the academic levels in this educational stage (Spanish Language, English Language, and Mathematics). In Spain, the Secondary Education Grading system ranges from 0 to 10 (10 = Matriculation with Honors, A +; 9.00–9.99 = Outstanding, A; 7.00–8.99 = Very good, B +; 6.00–6.99 = Good, B; 5.00–5.99 = Sufficient, C; 3.00–4.99 = Insufficient, D; 0.00–2.99 = Very Insufficient, F). The grades were provided by the administrative services of the participating schools at the end of the academic year.

Statistical analyses

The aim was to test several structural models with observed variables. There are two competing models. In Model 1 (see Fig. 1), test anxiety, self-efficacy, and metacognitive strategies predict students' academic stress and well-being, academic achievement, and procrastination. In Model 2 (see Fig. 1), there are direct effects of test anxiety, self-efficacy, and metacognitive strategies on several educational outcomes (students' academic stress, well-being, and academic achievement), as well as their indirect effects through procrastination. That is, the difference between Models 1 and 2 is that procrastination mediates the relationships in Model 2. These competing models are shown in Fig. 1.

After establishing a good model fit, a second aim of the research was to test for potential moderation effects of both gender and educational level on the structural parameters of the model. Accordingly, several multi-group models were specified. Models were estimated with Robust Maximum Likelihood in EQS 6.1 (Bentler, 1995), given that data were not multivariate normal (Mardia's normalized estimate = 5.52) (Finney & DiStefano, 2006). Finally, and given that separate grades per subject (Mathematics, Spanish-language, and English-language) were available for compulsory secondary students, the final model was estimated three more times, changing the overall measure of academic achievement to achievement in these three specific subjects. The aim of these three models was to test for potential differential effects of procrastination depending on the subject.

Model fit was assessed using several tests and indices (Hu & Bentler, 1999; Kline, 2015): (a) the chi-square statistic; (b) a comparative fit index (CFI) of more than .90 (and ideally, greater than .95) to indicate good fit; (c) a root mean squared error of approximation (RMSEA) of .08 or less (and ideally, less than .05); and (e) the standardized root mean squared residuals (SRMR), with values of .08 or less (and ideally, less than .05) indicating excellent fit. Based on the recommendations by Hu and Bentler (1999), a CFI of at least .90 (better .95), a RMSEA of less than .06, and a SRMR of less than .08 would together indicate a very good data-model fit. Nevertheless, overall fit must be accompanied by a careful diagnosis of the analytical fit (parameter estimates) of the model, in order to avoid using the aforementioned thresholds blindly (Kline, 2015).

To test for the moderator effects of gender and educational level, two multi-group routines were applied, one to compare boys and girls and another to compare CSE vs PSE students. The multi-group routine starts with the same model estimated in both groups without any constraints (across group equalities). This multi-group unconstrained model offers a baseline fit with which to compare other more parsimonious (constrained) models. In this context, structural parameters (covariances and structural effects) are then constrained to equality. If the model fit does not deteriorate, the more parsimonious model is retained, and no moderation effects are declared. However, if the model fit deteriorates, this indicates that some (or all) of the constraints were not correctly imposed, that is, that there are differences between the groups and, therefore, moderator effects. Models in the multi-group routine are nested and, therefore, may be compared using two rationales, the statistical rationale and the modelling rationale. The statistical rationale employs χ^2 differences ($\Delta\chi^2$) to compare constrained and unconstrained models, with non-significant values suggesting multi-group equivalence. However, this statistical approach has been criticized (Cheung & Rensvold, 2002), recommending the modelling approach. From this point of view, if a parsimonious model (such as the one that posits parameter equalities or constraints) shows adequate levels of practical fit, then the set of equalities is considered a reasonable approach to the data. CFI differences (ΔCFI) are usually used to evaluate measurement invariance. CFI differences of less than .01 (Cheung & Rensvold, 2002) are usually employed as cut-off criteria. Additionally, equalities are tested with Lagrangian Multiplier tests, which make it possible to find out which ones are correctly imposed and which are not.

