The role of academic context-related factors and problematic social media use in academic procrastination: A cross-sectional study of students in elementary, secondary, and tertiary education

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Abstract

The present study investigated students' academic procrastination in elementary, secondary, and tertiary education cross-sectionally, by simultaneously examining the predictive role of perceived academic context-related factors and problematic social media use (PSMU) in the manifestation of procrastination. Students from elementary ($N=532$), secondary ($N=561$) and tertiary education ($N=519$) from randomly selected Greek schools and university departments completed a self-report questionnaire, which included scales on academic procrastination, academic engagement, academic connectedness, and PSMU. The results showed that elementary and secondary school students procrastinate more than university students, who perceive procrastination as a problem and desire to reduce it to a greater extent. No gender differences were found regarding students' procrastination. Furthermore, the path analyses revealed similarities and differences in the explanatory models of procrastination for the three student-groups. Generally, academic engagement and connectedness negatively predicted academic procrastination, while PSMU negatively mediated this relationship. Nevertheless, among the three path models, different dimensions of the predictive variables involved contributed to procrastination in elementary, secondary, and tertiary education. The findings imply that in each level of education specific academic context-related psychological states could be enhanced along with the promotion of safe social media use to effectively prevent students' academic procrastination.

Keywords Academic procrastination · Academic context-related factors · Problematic social media use · Elementary school students · Secondary school students · University students

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1 Introduction

Procrastination is viewed as a common psychological phenomenon, which is reflected in different settings (Muliani et al., 2020) and can be manifested at a decisional and a behavioral level (Zarzycka et al., 2021). In the academic context, procrastination constitutes students' intentional delay in fulfilling academic tasks and assignments with specific deadlines, such as homework and studying for exams, which are usually considered difficult and demanding (Steel, 2007; Tezer et al., 2020). Sometimes this strategy has short-term benefits when students deliberately delay completing an academic task, as they know they can respond more constructively under time pressure (active procrastination). In contrast, passive procrastination concerns students' passive attitude towards the completion of academic tasks (Chun Chu & Choi, 2005). This type of procrastinating behavior, which the present study focuses on, can be seen as a dysfunctional academic behavior due to its multidimensional negative consequences in students' lives. Indicatively, students' academic procrastination has been negatively related to their achievement (Anierobi et al., 2021) and well-being (Bu et al., 2021).

Although consequences of academic procrastination have been examined, little is known about the explanatory academic context-related factors and behavioral mechanisms of this maladaptive pattern of behavior. The present study, incorporating these factors into the framework of the problem behavior theory (PBT) (Boyd et al., 2009; Jessor, 2001), proposes a new complex mediation model highlighting how significantly under-investigated factors, such as academic engagement, academic connectedness, and problematic social media use (PSMU), may intercorrelate with each other and contribute to academic procrastination. Finally, given the lack of comparative findings on procrastination across different levels of education, the present study examined the proposed mediation model cross-sectionally among students in elementary, secondary, and tertiary education.

1.1 Students' academic procrastination: Does the level of education matter?

A literature review on students' academic procrastination, shows that most of the studies during the last few decades have been conducted on student populations of secondary (Demir & Kutlu, 2018; Ebadi & Shakoorzadeh, 2015; Fulano et al., 2018; Gündüz, 2020; Klassen & Kuzucu, 2009; Latipah et al., 2021; Setiyowati et al., 2020; Vural, 2013; Yang et al., 2023) and tertiary education (Balkis, 2011, 2013; Karatas, 2015; Scheunemann et al., 2021; Vasiou et al., 2022; Wang et al., 2021). Specifically, it is mentioned that involvement in academic procrastination for secondary school and university students ranges from 45 to 83% (Klassen & Kuzucu, 2009; Setiyowati et al., 2020) and from 62 to 95%, respectively (Taura et al., 2015; Vasiou et al., 2022). However, only a limited number of studies have investigated this behavior in elementary school students with no clear findings regarding the prevalence of academic procrastination among these younger children (Al-Attiyah, 2010; Parantika et al., 2020; Xue et al., 2023).

The above research trend could be viewed as expected, considering that academic procrastination has been associated with variables, which seem to impact differently on students at different times in their education (elementary, secondary, and tertiary). For example, students' academic anxiety, the difficulty of assigned tasks, less interesting assignments, long hours of daily school/academic attendance, and the competitive school/academic climate, which usually predispose students to procrastinate during their studies, do not occur as often in elementary school (Ackerman & Gross, 2005; Esmaeili & Monadi, 2016). In the elementary school environment, there is usually less academic anxiety, more interesting and experiential learning activities, closer interpersonal relationships, and a less competitive school climate, compared to secondary and tertiary education (Lerdpornkulrat et al., 2018; Touloupis, 2021; Wong et al., 2008; Zapata-Caceres et al., 2021), the more intense research interest in adolescents' and young adults' academic procrastination could be explained. Therefore, there has been more intense research interest in adolescents' and young adults' academic procrastination. However, there are some studies which have confirmed the prevalence of academic procrastination among elementary school students (Al-Attiyah, 2010; Parantika et al., 2020; Xue et al., 2023). Therefore, it is highlighted the need to investigate the factors which may contribute to this behavior in the elementary school context, since the elementary schools constitute a fertile ground for preventing students' (academic) behavioral problems (Touloupis & Athanasiades, 2022a), such as academic procrastination.

Considering the above, there could be different procrastination rates when students are in elementary, secondary, and tertiary education. Unfortunately, based on the authors' knowledge, only one recent related study which compared elementary and secondary school students' procrastination and found that elementary school students did not procrastinate as much as secondary school students (Martín-Puga et al., 2022). Consequently, it is concluded that a future study investigating students' academic procrastination in elementary, secondary, and tertiary education simultaneously could offer a more comparative perspective regarding not only the extent of this behavior but also the possibly different predictive role of context-related factors in the three levels of education. Such research could inform prevention programs for academic procrastination for each level of education.

1.2 Gender issues in students' academic procrastination

As students' academic procrastination has triggered scientific research for several years, it is not surprising that the role of demographic characteristics, such as gender, in academically procrastinating behaviors has been widely examined. Most of the related findings over-emphasize university students' procrastination, considering that the level of difficulty in academic tasks/assignments in tertiary education makes students easily prone to develop procrastination in their academic duties. However, the findings seem to be conflicted. For example, some studies mention that male university students tend to procrastinate to a greater extent compared to females (Balkis & Erdinç, 2017; Khan et al., 2014; Ying & Lv, 2012), while others reveal females' over-representation in this behavior (Ghosh & Roy, 2017; Özer et al., 2009). Also,

some authors conclude that there is no significant gender-based difference in academic procrastination (Ajayi, 2020; Amoke et al., 2021; Harrison, 2014; He, 2017; Islak, 2011).

The significant under-investigation of academic procrastination in younger students, such as secondary and especially elementary school students, leads to even less research attention to gender differences in the manifestation of this behavior. For example, Ozer and Ferrari (2011) showed that adolescents' academic procrastination is found more often among females, while Martín-Puga et al. (2022) recently found male adolescents' over-engagement in this behavior. On the other hand, Ebadi and Shakoorzadeh (2015) some years ago revealed no gender differences. The scant studies with elementary school students have found that male students procrastinate more frequently than female students (Al-Attiyah, 2010; Parantika et al., 2020).

The above findings show that the role of students' gender in academic procrastination undoubtedly remains an unclear and/or contradictory research field in all levels of education, especially in elementary and secondary education. A future study trying to clarify the gender-based profile of students who procrastinate in the three levels of education could possibly highlight gender-based different risk groups of students who are considered vulnerable to adopt a maladaptive academic behavior in different educational contexts.

1.3 A theoretical framework for academic procrastination

In an attempt to interpretively frame academic procrastination, different perspectives, such as psychodynamic, behavioral, and cognitive, have been proposed. For example, according to psychodynamic theory, procrastination operates as a psychological defense in case a student fails to fulfill an academic task; the behavioral aspect poses that procrastination is activated when a student has learned to avoid a demanding situation; and the cognitive aspect considers procrastination to be because of dysfunctional thoughts/beliefs that trigger the delayed response to a task (Siaputra, 2010). The above theories, although explaining the manifestation of academic procrastination, seem to offer a more intrapersonal approach, focusing on individuals' emotional, behavioral, and cognitive characteristics as predictive of their procrastination. Indicatively, it has been systematically reported that students' emotional intelligence, namely their ability to recognize their own feelings and guide their thinking and actions appropriately, can negatively predict their academic procrastination (Chow, 2011; Deniz et al., 2009; Guo et al., 2019; Hen & Goroshit, 2014; Vasiou et al., 2022). Accordingly, students' low self-esteem, namely their general sense of low self-worth, and high anxiety make them prone to procrastination behaviors as a masking mechanism against fragile emotions (Batool et al., 2017; Lekich, 2006; Mehmet et al., 2014; Yang et al., 2023).