Results

Descriptive statistics and correlations among all the variables in the model are presented in Table 1. The three dimensions of self-regulated learning showed significant relationships with academic procrastination; the largest relationship was with metacognitive strategies. Metacognitive strategies, self-efficacy for learning, and academic procrastination showed significant relationships with academic stress, well-being, and academic achievement –except metacognitive strategies with well-being-.

Structural model

Next, the two competing structural models were tested (see Fig. 1). Model 1's fit was relatively poor: $\chi^2(6) = 28.72$, $p < .001$, CFI = .916, RMSEA = .092 [0.060- .127], SRMR = .045. Model 2 fitted the data well: $\chi^2(3) = 4.24$, $p > .05$, CFI = .996, RMSEA = .030 [.000—.090], SRMR = .017. Therefore, the comparison of the fit of the two models makes it clear that the mediator role of procrastination is tenable, and so this model will be maintained for further scrutiny. Nevertheless, some of the parameter estimates were statistically non-significant ($p > .05$) and very low in magnitude. These non-significant relationships were removed, and a new, more parsimonious model was tested. Specifically, the relationships removed were: the correlation between test anxiety and metacognitive strategies;

Table 1 Descriptive statistics and correlation matrix among the variables considered in the study

Dimensions/variables	M	SD	Sk	Ku	Correlations						
					TA	SE	MS	AP	AS	WB	AA
Test Anxiety (TA)	11.11	5.02	0.17	-0.93	1						
Self-efficacy (SE)	31.26	8.06	-0.33	-0.02	-.234***	1					
Metacognitive strategies (MS)	26.91	6.87	-0.41	0.03	.033	.316**	1				
Academic Procrastination (AP)	13.58	3.96	0.22	-0.23	.162***	-.279***	-.367***	1			
Academic stress (AS)	23.05	4.81	-0.31	-0.09	.312***	-.098**	.141***	.125**	1		
Well-being (WB)	3.60	1.99	0.38	0.05	-.377***	.364***	.058	-.223***	-.344***	1	
Academic achievement (AA)	6.32	1.74	-0.82	1.11	-.115**	.375***	.248***	-.244***	-.028	.069	1

M Means; *SD* Standard deviations; *Sk* Skewness; *Ku* Kurtosis; * $p < .05$, ** $p < .01$, *** $p < .001$

the structural effect of self-efficacy on academic stress; the structural effect of metacognitive strategies on well-being; and the structural effect of test anxiety on academic performance. This model fitted the data extremely well -$\chi^2(7) = 8.46$, $p > .05$, CFI = .995, RMSEA = .022 [.000—.064], SRMR = .028-, and given that the fit was similar to or even better than the fit of the more complex initial model, it was retained. Parameter estimates for this model are shown in Fig. 2.

Multi-group models by gender and educational level

First, a multi-group routine was used to test for potential moderation effects of gender on the overall model shown in Fig. 2. The baseline model was freely estimated in both samples, boys and girls, and it fitted the data extremely well: χ^2 (14) = 13.84, $p > .05$, CFI = .999, RMSEA = .001 [.000—.064], SRMR = .031. Then, all the structural parameters were constrained to be equal across samples. This constrained (more parsimonious) model also fitted the data extremely well: χ^2 (28) = 22.83, $p > .05$, CFI = .999, RMSEA = .001 [.000—.038], SRMR = .042. When the constrained and baseline models were compared, no significant differences were found in terms of statistical (χ^2 (14) = 9.21, $p > .05$) or practical fit (ΔCFI = .000). These results revealed that there were no moderation effects due to gender. In other words, the relationships shaped by the model were the same in both samples.