However, based on the PBT (Boyd et al., 2009; Jessor, 2001), a more complex explanatory framework is proposed for the development of problematic behaviors, such as academic procrastination. According to the PBT, academic procrastination may not be explained only in terms of intrapersonal characteristics/traits (e.g., intelligence, personality). It could also be explained by academic context-related

psychological states, which reflect individuals' quality of interaction with the academic circumstances and people (e.g., school, classroom, teachers, peers) and may act as protectors of this problematic behavior. Additionally, academic procrastination could be triggered by (face to face or virtual) behavioral mechanisms which may operate as risk factors (Boyd et al., 2009; Jessor, 2001). This perspective proposes that the development of academic procrastination may reflect a complex model of intercorrelations between protective academic context-related psychological states and aggravating risky behaviors. Finally, scholars have pointed out that the way students perceive and interpret their context-related psychological states and their behavioral mechanisms tend to have a greater effect on their academic behaviors compared to the objective reality (Fraser et al., 1986; Winston et al., 1994). Therefore, within the framework of the PBT, the present study examined the way students perceive the factors under study.

The next two subsections explain why within the proposed explanatory model perceived academic engagement and connectedness were treated more as academic context-related protectors and problematic social media use was considered as a risk behavioral mechanism for academic procrastination.

1.4 The role of academic context-related factors in academic procrastination

Some studies trying to adopt a more context-related perspective towards academic procrastination have highlighted that perceived task-related characteristics, such as high demands, grade pressure, and deadlines, can facilitate students' unnecessary delay in their involvement in academic assignments (Nordby et al., 2017; Svartdal et al., 2020). However, it could be stated that these findings strictly focus on specific situational characteristics mostly related to the academic tasks themselves. However, the above studies do not consider students' perceived psychological states that are dependent on the school/classroom context and may contribute to students' academic procrastination.

Perceived academic engagement and connectedness, which have been found to facilitate students' academic performance/achievement, adaptation, and general well-being (Casuso-Holgado et al., 2013; Datu & King, 2018; Liu et al., 2020; Sampasa-Kanyinga et al., 2019; Vizoso et al., 2018), could be considered among these academic context-related factors. Academic engagement refers to the way students engage in the academic/classroom environment and interact with others and with procedures in the academic settings. Despite the multidimensional nature of academic engagement, most authors propose that this construct is reflected in behavioral (e.g., participation in school/university activities), emotional (e.g., liking of school/university activities), and cognitive aspects (e.g., self-regulatory learning while collaborating) (Appleton et al., 2008; Fredricks et al., 2005; Upadyaya & Salmela-Aro, 2013). All three dimensions are considered to contribute significantly to students' positive learning outcomes (Appleton et al., 2008; Upadyaya & Salmela-Aro, 2013). Perceived academic connectedness is identified as a sense of belonging that individuals feel towards their academic environment (school/university, teachers, peers). This sense seems to reflect a

variety of sources in the school context, such as student–teacher relationships and peer relationships and it is viewed as a fundamental need, considering the social nature of humankind (Baumeister & Leary, 1995; Santos & Collins, 2016). According to self-determination theory (Deci & Ryan, 2000), except for competency and autonomy, students' perceived connectedness to the academic context constitutes a critical motivational component to explain their positive academic behaviors and avoid dysfunctional ones (e.g., procrastination).

Both perceived academic engagement and connectedness reflect to a great extent the way a set of overlapping and multilayered environmental systems/contexts, such as classroom, school, peers, interact with each other and shape these perceived academic context-related psychological states (e.g., Bronfenbrenner & Morris, 1998; Reschly & Christenson, 2012). In other words, academic engagement and connectedness could be perceived as "proximal processes" that different contexts posit as the primary mechanisms for students' learning and development (Bronfenbrenner & Morris, 1998; Reschly & Christenson, 2012). Therefore, academic engagement and connectedness, although reflecting an individual psychological state, cannot be perceived strictly only as intrapersonal characteristics/traits (e.g., emotional intelligence). They could be seen more as academic context-related factors, since they are heavily influenced by the context of the educational environment, reflecting the quality of students' interaction with the academic context and the influence of this context on them. Within this perspective, previous studies have considered students' perceived school engagement and school climate (as a construct conceptually close to school connectedness) more as school-related and environmental factors (Jones & Lafreniere, 2014; Mulvey et al., 2019; Rudasill et al., 2018).

Despite the significance of perceived academic engagement and connectedness, which seem to positively correlate with each other (Pinzone & Reschly, 2021; Reyes et al., 2012), the studies that have investigated their role in students' academic procrastination are scant in the international literature. Based on the authors' knowledge, only one study has been identified, highlighting the positive predictive role of classroom engagement in academic procrastination among university students (Hui et al., 2019). In other words, when students interact positively with their peers and instructors and engage qualitatively in the academic circumstances and procedures, they are less prone to develop academically procrastinating behaviors (Hui et al., 2019). Accordingly, Nabaei et al. (2021) recently showed that secondary school students' sense of academic identity, as a possible outcome of school connectedness, can protect them from academic procrastination. Unfortunately, there are no related findings regarding the role of perceived academic engagement and connectedness in academic procrastination among elementary school students.

Therefore, it is concluded that the protective role of perceived academic context-related factors, such as academic engagement and connectedness, in academic procrastination, needs further investigation in student populations in tertiary, secondary, and especially in elementary education. In this way, possibly different academic context-related protective factors against procrastination could be highlighted in different educational settings.

1.5 The role of problematic social media use in the relationship between academic context-related factors and academic procrastination

Since the outbreak of the COVID-19 pandemic and the imposed limited face-to-face social interactions, social media use (e.g., Facebook, Twitter, Instagram, Tik-Tok) has taken on even greater importance in students' and young adults' daily lives (Nilsson et al., 2022; Vanherle et al., 2022). Although social media use has facilitated the maintenance of close interpersonal relationships during the period of pandemic (Taylor et al., 2021), it can often lead to problematic situations, such as excessive and controllable use (Jiang, 2021). In general, problematic social media use (PSMU) can have consequences in mood changes, thoughts about social media as a prominent daily habit, and negative feelings when social media use is not accessible.

According to current studies, PSMU has been found to have a negative impact on university (Andangsari et al., 2018; Aznar-Díaz et al., 2020; Nwosu et al., 2020; Yang et al., 2019) and secondary school students' academic procrastination (Tezer et al., 2020), as excessive social media use makes students delay involvement in academic tasks/assignments. Based on the PBT (Boyd et al., 2009; Jessor, 2001) this finding could mean that students' way of social media use can be perceived as a maladaptive behavioral pattern, which along with perceived academic engagement and connectedness, as perceived context-related factors, could also influence students' involvement in academic procrastination.

Furthermore, recent findings have shown that there is a predictive relationship between the above academic context-related factors and PSMU. Specifically, studies conducted on secondary school students highlight their perceived academic engagement as a negative predictive factor of their problematic use of mobile phones as well as Internet and gaming addiction (Chen et al., 2021a, 2021b; Li & Zhu, 2020; Li et al., 2021). Furthermore, other authors have mentioned the negative predictive role of secondary (Li et al., 2013, 2022; Tian et al., 2018) and elementary school students' perceived academic connectedness in their problematic Internet and online game use (Wei et al., 2019). In other words, when students feel that they are engaged in their academic/school context and interact with teachers/peers multidimensionally (e.g., behaviorally, emotionally) and feel psychologically connected to the academic environment, they are less vulnerable to develop a maladaptive pattern of Internet and social media use daily (Li & Zhu, 2020; Li et al., 2013, 2022; Tian et al., 2018).

It is therefore concluded that there are binary predictive relationships between academic engagement/connectedness and PSMU, on the one hand, as well as between PMSU and academic procrastination, on the other hand. This conclusion along with the previously reported predictive relationship between academic engagement/connectedness and academic procrastination could lead to the following hypothetical model: PSMU is likely to operate as an underlying risky behavioral mechanism, namely a mediating variable, which could burden the relationship between perceived academic context-related factors (academic engagement/connectedness) and academic procrastination. Nevertheless, according to the authors' knowledge, no study based on the PBT has examined this hypothetical structure of relationships for the three levels of education (elementary, secondary, tertiary) separately, which are characterized by different contextual characteristics. A related
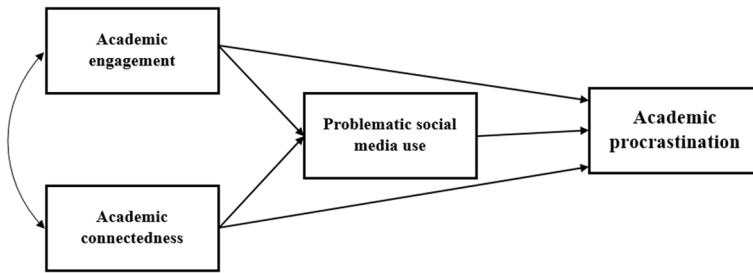
Fig. 1 Hypothetical structural model of the network of the relationships among variables. *Note.* The convex arrow shows the correlation between the variables

study could reveal possibly different patterns of intercorrelations among perceived academic context-related factors and PSMU, offering a more detailed explanation of students' procrastination behaviors in three different age groups and therefore proposing possibly differentiated related prevention/intervention strategies.

1.6 Purpose, goals and hypotheses of the present study

In summary, considering the literature findings and gaps presented above, the present study aimed to investigate students' academic procrastination in elementary, secondary, and tertiary education cross-sectionally. At the same time, the role of students' perceived academic context-related factors as well as their PSMU in their academic procrastination was examined through a mediation model for the three levels of education. According to the related literature, the hypothetical model of relationships among the variables involved for the three levels of education is shown in Fig. 1.

Specifically, the main research goals of the present study were to investigate:

(a) Differences in students' academic procrastination based on their level of education (elementary, secondary, tertiary).
(b) The effect of the students' gender on their academic procrastination in the three levels of education.
(c) The structure of the relationships among students' academic procrastination, perceived academic context-related factors (academic engagement/connectedness) and PSMU in the three levels of education.

Based on most of the available related studies, it is hypothesized that:

(a) Academic procrastination concerns students of secondary and tertiary education to a greater extent (frequency, perceive it as a problem, desire to reduce it), compared to elementary school students (Hypothesis 1) (Martín-Puga et al., 2022).
(b) Students' gender in tertiary and secondary education does not constitute a statistically significant differentiating factor for academic procrastination (Hypothesis

2a) (Ajayi, 2020; Amoke et al., 2021; Ebadi & Shakoorzadeh, 2015; Harrison, 2014; He, 2017; Islak, 2011), while in elementary education males procrastinate more than females (Hypothesis 2b) (Al-Attiyah, 2010; Parantika et al., 2020).

(c) Students' perceived academic context-related factors (academic engagement/connectedness) negatively predict their procrastination (Hypothesis 3a) (Hui et al., 2019; Nabaei et al., 2021), while PSMU negatively mediates the relationship between perceived academic context-related factors (academic engagement/connectedness) and academic procrastination (Hypothesis 3b) (Li & Zhu, 2020; Li et al., 2013, 2021; Nwosu et al., 2020; Tezer et al., 2020; Wei et al., 2019).

2 Method

2.1 Sample

The sample of the present study consisted of students of Greek elementary ($N=532$), secondary ($N=561$), and tertiary education ($N=519$) who made use of social media. To ensure a geographically representative sample, 10 elementary and 12 secondary schools were randomly selected from economically diverse districts of Thessaloniki, which is considered a multicultural city indicative of other European cities (Horsti, 2017). Accordingly, nine different university departments from different university schools (e.g., School of Social Sciences and Humanities/Economics) were randomly selected from Aristotle University of Thessaloniki, which is the among the largest universities in Greece, with a student population representative of other European institutions of higher education (due to anonymization the citation will be added). The above procedure for the random sample collection was also applied in the case of the pilot sample (elementary education: $N=109$, secondary education: $N=121$, tertiary education: $N=115$). However, since the pilot study did not indicate the necessity of modifying the research questionnaire, the pilot data was incorporated into the sample selected during the main phase of the study resulting in the total sample for the three levels of education. It should be highlighted that the participants were students who attended the last grades of elementary education (fifth and sixth), the middle grades of secondary education,[1] and their first years of their university studies, as academic procrastination is usually identified to a greater extent during these periods (Al-Attiyah, 2010; Balkis, 2013; Scheunemann et al., 2021; Setiyowati et al., 2020; Vural, 2013; Yang et al., 2023). Demographic information regarding students' gender and school grade (for elementary and secondary school students) as well as for years of study (for university students) is shown in Table 1, where students were mainly equally distributed in the three levels of education based on their gender. The age of the students ranged between 11 and 12 years old in elementary education ($M=11.4$, $SD=0.95$), 14 and 15 years old in secondary

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[1] In Greece, elementary education and secondary education last 6 years each (Ministry of Education, n.d.).

Table 1 Students' demographic characteristics

Demographic variables	Level of education											
	Elementary				Secondary				Tertiary			
Gender	Boys		Girls		Boys		Girls		Boys		Girls	
	f	%	f	%	f	%	f	%	f	%	f	%
	261	49.1	271	50.9	283	50.4	278	49.6	251	48.3	267	51.7
Grade/year of study	5th Grade		6th Grade		2nd Grade		3rd Grade		1st Year		2nd Year	
	f	%	f	%	f	%	f	%	f	%	f	%
	265	49.8	267	50.2	297	52.9	264	47.1	264	50.8	255	49.2

education ($M = 14.8$, $SD = 0.39$), and 19 and 20 years old in tertiary education ($M = 19.7$, $SD = 0.89$).

2.2 Measures

Except for the introductory demographic questions (e.g., gender, age), the self-reported questionnaire included the following scales.

2.2.1 Academic procrastination

Students' academic procrastination was measured with the Greek version (using the back-and-forth translation method) of the first part of Procrastination Assessment Scale Students (PASS; Solomon & Rothblum, 1984), as it has been used in other related Greek studies (Vasiou et al., 2022). This part includes 18 items reflecting three dimensions of procrastination: (a) the extent of students' procrastination in specific academic areas (writing an assignment, studying for exams/tests, keeping up with weekly reading assignments, general academic duties such as courses registration, meeting with instructors, other academic activities such as help in organizing conferences) (e.g., "To what extent do you procrastinate in writing an assignment?"), (b) the extent students perceive procrastination in these areas as a problem (e.g., "To what extent procrastination in writing an assignment is a problem for you?"), and (c) the extent of students' desire to reduce procrastination in these areas (e.g., "To what extent do you want to reduce procrastination in writing an assignment?). The first and the second dimension of students' academic procrastination are answered on a 5-point Likert scale (from $1 = I$ *never procrastinate/Not at all a problem* to $5 = I$ *always procrastinate/Always a problem*), while the third dimension is answered on a 3-point Likert scale (from $1 = I$ *do not wish to reduce it* to $3 = I$ *certainly want to reduce it*). Summing the scores of the 6 items ratings in each one of the three dimensions of procrastination results in the following scores: (a) *Extent of procrastination* score, ranging from 6 to 30 points with $M = 2.5$ ($SD = 1.91$) corresponding to an average level of extent of procrastination, (b) *Procrastination as a problem* score, ranging

from 6 to 30 points with $M = 2.5$ ($SD = 1.83$) corresponding to an average level of perceived procrastination as a problem, and (c) *Desire to reduce procrastination* score, ranging from 6 to 18 points with $M = 1.5$ ($SD = 0.81$) corresponding to an average level of desire to reduce procrastination. The higher the mean score of each dimension the higher the corresponding parameter of students' procrastination (Solomon & Rothblum, 1984). The scale has been used among university and secondary school students with good psychometric properties (from $a = 0.70$ to $a = 0.84$; Afzal & Jami, 2018; Lenggono & Tentama, 2020). To administer the same scale to secondary and elementary school students, some phraseological adjustments were made to the wording of the items, so that students can answer the three dimensions of procrastination (extent, perception that it is a problem, desire to reduce it) about specific school duties. Specifically, "general academic duties" (e.g., course registration, filling out forms) was replaced by "general school duties" (e.g., packing a school bag, returning a test signed by a parent/guardian), "meetings with instructors" was replaced by "meetings with teacher(s)", and "other academic activities" (e.g., help in organizing conferences) was replaced by "other school activities (e.g., help in organizing school bazaars).

2.2.2 Academic engagement

Students' academic engagement was measured with the Greek version (authors used the back-and-forth translation method) of the School Engagement Measure (SEM; Fredricks et al., 2005). However, some phraseological adjustments were made to the wording of the items (e.g., school vs. university) without however changing their content, so the measure can also be able to be administered to university students. This scale includes 16 items reflecting three overlapping but at the same time distinct types of engagement: emotional (5 items) which concerns positive feelings and a sense of belonging at school/university (e.g., liking of school/university), cognitive (7 items) which is reflected in students' self-regulated learning strategies (e.g., self-monitoring) to achieve mindful awareness and advanced academic skills (e.g., "I read additional books about things we do at school/university"), and behavioral engagement (4 items) which concerns students' positive conduct at school/university (e.g., "I pay attention in classroom, and I stay out of trouble at school/university"). Answers are given on a 5-point Likert scale (from 1 = *Never* to 5 = *Always*). Summing the scores of the items ratings in each one of the three types of engagement results in the following scores: (a) *Emotional engagement* score, ranging from 5 to 25 points with $M = 2.5$ ($SD = 1.34$) corresponding to an average level of emotional engagement, (b) *Cognitive engagement* score, ranging from 7 to 35 points with $M = 2.5$ ($SD = 1.28$) corresponding to an average level of cognitive engagement and (c) *Behavioral engagement* score, ranging from 4 to 20 points with $M = 2.5$ ($SD = 0.98$) corresponding to an average level of behavioral engagement. The higher the mean score of each case the higher the corresponding type of students' academic engagement (Fredricks et al., 2005). The scale has been used among elementary and secondary school students with good psychometric properties (from $a = 0.83$ to $a = 0.92$; Fredricks & McColskey, 2012; Hazel et al., 2013).