A second multi-group routine was used, this time to test for potential moderation effects of educational level. The baseline model (no constraints) again fitted the data very well: χ^2 (14) = 14.46, $p > .05$, CFI = .999, RMSEA = .012 [.000—.066], SRMR = .043. Then, a second multi-group model was estimated with all structural parameters constrained to equality in both groups, and model fit was: χ^2 (28) = 41.31, > .05, CFI = .974, RMSEA = .036 [.000—.067], SRMR = .063. When this

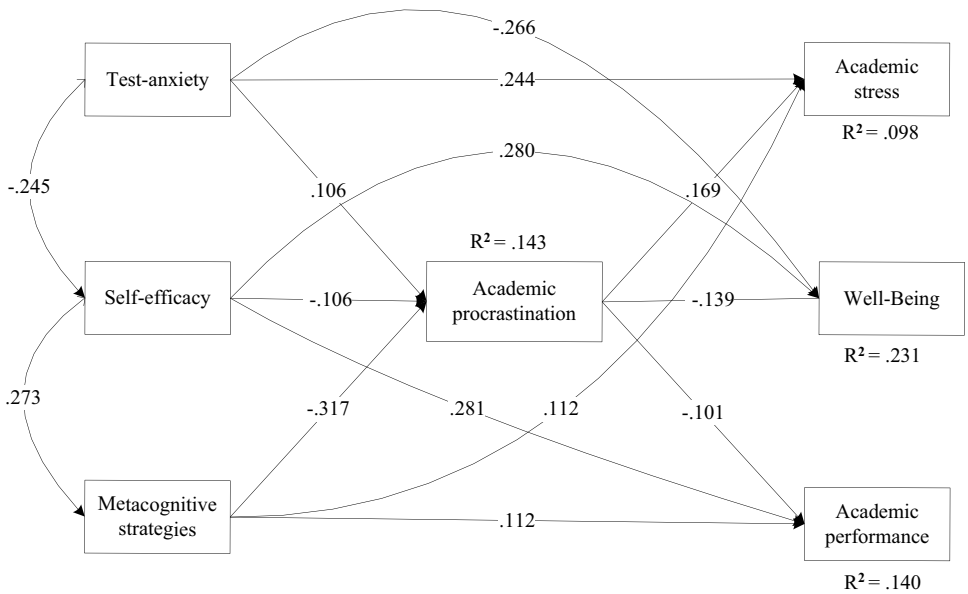

Fig. 2 Standardized parameter estimates in the model

constrained model was compared to the baseline multi-group model, there were no statistically significant differences between the two chi-squares (χ^2 (14) = 9.21, > .05), but there were practical fit differences (ΔCFI = .025). Additionally, the LM test found that two of the constraints were not correctly imposed. That is, their release and free estimation in both samples would improve model fit. Given these results, a third multi-group model was estimated, with all parameter estimates constrained to equality except these two aforementioned estimates: the structural path from metacognitive strategies to procrastination and the path from self-efficacy to academic performance. This new model fitted the data extremely well: χ^2 (26) = 23.69, $p > .05$, CFI = .999, RMSEA = .001 [.000—.047], SRMR = .050. More importantly, when this model was compared to the baseline model, there were no statistical (χ^2 (12) = 9.28, > .05) or practical fit differences (ΔCFI = .000). On the whole, the results revealed that there were two relationships in which educational level acted as a moderator. All parameter estimates are shown in Fig. 3.

Structural model for three different subjects

The adequacy and predictive capacity of the structural model for the end-of-year grades obtained by the students in three specific subjects taught at all the educational levels of Compulsory Secondary Education (Spanish language, English language, and Mathematics) were also analyzed. Thus, the structural model depicted in Fig. 2 was estimated three more times, one per academic subject, replacing the average grade obtained by the students at the end of the school year with their Spanish language grades, then with their English language grades, and finally with their Mathematics grades. The parameter estimates for these three models are offered in Figure 4 as supplementary material. Preliminary analyses showed significant and strong correlations among students' grades in the three subjects ($r_{Spanish\text{-}English} = .70$; $r_{Spanish\text{-}Mathematics} = .59$; $r_{English\text{-}Mathematics} = .76$) and between these grades and their average grade at the end of the academic year (.71, .59 and .67, respectively).