2.2.3 Academic connectedness

Students' academic connectedness was measured with the Greek version (authors used the back-and-forth translation method) of the School Connectedness Scale, which is a subscale of the broader California Healthy Kids Survey (CHKS), developed by the California Department of Education. This subscale includes 5 items examining students' psychological bonds toward academic context (school/university) (Libbey, 2004; Resnick et al., 1997). Some phraseological adjustments were made to the wording of the items (e.g., school vs. university) without however changing their content, so the measure can also be administered to university students. This subscale reflects one factor ("Academic connectedness") while examples of the items are the following: "I feel close to people at this school/university", "I feel like I am part of this school/university", etc. Answers are given on a 5-point Likert scale (from $1 = $ *Strongly disagree* to $5 = $ *Strongly agree*). SCS total score ranges from 5 to 25 points with $M = 2.5$ $(SD = 1.38)$ corresponding to an average level of academic connectedness. Higher mean scores indicate higher levels of academic connectedness. Previous studies on school students (e.g., Furlong et al., 2011) provide good psychometric properties for the SCS (from $a = 0.82$ to $a = 0.88$).

2.2.4 Problematic social media use

Students' Problematic Social Media Use (PSMU) was measured with the Greek version (authors used the back-and-forth translation method) of the Social Media Use Questionnaire (SMUQ; Xanidis & Brignell, 2016). This questionnaire includes 9 items reflecting the aspects of *withdrawal* (5 items such as "I use SNS when I am in the company of friends"), namely someone's social isolation due to the excessive SMU, and *compulsion* (4 items such as "I lose track of time when I use SNS"), namely individuals' uncontrollable SMU. Answers are given on a 5-point Likert scale (from $0 = $ *Never* to $4 = $ *Always*). Summing the scores of the items ratings in each one of the two aspects of PSMU results in the following scores: (a) *Withdrawal* score ranging from 0 to 20 points with $M = 2.0$ $(SD = 1.21)$ corresponding to an average level of withdrawal, and (b) *Compulsion* score ranging from 0 to 16 points with $M = 2.0$ $(SD = 1.08)$ corresponding to an average level of compulsion. Higher mean scores in each case indicate higher levels of each aspect of PSMU. Previous studies on university students (e.g., Kircaburun et al., 2020) reveal good psychometric properties for the SMUQ (from $a = 0.83$ to $a = 0.90$).

2.3 Procedure

Upon approval of the study by the Institute of Educational Policy of the Greek Ministry of Education, the study was conducted from January 2022 to June 2022. Specifically, an email was sent to randomly selected elementary $(N = 15)$ and secondary schools $(N = 15)$. The email included details about the purpose as well as the approval of the study. Out of these schools, 10 (response rate of

66.6%) and 12 (response rate of 80%), respectively, responded positively to the corresponding author's email. Subsequently, the author sent a second email to the responding schools. This email included a consent form, which was delivered by the school principal to students' parents/guardians, asking the latter to sign in if they agree with their child's participation in the study. Once the signed consent forms were collected by the school principals, the authors visited the schools and administered the questionnaires to the students, which were completed in the teacher's and authors' presence. No incentives were given to the participants for the completion of the questionnaires. The questionnaires were completed only by the students who answered that they use social media. The duration of the completion was estimated at about 15 min. A similar procedure was followed for the university students. Specifically, an email was sent to the instructors who taught in the first and second year of studies in the randomly selected university departments. The email included all the necessary information about the study and the related approval, asking instructors to schedule a meeting for the distribution of the questionnaires to the students when in their classrooms. The above procedures in elementary and secondary schools, on the one hand, and the universities, on the other hand, were also applied for the data selection of both the pilot (from January 2022 to February 2022) and the main study (from March 2022 to June 2022). All students, parents/guardians, and teachers/instructors participated in the study on a voluntary basis, while the anonymity of the data was preserved.

2.4 Methods of analyses

Without any missing values, the following statistical analyses were applied to the data: To check the psychometric properties of the scales Principal Component Analyses (PCA), Confirmatory Factor Analyses (CFA) and Cronbach's alpha were used (see supplemental file). Descriptive statistics were used for students' perceived academic procrastination/engagement/connectedness, and PSMU. To examine the dyadic relations between the above variables a series of Pearson correlation analyses was applied (Pearson r). To investigate the effect of the level of education (elementary, secondary, tertiary) on students' academic procrastination (Hypothesis 1) a multivariate analysis of variance (MANOVA) was carried out. In this analysis the three levels of education were set as the independent variable and the three factors of the procrastination scale were considered as dependent variables. To examine the effect of students' gender on academic procrastination (Hypothesis, 2a and 2b) a multivariate analysis of variance (MANOVA) was applied in the three student groups, setting gender as independent variable and the three factors of the procrastination scale as dependent variables. To check the structure of the relationships among the variables involved that could lead to academic procrastination (Hypothesis 3a and 3b) path analysis of the data (using the Mplus programme with the Maximum Likelihood method) was applied in the three student groups.

Table 2 Students' academic procrastination/engagement/connectedness and PSMU

	Level of education					
	Elementary		Secondary		Tertiary	
	M	SD	M	SD	M	SD
Academic procrastination						
Extent of procrastination	4.01	1.05	4.18	1.42	3.23	1.99
Procrastination as a problem	2.09	0.97	2.12	0.88	2.89	1.54
Desire to reduce procrastination	1.04	1.07	1.14	1.15	2.21	1.32
Academic engagement						
Emotional	2.33	1.42	2.01	1.22	2.09	1.38
Cognitive	2.23	1.98	2.27	1.81	2.32	1.49
Behavioral	2.38	1.55	2.09	1.14	2.31	1.78
Academic connectedness	2.35	0.93	2.08	0.82	2.10	1.03
PSMU						
Withdrawal	3.21	1.28	3.34	1.07	2.88	1.19
Compulsion	3.14	1.87	3.11	1.74	2.83	1.12

M = Mean, SD = Standard Deviation

3 Results

3.1 Students' perceived academic procrastination, engagement, connectedness and PSMU

Regarding students' academic procrastination, the mean scores in Table 2 show that the *extent of procrastination* was generally above the average level for all the student groups. Within a more comparative perspective, it seemed that procrastination among students of elementary and secondary education was slightly higher, compared to university students. On the contrary, university students seemed to *perceive procrastination as a problem* and they *desire to reduce it* to a greater extent, compared to elementary and secondary school students who expressed the above dimensions at below average level.

Regarding students' academic engagement, the mean scores in Table 2 show that *emotional, cognitive*, and *behavioral engagement* were generally below average for the three student groups. Within a more comparative perspective we could state that elementary school students' emotional engagement was slightly higher, compared to secondary school and university students. Cognitive engagement was approximately at the same level for the three student groups, while behavioral engagement was slightly lower for secondary school students, compared to elementary school and university students.

Furthermore, the mean scores in Table 2 show that students' *academic connectedness* in elementary, secondary, and tertiary education were generally below

average. Within a more comparative perspective we could state that elementary school students' academic connectedness was considered slightly higher, compared to secondary school and university students.

Finally, PSMU proved to be generally above average for the three student groups. Comparing the three student populations, it seemed that *withdrawal* and *compulsion* was slightly higher for elementary and secondary school students, compared to university students (see Table 2).

3.2 Correlations among the variables

Correlational analyses were run separately for the three student groups to ensure the same pattern of correlations among variables for the three levels of education. The same pattern emerged in each case (see Table 3). Specifically, for students of elementary, secondary, and tertiary education the following correlations emerged: Positive correlations among the dimensions of academic procrastination, the types of academic engagement, as well as the dimensions of PSMU. Positive correlations between the dimensions of academic procrastination, on the one hand, and the dimensions of PSMU, on the other hand. Negative correlations between the dimensions of academic procrastination, on the one hand, and the types of academic engagement as well as academic connectedness, on the other hand. Negative correlations between the dimensions of PSMU, on the one hand, and the types of academic engagement as well as the academic connectedness, on the other hand. Finally, positive correlations between the types of academic engagement and academic connectedness.