The structural model with the Spanish language grades fitted the data well: χ^2 (7) = 4.78, $p > .05$, CFI = .999, RMSEA = .027 [.000—.068], SRMR = .017. Regarding the effects on the Spanish language grades, they were: $\beta = -.16$ ($p < .01$) for procrastination, $\beta = .13$ ($p < .01$) for metacognitive strategies, and $\beta = .41$ ($p < .01$) for self-efficacy. Overall, these three predictors explained 29% of the variance.

The structural model with the English language grades also fitted the data well: χ^2 (7) = 4.51, $p > .05$, CFI = .999, RMSEA = .013 [.000—.060], SRMR = .014. Regarding the effects on the English language grades, they were: $\beta = -.19$ ($p < .01$) for procrastination, $\beta = .05$ ($p > .05$) for metacognitive strategies, and $\beta = .43$ ($p < .01$) for self-efficacy. Overall, these three predictors explained 28% of the variance.

Finally, the structural model with the Mathematics grades also fitted the observed data well: χ^2 (7) = 6.09, $p > .05$, CFI = .996, RMSEA = .027 [.000—.068], SRMR = .017. Regarding the effects on the Mathematics grades, they were: $\beta = -.15$ ($p < .01$) for procrastination, $\beta = .09$ ($p > .05$) for metacognitive strategies, and $\beta = .41$ ($p < .01$) for self-efficacy. Overall, these three predictors explained 27.1% of the variance.

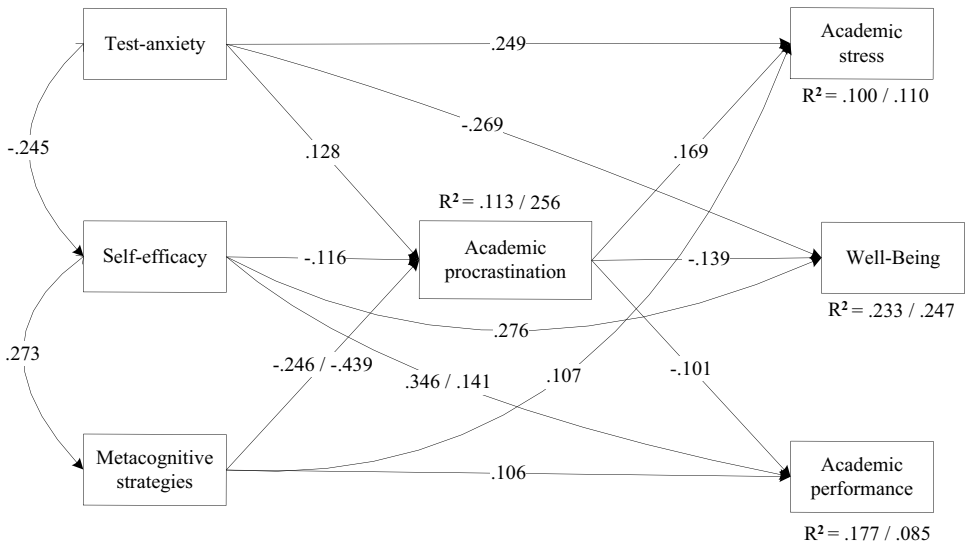

Fig. 3 Standardized parameter estimates in the model: moderation effects of educational level *(Note:* all parameters are statistically significant, $p < .05$; when two values are given for the same effect, the first one belongs to CSE and the second one to PSE)

Discussion and conclusions

The purpose of this study was to evaluate a structural theoretical model of the relationships between academic procrastination, self-regulated learning, students' well-being, academic stress, and academic achievement in secondary education. The model proposes the existence of direct effects of both academic procrastination and self-regulated learning on the three educational outcomes considered, also examining the mediator role of students' procrastination in the effects of self-regulated learning on these outcomes. In addition, the possible moderator effects of gender and educational level on the specific relationships in the model are also analyzed.