3.3 The effect of level of education on students' academic procrastination

The above descriptive findings regarding students' academic procrastination were also confirmed by the MANOVAs results. Meeting the assumptions of Box's test of equality of covariance matrices (Box's $M = 121.44$, $F = 1.35$, $p = .19$) and Levene's test of equality of error variances for students of elementary, $F(3, 1608) = 3.21$, $p = .27$, secondary, $F(3, 1608) = 2.89$, $p = .14$, and tertiary education, $F(3, 1608) = 4.12$, $p = .21$, the results revealed a significant interaction effect of the level of education on students' academic procrastination, Pillai's Trace $= 0.059$, $F(3, 1608) = 9.309$, $p = .000$, partial $\eta^2 = 0.51$, for all the three dimensions of procrastination: *extent of procrastination*, $F(1, 1608) = 7.791$, $p = 0.000$, partial $\eta^2 = 0.43$, *procrastination as a problem*, $F(1, 1608) = 8.092$, $p = .000$, partial $\eta^2 = 0.41$, and *desire to reduce procrastination*, $F(1, 1608) = 8.722$, $p = .000$, partial $\eta^2 = 0.39$.

Applying Bonferroni post-hoc tests ($p < .016$) to investigate the statistical significance of pair comparisons, it was found that elementary ($M = 4.01$, $SD = 1.05$) and secondary school students ($M = 4.18$, $SD = 1.42$) seemed to procrastinate more, compared to university students ($M = 3.23$, $SD = 1.99$). In contrast, university students seemed to perceive procrastination as a problem to a greater extent ($M = 2.89$, $SD = 1.54$), compared to elementary ($M = 2.09$, $SD = 0.97$) and secondary school

Table 3 Correlations among variables

Variables	Level of education	Extent of procrastination			Procrastination as a problem			Desire to reduce procrastination			Emotional engagement		
	(a)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
Procrastination as a problem (a)	.309**												
(b)			.284**										
(c)				.319**									
Desire to reduce procrastination (a)	.391**				.412**								
(b)			.342**			.319**							
(c)				.304**			.405**						
Emotional engagement (a)	-.423**				-.438**			-.242*					
(b)			-.315**			-0.314**			-.314**				
(c)				-.323**			-.404**			-.452**			
Cognitive engagement (a)	-.218*				-.212*			-.204*			.555**		
(b)			-.287**			-.129*			-.405**			.488**	
(c)				-.231*			-.441**			-.409**			.503**
Behavioral engagement (a)	-.208*				-.203*			-.212*			.489**		
(b)			-.388**			-.211*			-.444**			.501**	
(c)				-.391**			-.220*			-.478**			.544**
Academic connectedness (a)	-.423**				-.398**			-.399**			.599**		
(b)			-.129*			-.204*			-.408**			.439**	
(c)				-.202*			-.388**			-.493**			.582**
Withdrawal (a)	.311**				.408**			.352**			-.499**		
(b)			.409**			.221*			.443**			-.509**	
(c)				.398**			.333**			.553**			-.502**
Compulsion (a)	.214*				.401**			.401**			-.408**		
(b)			.201*			.359**			.502**			-.434**	
(c)				.221*			.355**			.509**			.500**

Table 3 (continued)

Variables	Level of education	Cognitive engagement			Behavioral engagement			Academic connectedness			Withdrawal		
		(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
Procrastination as a problem	(a)												
	(b)												
	(c)												
Desire to reduce procrastination	(a)												
	(b)												
	(c)												
Emotional engagement	(a)												
	(b)												
	(c)												
Cognitive engagement	(a)												
	(b)												
	(c)												
Behavioral engagement	(a)	.543**											
	(b)		.489**										
	(c)			.593**									
Academic connectedness	(a)	.499**			.545**								
	(b)		.552**			.452**							
	(c)			.541**			.399**						
Withdrawal	(a)	-.489**			-.430**			-.591**					
	(b)		-0.439**			-.358**			-.491**				
	(c)			-.383**			-.409**			-.459**			

Table 3 (continued)

Variables	Level of education	Cognitive engagement			Behavioral engagement			Academic connectedness			Withdrawal		
		(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)	(a)	(b)	(c)
Compulsion	(a)	-.453**			-.498**			-.421**			.595**		
	(b)		-.404**			-.397**			-.353**			.529**	
	(c)			-.389**			-.401**			-.399**			.493**

(a) Elementary education, (b) Secondary education, (c) Tertiary education

$*p<0.05$, $**p<0.01$

students ($M=2.12$, $SD=0.88$). University students expressed their desire to reduce procrastination to a greater extent ($M=2.21$, $SD=1.32$), compared to elementary ($M=1.04$, $SD=1.07$) and secondary school students ($M=1.14$, $SD=1.15$).

3.4 The effect of gender on students' academic procrastination

Meeting the assumptions of Box's test of equality of covariance matrices (Box's $M=145.09$, $F=1.94$, $p=.29$) and Levene's test of equality of error variances for elementary, $F(3, 528)=2.93$, $p=.23$, secondary, $F(3, 557)=3.07$, $p=.21$, and tertiary education, $F(3, 515)=3.29$, $p=.11$, the results showed a non-significant interaction effect of students' gender on the three dimension of academic procrastination: *extent of procrastination*, $F(1, 1608)=4.498$, $p=.18$, *procrastination as a problem*, $F(1, 1608)=3.115$, $p=.11$, and *desire to reduce procrastination*, $F(1, 1608)=4.892$, $p=.11$.

3.5 The structure of the relationships among the variables

To depict the structure of the relationships (path analyses) between the variables involved (dimensions of academic engagement, academic connectedness, and PSMU), which leads to the three dimensions of academic procrastination (dependent variable) for the three student groups, a series of preliminary analyses of multiple regressions was performed to test the dyadic predictive relationships between the variables in each case. After checking skewness and kurtosis values of the variables, which were smaller than |3| and smaller than |10|, respectively (Kline, 2004), the assumptions of normality were met for each case. Subsequently, path analyses were carried out using the Maximum Likelihood Estimation Method. Without any missing cases, the path model that resulted had good fit indexes for students of elementary, χ^2 (39, $N=532$)$=34.889$, $p=.21$ (CFI$=0.991$, TLI$=0.937$, RMSEA$=0.063$, SRMR$=0.083$) (explaining 38% of the variance of procrastination—see Fig. 2), secondary, χ^2 (43, $N=561$)$=15.802$, $p=.19$ (CFI$=0.981$, TLI$=0.914$, RMSEA$=0.065$, SRMR$=0.088$) (explaining 32% of the variance of procrastination—see Fig. 3), and tertiary education, χ^2 (38, $N=519$)$=49.209$, $p=.09$ (CFI$=0.983$, TLI$=0.922$, RMSEA$=0.061$, SRMR$=0.084$) (explaining 35% of the variance of procrastination—see Fig. 4).

Regarding elementary school students, it was found that their emotional engagement ($\beta=-0.45^{**}$), and their academic connectedness ($\beta=-0.39^{**}$) directly and negatively predicted the extent of their procrastination. Also, withdrawal (as a dimension of PSMU) negatively mediated the relationship between these students' emotional engagement, on the one hand, and their extent of procrastination ($Z^2=-3.35$, $p=0.000$) their perception that procrastination is a problem ($Z=-4.21$, $p=.000$), and their desire to reduce it ($Z=-3.19$, $p=.001$), on the other hand. Accordingly, withdrawal negatively mediated the relationship between

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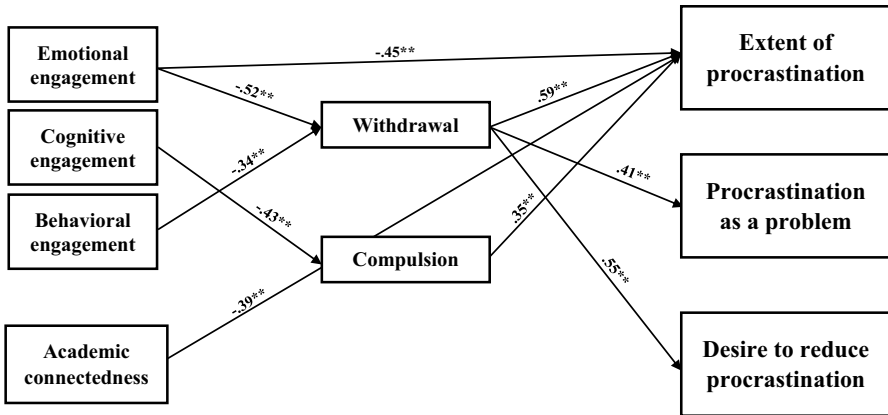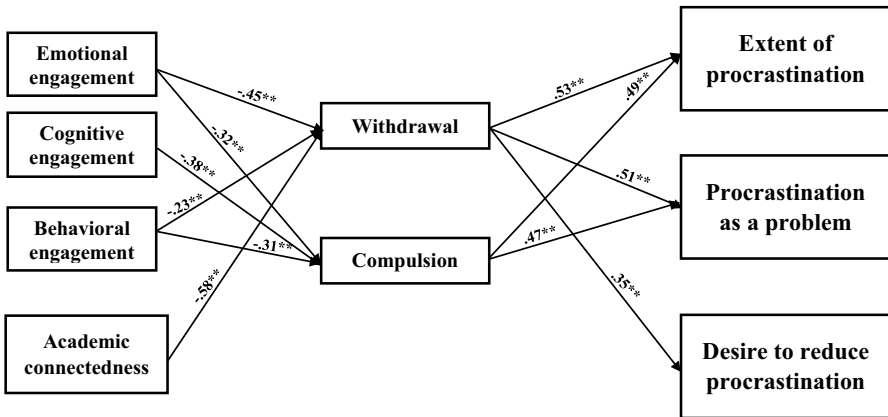[2] $Z=$ standardized normal distribution value.