The initial analyses showed the existence of significant relationships among the study variables in the expected direction, with similar magnitudes to those found in previous research in secondary education (e.g., Albert, 2017; Pintrich & De Groot, 1990) and with university students (e.g., Broadent & Poon, 2015; Feyzi Behnagh & Ferrari, 2022; Kim & Seo, 2015; Richardson et al., 2012). Thus, academic procrastination showed moderate negative relationships with metacognitive strategies and self-efficacy for learning (e.g., Klassen & Kuzucu, 2009; Orpen, 1998) and a small positive relationship with test anxiety (e.g., Klassen et al., 2009; Rosário et al., 2009). The three dimensions of self-regulated learning considered show significant relationships with each other, with academic performance, and with students' well-being (e.g., Albert, 2017; Pintrich et al., 1993). Both the metacognitive strategies and self-efficacy for learning dimensions showed moderate positive correlations with academic performance and well-being, whereas they differed in their relationship with stress. In contrast, test anxiety showed a negative association with academic performance and personal well-being and a positive relationship with academic stress. Lastly, procrastination showed an inverse relationship with academic achievement (e.g., Howell et al., 2006; Kim & Seo, 2015; Lubbers et al., 2010) and students' well-being (e.g., Klassen et al., 2009), and a positive association with academic stress (e.g., Klassen et al., 2009; Yaseminejadm et al., 2013).

The results show that the proposed structural model fitted the data well, explaining a percentage of the variance in the three educational outcomes considered (14% for academic achievement, 23.1% for students' well-being, and 9.8% for academic stress) and revealing its ability to explain the relationships among the dimensions considered in the study. Thus, the results highlight the relevance and complementary nature of the cognitive, motivational, and emotional dimensions of self-regulated learning in predicting students' procrastination, as well as the direct effects of the self-regulation dimensions and procrastination on students' personal well-being, academic stress, and academic achievement (e.g., Richardson et al., 2012). More specifically, there are significant effects of the three dimensions of self-regulated learning on academic procrastination (e.g., Klassen et al., 2008, 2009, 2011), with metacognitive strategies showing the greatest effects ($\beta = -.317$; $p < .01$). These results support the idea that procrastination in secondary education is related to students' difficulties with cognitively and motivationally self-regulating their school activity (e.g., Howell & Watson, 2007; Rabin et al., 2011). Additionally, the findings show that procrastination should also be considered a maladaptive emotion regulation strategy used to face negative emotions produced by academic tasks and studying by postponing them in order to avoid the discomfort and anxiety they provoke (e.g., Sirois & Pychyl, 2013, 2016; Tice et al., 2001).

In addition, the three dimensions of self-regulated learning also show significant direct effects on students' well-being, academic stress, and academic achievement. Thus, both metacognitive strategies and self-efficacy have positive effects on achievement, although the latter has greater effects ($\beta = .281$, $p < .01$) (e.g., Klassen & Kuzucu, 2009). Moreover, congruent with the close relationship between the two constructs (Onwuegbuzie, 2004; Yerdelen et al., 2016), test anxiety presents greater effects on academic stress ($\beta = .244$, $p < .01$). Finally, self-efficacy and test anxiety show opposite effects, with similar magnitudes, on students' well-being, emphasizing the role of the motivational and emotional dimensions of self-regulated learning in well-being (e.g., Simon and Durand-Bush, 2014). In summary, the results support the important role of self-regulated learning in Secondary Education, not only in academic procrastination, but also in the three educational outcomes considered (e.g., Balkis & Duru, 2016; Hofer et al., 2011).

Furthermore, also coinciding with the study hypotheses, procrastination has direct negative effects on students' achievement ($\beta = -.101$, $p < .05$) and well-being ($\beta = -.139$, $p < .05$), and positive effects on academic stress ($\beta = .169$, $p < .05$) (e.g., Sirois, 2007; Sirois & Pychyl, 2016; Tice & Baumeister, 1997; Van Eerde, 2003). However, although these results show the relevance and diversity of the undesired effects of students' procrastination, the effects are small and comparable to those found in previous research in this educational stage (e.g., García-Ros et al., 2016; Kim & Seo, 2015). In any case, it is relevant to highlight that direct effects of procrastination are found on all three educational outcomes considered, after computing the effects of the three dimensions of self-regulated learning. Previous research repeatedly highlights these dimensions as relevant predictors of students' academic performance and well-being

(e.g., Richardson et al., 2012), while this study also highlights that procrastination partially mediates its effects on the educational outcomes considered.

The structural model also showed adequate fit to the data when considering the academic results of CSE students in three specific subjects (Spanish Language, English Language, and Mathematics), beyond the fit found for the average academic performance obtained by the students at the end of the course (average end-of-year grade). Thus, the model explained a very similar percentage of variance in performance in the three academic subjects (29%, 28%, and 27%, respectively), as well as effects of very similar magnitudes among the model variables. However, when comparing these results with those obtained for average academic performance at the end of the school year, relevant differences are found: (a) The structural model predicts performance in the specific subjects to a much greater degree than it explains average academic performance (in this case, in CSE, it explains 17% of its variance); (b) Several effects are much greater when analyzing the model that considers achievement in the specific subjects rather than average achievement: metacognive strategies on procrastination (model for subjects grades, $\beta = -.320$; for the average grade $\beta = -.246$), self-efficacy for learning on achievement (for subject grades, $\beta = .411$; for average grade, $\beta = .346$), and procrastination on academic achievement (for Mathematics, $\beta = -.192$; for average grade $\beta = -.101$). One possible explanation could be that considering average academic achievement masks the effects of self-regulated learning and procrastination on students' results. In other words, academic performance as considered in this study is the average of students' grades in subjects with high cognitive load (e.g., the three subjects considered in this study) and in subjects with lower cognitive load and difficulty (e.g., music, art, physical education), although self-regulated learning and procrastination would be better predictors of academic performance in the former than in the latter. This interpretation is congruent with the results found in the meta-analyses that analyze the effects of self-regulated learning (Dent & Koenka, 2016) and procrastination (Kim & Seo, 2015) on academic achievement, highlighting the moderator role of the academic subjects. However, given that the analysis of the fit of the structural model considers achievement in the specific subjects with a subsample of study participants, these comments should be interpreted with caution, and this question should be investigated in greater depth in future studies.

The analyses designed to evaluate the possible moderator effects of gender and educational level on the relationships and effects shown in the resulting model reveal that there were no significant differences between males and females. The few studies that have analyzed this question indicate that self-efficacy can be a better predictor of academic procrastination in women than in men (Klassen & Kuzucu, 2009). This question highlights the need to investigate this aspect in greater depth. However, the results show the moderator role of the educational stage in the effects of the metacognitive strategies on procrastination (significantly higher in PSE than in CSE) and of self-efficacy on academic achievement (higher in CSE than in PSE). The differences in the effect of the metacognitive strategies on academic procrastination can be explained by the degree of autonomy required of students in CSE and PSE. Thus, in PSE, students are required to have a higher level of self-regulation over their own learning processes, whereas in CSE there is greater follow-up, supervision, and support from teachers (and families) in performing academic tasks, which can reduce the level of students' procrastination and help them to obtain satisfactory academic results. Thus, the negative effects on academic procrastination are higher in PSE if students have not developed metacognitive strategies related to planning, monitoring, and assessment of their own academic activity (Pintrich, 2004). Moreover, the fact that self-efficacy is a better predictor of academic achievement in CSE than in PSE can be explained by the decline in the motivational dimensions and levels of academic engagement in CSE, which return to higher and more homogeneous levels among students in PSE (e.g., Archambault et al., 2009; García-Ros et. al., 2018a).

In summary, the results show the adequacy of the structural model proposed, revealing the direct effects of the three self-regulated learning dimensions and academic procrastination on students' academic stress, personal well-being, and academic achievement in secondary education, as well as the mediator role of procrastination in the effects of self-regulated learning on these educational outcomes. Additionally, whereas all the structural relationships are homogeneous between women and men, the educational level moderates the relationship between metacognitive strategies and students' procrastination and between self-efficacy for learning and academic achievement.