Fig. 2 Schematic representation of the path model for elementary school students' academic procrastination. *Note 1.* The values on the arrows are standardized coefficients of the model. The following correlations were included in the model but not depicted in the Figure for clarity reasons: Emotional engagement—Cognitive engagement = 0.59**, Emotional engagement—Behavioral engagement = 0.47**, Cognitive engagement—Behavioral engagement = 0.33**, Academic connectedness—Emotional engagement = 0.46**, Academic connectedness—Cognitive engagement = 0.41**, Academic connectedness—Behavioral engagement = 0.33*, Withdrawal—Compulsion = 0.59**, Extent of procrastination—Procrastination as a problem = 0.58**, Extent of procrastination—Desire to reduce procrastination = 0.52**, Procrastination as a problem—Desire to reduce procrastination = 0.57**. *Note 2.* **p < .01

Fig. 3 Schematic representation of the path model for secondary school students' academic procrastination. *Note 1.* The values on the arrows are standardized coefficients of the model. The following correlations were included in the model but not depicted in the Figure for clarity reasons: Emotional engagement—Cognitive engagement = 0.54**, Emotional engagement—Behavioral engagement = 0.51**, Cognitive engagement—Behavioral engagement = 0.39**, Academic connectedness—Emotional engagement = 0.38**, Academic connectedness—Cognitive engagement = 0.55**, Academic connectedness—Behavioral engagement = 0.39**, Withdrawal—Compulsion = 0.59**, Extent of procrastination—Procrastination as a problem = 0.49**, Extent of procrastination—Desire to reduce procrastination = 0.51**, Procrastination as a problem—Desire to reduce procrastination = 0.37**. *Note 2.* **p < .01
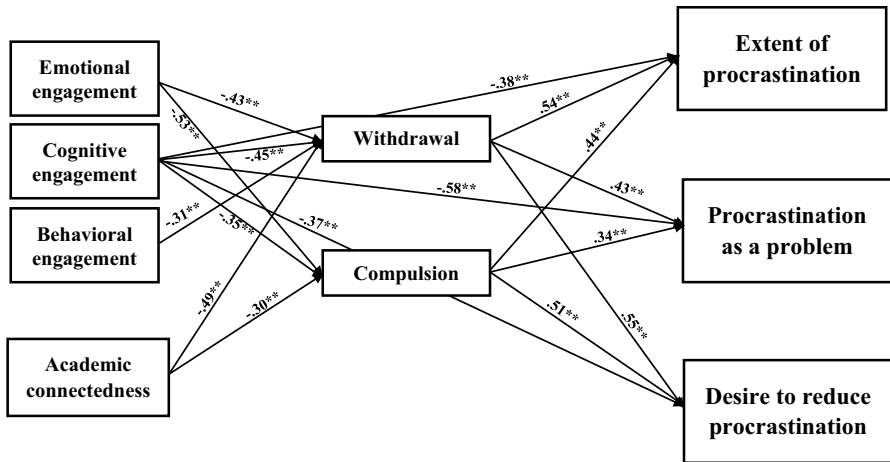
Fig. 4 Schematic representation of the path model for university students' academic procrastination. *Note 1*. The values on/under the arrows are standardized coefficients of the model. The following correlations were included in the model but not depicted in the Figure for clarity reasons: Emotional engagement—Cognitive engagement=0.49**, Emotional engagement—Behavioral engagement=0.41**, Cognitive engagements—Behavioral engagement=0.54**, Academic connectedness—Emotional engagement=0.59**, Academic connectedness—Cognitive engagement=0.48**, Academic connectedness—Behavioral engagement=0.40**, Withdrawal—Compulsion=0.37**, Extent of procrastination—Procrastination as a problem=0.33**, Extent of procrastination—Desire to reduce procrastination=0.58**, Procrastination as a problem—Desire to reduce procrastination=0.43**. *Note 2.* **$p < 001$

students' behavioral engagement, on the one hand, and their extent of procrastination ($Z=-2.93$, $p=.003$), their perception that procrastination is a problem ($Z=-3.48$, $p=.004$), and their desire to reduce it ($Z=-4.12$, $p=.001$), on the other hand. Finally, compulsion (as a dimension of PSMU) negatively mediated ($Z=-4.33$, $p=.005$) students' cognitive engagement and the extent of their procrastination.

Standardized estimates of total, direct, and indirect effects on the three dimensions of procrastination (extent of procrastination, procrastination as a problem, desire to reduce procrastination) and mediator variables are shown in Table 4.

As far as secondary school students, it was found that withdrawal negatively mediated the relationship between students' emotional and behavioral engagement, on the one hand, and their extent of procrastination (for emotional: $Z=-2.15$, $p=.000$ and behavioral engagement: $Z = 2.33$, $p=.001$), their perception that procrastination is a problem (for emotional: $Z=-3.41$, $p=.004$ and behavioral engagement: $Z=-3.01$, $p=.003$), and their desire to reduce it (for emotional: $Z=-2.08$, $p=.004$ and behavioral engagement: $Z=-3.05$, $p=0.000$), on the other hand. Furthermore, compulsion (as a dimension of PSMU) negatively mediated the relationship between students' emotional, cognitive, and behavioral engagement, on the one hand, and their extent of procrastination (for emotional: $Z=-5.05$, $p=.001$, cognitive: $Z=-4.24$, $p=.005$, and behavioral engagement: $Z=-5.31$, $p=.002$) as well as

Table 4 Standardized estimates of total, direct, and indirect effects on procrastination and mediator variables for elementary school students

Paths	Effect	% explained of total effect
Emotional engagement → extent of procrastination (total effect)	-0.19	–
Emotional engagement → extent of procrastination (direct effect)	-0.08	45%
Emotional engagement → withdrawal → extent of procrastination (indirect effect)	-0.11	55%
Emotional engagement → procrastination as a problem (total effect)	-0.15	–
Emotional engagement → procrastination as a problem (direct effect)	-0.02	34%
Emotional engagement → withdrawal → procrastination as a problem (indirect effect)	-0.13	56%
Emotional engagement → desire to reduce procrastination (total effect)	-0.14	–
Emotional engagement → desire to reduce procrastination (direct effect)	-0.05	42%
Emotional engagement → withdrawal → desire to reduce procrastination (indirect effect)	-0.09	58%
Cognitive engagement → extent of procrastination (total effect)	-0.18	–
Cognitive engagement → extent of procrastination (direct effect)	-0.07	40%
Cognitive engagement → compulsion → extent of procrastination (indirect effect)	-0.11	60%
Behavioral engagement → extent of procrastination (total effect)	-0.18	–
Behavioral engagement → extent of procrastination (direct effect)	-0.05	34%
Behavioral engagement → withdrawal → extent of procrastination (indirect effect)	-0.13	76%
Behavioral engagement → procrastination as a problem (total effect)	-0.17	–
Behavioral engagement → procrastination as a problem (direct effect)	-0.07	41%
Behavioral engagement → withdrawal → procrastination as a problem (indirect effect)	-0.10	59%
Behavioral engagement → desire to reduce procrastination (total effect)	-0.15	–
Behavioral engagement → desire to reduce procrastination (direct effect)	-0.06	43%
Behavioral engagement → withdrawal → desire to reduce procrastination (indirect effect)	-0.09	57%
Academic connectedness → extent of procrastination (direct effect)	-0.15	83%

their perception that procrastination is a problem (for emotional: $Z=-4.49$, $p=.001$, cognitive: $Z=-3.08$, $p=.005$, and behavioral engagement: $Z=-4.41$, $p=.008$), on the other hand. Finally, withdrawal (as a dimension of PSMU) negatively mediated the relationship between students' academic connectedness, on the one hand, and their extent of procrastination ($Z=-2.42$, $p=.007$), their perception that procrastination is a problem ($Z=-3.11$, $p=.005$), and their desire to reduce it ($Z=-2.14$, $p=.008$), on the other hand.

Standardized estimates of total, direct, and indirect effects on the three dimensions of procrastination (extent of procrastination, procrastination as a problem, desire to reduce procrastination) and mediator variables are shown in Table 5.

Table 5 Standardized estimates of total, direct, and indirect effects on procrastination and mediator variables for secondary school students

Paths	Effect	% explained of total effect
Emotional engagement→extent of procrastination (total effect)	-0.21	–
Emotional engagement→extent of procrastination (direct effect)	-0.04	22%
Emotional engagement→extent of procrastination (total indirect effect)	-0.17	88%
Emotional engagement→withdrawal→extent of procrastination	−0.09	48%
Emotional engagement→compulsion→extent of procrastination	-0.08	40%
Emotional engagement→procrastination as a problem (total effect)	-0.14	–
Emotional engagement→procrastination as a problem (direct effect)	-0.03	32%
Emotional engagement→procrastination as a problem (total indirect effect)	-0.11	68%
Emotional engagement→withdrawal→procrastination as a problem	-0.06	37%
Emotional engagement→compulsion→procrastination as a problem	-0.05	31%
Emotional engagement→desire to reduce procrastination (total effect)	-0.20	–
Emotional engagement→desire to reduce procrastination (direct effect)	-0.09	47%
Emotional engagement→withdrawal→desire to reduce procrastination (indirect effect)	-0.11	53%
Cognitive engagement→extent of procrastination (total effect)	-0.19	–
Cognitive engagement→extent of procrastination (direct effect)	-0.08	43%
Cognitive engagement→compulsion→extent of procrastination (indirect effect)	-0.11	57%
Cognitive engagement→procrastination as a problem (total effect)	-0.16	–
Cognitive engagement→procrastination as a problem (direct effect)	-0.05	29%
Cognitive engagement→compulsion→procrastination as a problem (indirect effect)	-0.11	71%
Behavioral engagement→extent of procrastination (total effect)	-0.14	–
Behavioral engagement→extent of procrastination (direct effect)	-0.06	41%
Behavioral engagement→extent of procrastination (total indirect effect)	-0.08	59%
Behavioral engagement→withdrawal→extent of procrastination	-0.05	30%
Behavioral engagement→compulsion→extent of procrastination	-0.03	29%
Behavioral engagement→procrastination as a problem (total effect)	-0.15	–
Behavioral engagement→procrastination as a problem (direct effect)	-0.05	35%
Behavioral engagement→procrastination as a problem (total indirect effect)	-0.10	65%
Behavioral engagement→withdrawal→procrastination as a problem	-0.04	30%
Behavioral engagement→compulsion→procrastination as a problem	-0.06	35%
Behavioral engagement→desire to reduce procrastination (total effect)	-0.19	–
Behavioral engagement→desire to reduce procrastination (direct effect)	-0.07	37%
Behavioral engagement→withdrawal→desire to reduce procrastination (indirect effect)	-0.12	63%
Academic connectedness→extent of procrastination (total effect)	-0.16	–
Academic connectedness→extent of procrastination (direct effect)	-0.07	42%
Academic connectedness→withdrawal→extent of procrastination (indirect effect)	-0.09	58%
Academic connectedness→procrastination as a problem (total effect)	-0.17	–
Academic connectedness→procrastination as a problem (direct effect)	-0.08	48%

Table 5 (continued)

Paths	Effect	% explained of total effect
Academic connectedness → withdrawal → procrastination as a problem (indirect effect)	-0.09	52%
Academic connectedness → desire to reduce procrastination (total effect)	-0.19	–
Academic connectedness → desire to reduce procrastination (direct effect)	-0.06	32%
Academic connectedness → withdrawal → desire to reduce procrastination (indirect effect)	-0.13	68%

Regarding university students, it was found that that their cognitive engagement predicted directly and negatively their extent of procrastination ($\beta = -0.38$**), their perception that procrastination is a problem ($\beta = -0.58$**), and their desire to reduce it ($\beta = -0.37$**). Additionally, withdrawal negatively mediated the relationship between students' emotional, cognitive, and behavioral engagement, on the one hand, and their extent of procrastination (for emotional: $Z = -4.35$, $p = .008$, cognitive: $Z = -4.14$, $p = .005$, and behavioral engagement: $Z = -4.79$, $p = .004$), their perception that procrastination is a problem (for emotional: $Z = -3.79$, $p = .001$, cognitive: $Z = -3.17$, $p = .003$, and behavioral engagement: $Z = -4.28$, $p = .005$), and their desire to reduce it (for emotional: $Z = -3.49$, $p = .000$, cognitive: $Z = -3.37$, $p = .004$, and behavioral engagement: $Z = -4.02$, $p = .002$), on the other hand. Furthermore, compulsion (as a dimension of PSMU) negatively mediated the relationship between students' emotional and cognitive engagement, on the one hand, and their extent of procrastination (for emotional: $Z = -2.34$, $p = .004$ and cognitive engagement: $Z = -3.04$, $p = .007$), their perception that procrastination is a problem (for emotional: $Z = -3.77$, $p = .001$ and cognitive engagement: $Z = -3.82$, $p = .000$), and their desire to reduce it (for emotional: $Z = -4.17$, $p = .002$ and cognitive engagement: $Z = -3.29$, $p = .008$), on the other hand. Finally, students' academic connectedness predicted negatively and indirectly their extent of procrastination (1st dimension), their perception that procrastination is a problem (2nd dimension) and their desire to reduce it (3rd dimension), through the negative mediating role of withdrawal (for 1st: $Z = -2.19$, $p = .005$, 2nd: $Z = -3.37$, $p = .009$, and 3rd dimension of procrastination: $Z = -4.12$, $p = .003$), and compulsion (for 1st: $Z = -2.01$, $p = .004$, 2nd: $Z = -3.18$, $p = .001$, and 3rd dimension of procrastination: $Z = -2.19$, $p = .007$).

Standardized estimates of total, direct, and indirect effects on the three dimensions of procrastination (extent of procrastination, procrastination as a problem, desire to reduce procrastination) and mediator variables are shown in Table 6.

Table 6 Standardized estimates of total, direct, and indirect effects on procrastination and mediator variables for university students

Paths	Effect	% explained of total effect
Emotional engagement→extent of procrastination (total effect)	-0.20	–
Emotional engagement→extent of procrastination (direct effect)	-0.08	38%
Emotional engagement→extent of procrastination (total indirect effect)	-0.12	62%
Emotional engagement→withdrawal→extent of procrastination	-0.05	35%
Emotional engagement→compulsion→extent of procrastination	-0.07	27%
Emotional engagement→procrastination as a problem (total effect)	-0.18	–
Emotional engagement→procrastination as a problem (direct effect)	-0.07	28%
Emotional engagement→procrastination as a problem (total indirect effect)	-0.11	72%
Emotional engagement→withdrawal→procrastination as a problem	-0.05	35%
Emotional engagement→compulsion→procrastination as a problem	-0.06	37%
Emotional engagement→desire to reduce procrastination (total effect)	-0.21	–
Emotional engagement→desire to reduce procrastination (direct effect)	-0.09	41%
Emotional engagement→desire to reduce procrastination (total indirect effect)	0.12	59%
Emotional engagement→withdrawal→desire to reduce procrastination	-0.05	28%
Emotional engagement→compulsion→desire to reduce procrastination	-0.07	31%
Cognitive engagement→extent of procrastination (total effect)	-0.19	–
Cognitive engagement→extent of procrastination (direct effect)	-0.10	59%
Cognitive engagement→extent of procrastination (total indirect effect)	-0.09	41%
Cognitive engagement→withdrawal→extent of procrastination	-0.05	23%
Cognitive engagement→compulsion→extent of procrastination	-0.04	18%
Cognitive engagement→procrastination as a problem (total effect)	-0.17	–
Cognitive engagement→procrastination as a problem (direct effect)	-0.09	55%
Cognitive engagement→procrastination as a problem (total indirect effect)	-0.08	45%
Cognitive engagement→withdrawal→procrastination as a problem	-0.04	21%
Cognitive engagement→compulsion→procrastination as a problem	-0.05	24%
Cognitive engagement→desire to reduce procrastination (total effect)	-0.19	–
Cognitive engagement→desire to reduce procrastination (direct effect)	-0.08	40%
Cognitive engagement→desire to reduce procrastination (total indirect effect)	-0.11	60%
Cognitive engagement→withdrawal→desire to reduce procrastination	-0.04	23%
Cognitive engagement→compulsion→desire to reduce procrastination	-0.07	37%
Behavioral engagement→extent of procrastination (total effect)	-0.15	–
Behavioral engagement→extent of procrastination (direct effect)	-0.06	35%
Behavioral engagement→withdrawal→extent of procrastination (indirect effect)	-0.09	65%
Behavioral engagement→procrastination as a problem (total effect)	-0.14	–
Behavioral engagement→procrastination as a problem (direct effect)	-0.04	32%
Behavioral engagement→withdrawal→procrastination as a problem (indirect effect)	-0.10	68%
Behavioral engagement→desire to reduce procrastination (total effect)	-0.14	–
Behavioral engagement→desire to reduce procrastination (direct effect)	-0.05	41%

Table 6 (continued)