These results have numerous implications for educational practices in secondary education. One of them is the importance of promoting cognitive, motivational, and emotional dimensions of self-regulated learning to prevent and reduce students' procrastination and improve their academic achievement and stress, as well as their personal well-being. Furthermore, the results show that it is important for teachers to focus on reducing academic procrastination in both CSE and PSE, given its direct effects and its mediator role in the effects of self-regulated learning on the educational outcomes considered. More specifically, the results indicate that educational practices designed to promote the development of metacognitive strategies (e.g., planning and regulating study processes and behaviors, establishing and prioritizing

sub-objectives when performing tasks) can help to reduce procrastination to a greater degree in this educational stage. Moreover, although self-efficacy for learning and test anxiety show less important effects on students' procrastination, their effects on personal well-being, stress, and academic achievement also highlight the relevance of fostering their improvement in both CSE and PSE.

The results also point to the relevance of intervening in academic procrastination in secondary education, given its undesired effects on the three outcomes considered. Furthermore, coinciding with previous research, intervention in academic procrastination can produce positive effects on both the levels of academic achievement and the emotional dimensions linked to the school activity in secondary education. In addition, actions designed to reduce procrastination can increase their effectiveness if they focus on improving not only the students' metacognitive strategies, but also their time management strategies and levels of self-efficacy while reducing their academic stress and test anxiety (e.g., creating a positive and supportive classroom environment, teaching test preparation strategies and stress management) (e.g., Kachgal et al., 2001). In conclusion, these results reveal the importance of focusing our efforts on reducing students' procrastination in secondary education by adopting an intervention approach that considers the complex interactions among the behavioral, cognitive, and affective components involved in self-regulated learning (e.g., Rozental & Carlbring, 2014; Schouwenburg et al., 2004).

The present study has several limitations. First, although it starts from a consolidated theoretical model of self-regulated learning (Pintrich, 2004) and uses a prestigious assessment instrument -the MSLQ- in secondary education (Albert, 2017; Pintrich & De Groot, 1990), it does not assess dimensions of self-regulated learning that are considered in its version for university students and that have been shown to be relevant in predicting procrastination and academic achievement in college (e.g., Park & Sperling, 2012; Richardson et al., 2012; Wolters et al., 2017), as well as in some specific studies in secondary education (e.g., effort regulation, Ziegler et al., 2018). Consequently, future studies should also consider these other dimensions of self-regulated learning (e.g., time and work environment management, effort regulation, task value, control beliefs about learning, peer-learning, help-seeking) (Pintrich et al., 1993). Additionally, in order to improve our knowledge about the relationships between the variables considered in the study, future research could also consider different types (e.g., active and passive procrastination) (e.g., Choi & Moran, 2009) and profiles of procrastinators (e.g., Rebetez et al., 2015) found in studies with undergraduates. Second, it would have been interesting to consider a more complex longitudinal research design that would assess the study variables several times throughout the academic year, given that there may be important intra- and inter-individual differences in their evolution, relationship, and effects depending on the proximity to academic assessments (e.g., Tice & Baumeister, 1997; Ziegler & Opdenakker, 2018). In addition, a larger and more representative sample of Spanish secondary school students would have allowed us to generalize the research results to a greater degree. Furthermore, given the limitations of self-report assessment instruments (Fulmer et al., 2009), future studies should also use behavioral measures of procrastination (e.g., speech or behavior during task, absence or late submission of assignments), given that the type of measures used can mediate the observed relationships between self-regulated learning, procrastination, and academic achievement (e.g., Dent & Koenka, 2016). In any case, we think this study makes significant contributions to filling a relevant gap in the previous research, given the lack of studies analyzing procrastination in secondary education and the need to address the excessive fragmentation of the research in this area. Thus, the present study offers a more integrated and comprehensive view of the set of relationships and effects among the variables considered, showing that procrastination partially mediates the effects of selfregulates learning on the three educational outcomes consideded, as well as the potential moderator role of the educational stage on them, providing guidelines to consider in interventions in this area to improve students' academic outcomes and well-being in secondary education.

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Data availability The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Declarations

Ethics approval and consent The study were reviewed and approved by The Ethics Committee of the University of Valencia (ref. H1523870265031). The participants provided their written informed consent to participate in this study, and for those under 18 years old, parents' informed consent was obtained).

Competing interest The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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