Paths	Effect	% explained of total effect
Behavioral engagement→withdrawal→desire to reduce procrastination (indirect effect)	-0.09	59%
Academic connectedness→extent of procrastination (total effect)	-0.20	–
Academic connectedness→extent of procrastination (direct effect)	-0.07	34%
Academic connectedness→extent of procrastination (total indirect effect)	-0.13	66%
Academic connectedness→withdrawal→extent of procrastination	-0.08	39%
Academic connectedness→compulsion→extent of procrastination	-0.05	27%
Academic connectedness→procrastination as a problem (total effect)	-0.16	–
Academic connectedness→procrastination as a problem (direct effect)	-0.07	45%
Academic connectedness→procrastination as a problem (total indirect effect)	-0.09	55%
Academic connectedness→compulsion→procrastination as a problem	-0.05	31%
Academic connectedness→withdrawal→procrastination as a problem	-0.04	24%
Academic connectedness→desire to reduce procrastination (total effect)	-0.19	–
Academic connectedness→desire to reduce procrastination (direct effect)	-0.05	31%
Academic connectedness→desire to reduce procrastination (total indirect effect)	-0.14	69%
Academic connectedness→withdrawal→desire to reduce procrastination	-0.08	39%
Academic connectedness→compulsion→desire to reduce procrastination	-0.06	30%

4 Discussion

The present study aimed to investigate academic procrastination among students of elementary, secondary, and tertiary education cross-sectionally. At the same time, adopting the framework of the PBT, examined the role of perceived academic context-related factors (academic engagement/connectedness) as well as the PSMU in students' academic procrastination in the three levels of education.

4.1 The role of level of education in academic procrastination

The findings showed that the level of education significantly affected dimensions of students' academic procrastination. Specifically, elementary and secondary school students seemed to procrastinate to a greater extent compared to university students. On the other hand, university students perceive procrastination as a problem and want to reduce it to a greater extent compared to the rest of the students. The above results partially confirm Hypothesis 1, as it was expected that mainly adolescents (secondary education) and young adults (tertiary education) engage in behaviors indicative of procrastination (e.g., frequency, desire to reduce it). Nevertheless, it seems that even young children (elementary education) tend to procrastinate to a great extent, which is in contrast with Martín-Puga et al. (2022), who recently mentioned that adolescents procrastinate more than young children.

However, the present finding is in line with other studies, which reveal that this dysfunctional academic behavior concerns even younger age groups (e.g.,

Al-Attiyah, 2010; Parantika et al., 2020; Xue et al., 2023). This finding could also reflect the fact that the study was conducted in the aftermath of the pandemic period, which negatively affected students' learning motivations generally (Fajri et al., 2021). The last two years of students' frequent absence from academics/school are likely to have contributed to the lack of consistency, organization, and responsiveness to academic duties (behaviors indicative of academic procrastination) in all age groups of students, regardless of the organizational characteristics of the academic context (e.g., closer interpersonal relationships in elementary schools).

Also, the fact that university students believe that procrastination is a problem, and they desire to reduce it to a greater extent, compared to the rest of the participants, probably reflects the following: In most cases, university students tend to choose their studies and attend classrooms voluntarily not mandated as school students are. Therefore, they are expected to exhibit learning self-regulation and self-control (e.g., by admitting that procrastination is a problem/trying to reduce it) to achieve their academic goals to a greater extent, compared to secondary/elementary school students whose studies are compulsory. However, future related comparative studies could reveal the longitudinality of the pattern of procrastination for the three levels of education.

4.2 Gender issues in academic procrastination

The current study showed that at all levels of education (elementary, secondary, tertiary), students' gender was not a significant differentiating factor for their academic procrastination. This finding confirms Hypothesis 2a, as based on related studies (Ajayi, 2020; Amoke et al., 2021; Ebadi & Shakoorzadeh, 2015; He, 2017; Islak, 2011), it was expected that both males and females procrastinate in tertiary and secondary education approximately to the same extent. Nevertheless, the present finding is in contrast with previous studies (Al-Attiyah, 2010; Parantika et al., 2020) and Hypothesis 2b, according to which it was expected that elementary school males procrastinate more than females. As has already been mentioned, the harmful consequences of the period of the COVID-19 pandemic for students' learning motivation and achievements (Fajri et al., 2021) might have triggered maladaptive patterns of academic behavior (e.g., procrastination) in most students, regardless of not only their level of education but their gender as well.

4.3 The role of academic context-related factors in academic procrastination

Based on the path analysis results for the three student groups, Hypothesis 3a was partially confirmed. The reason for this finding might be that in the case of elementary school and university students, academic procrastination was predicted directly and negatively, not by all, but only by specific types of engagement in their academic context. Generally, this finding concurs with the study by Hui et al. (2019), which showed that when university students are engaged in their academic context/environment in different qualitative ways (e.g., cognitively), they tend to procrastinate less regarding their academic duties.

It therefore could be that a perceived supportive academic environment, which enhances students' positive emotional, cognitive, and behavioral interaction with teachers and peers in the classroom context, could have the potential to predispose students to fulfill their academic/school obligations consistently. In contrast with the students at elementary and tertiary education, secondary school students' academic procrastination was not predicted directly, but only indirectly by their academic engagement, through the mediating role of PSMU (withdrawal and compulsion). This finding is discussed in detail in the next subsection, where the role of PMSU is presented.

It should be emphasized that the types of academic engagement with a predictive value for students' procrastination seem to differ between elementary and tertiary education. Specifically, for elementary school students, it was shown that emotional engagement was the only type of academic engagement that had the potential to influence their extent of procrastination directly and negatively. This could be expected, considering that elementary school years correspond to a sensitive period where children's social-emotional development is to a significant extent under formation and is influenced by the key role of teachers' behaviors (Aviles et al., 2006; Goldberg et al., 2019). Consequently, the students' perceived emotional interaction with teachers and peers while students engage in the learning process seems to have the potential to act protectively against their procrastination behaviors during the elementary school years. The fact that elementary school students' emotional engagement did not directly predict their perception that procrastination is a problem and their desire to reduce could imply the following: the above two dimensions of procrastination require a greater awareness of the negative consequences. Therefore, more advanced related cognitive and metacognitive strategies (e.g., self-controlling) are needed, which are usually used to a lesser extent by young children, such as elementary school students, compared to older adolescents and young adults (Schneider, 2008; Schneider & Löffler, 2016).

Regarding university students, only cognitive engagement seemed to predict their academic procrastination directly and negatively. This finding could imply that, compared to younger children, university students could tend to pursue their academic goals more maturely and more consciously in a more impersonal and emotionally distant academic context. Consequently, it could be expected that their academic procrastination is not influenced by their perceived emotional interaction with instructors and peers in the academic context of classrooms (emotional engagement) as much as by their cognitive and/or metacognitive skills (e.g., self-regulation, self-control) they manifest while interacting within classroom (cognitive engagement). The fact that university students' behavioral engagement did not directly predict their academic procrastination could be attributed to university students' frequently limited involvement in various activities in the academic community, such as participation in university's projects/volunteering actions (Touloupis & Athanasiades, 2022b), which would reflect students' behavioral involvement in the academic context. Additionally, the fact the students' appropriate conduct/behavior within the university classrooms/campus (indicative of positive behavioral engagement) is usually taken for granted by most adult students probably does not endow behavioral

engagement with a dynamic predictive power to act protectively against students' procrastination.

Furthermore, it was found that university students' cognitive engagement directly predicted not only their extent of academic procrastination but also their perception that procrastination is a problem (2nd dimension) and their desire to reduce it (3rd dimension). As previously mentioned, this probably implies that these two dimensions of procrastination presuppose more advanced cognitive/metacognitive characteristics (e.g., awareness of procrastination's consequences, conscious attempt to reduce it), which are more frequently manifested by adolescents and young adults (Schneider, 2008; Schneider & Löffler, 2016). Besides, the perception that procrastination is a problem and the desire to reduce it were expressed by university students to a higher extent compared to the other student groups.

The partial conformation of Hypothesis 3a is also reflected in the fact that academic connectedness directly predicted academic procrastination only in the case of elementary school students. This could be attributed to the usually closer interpersonal relationships between students and teachers in elementary schools compared to secondary and tertiary education, where a more psychologically distant climate prevails in the academic context (Wong et al., 2008; Zapata-Caceres et al., 2021). Therefore, it is likely that elementary school students experience a stronger sense of closeness/connectedness to their school environment/context, which, in turn, might protect them against dysfunctional academic behaviors such as procrastination. Generally, this finding is in line with the only related recent study by Nabaei et al. (2021), which showed that students' perceived sense of academic identity, as a possible outcome of school connectedness, negatively predicts their procrastination regarding school duties. However, as the findings of Nabaei et al. (2021) concern only secondary school students, it is highlighted that the relationship between academic connectedness and procrastination in other levels of education needs further investigation.

4.4 The mediating role of PSMU between academic context-related factors and academic procrastination

In accordance with Hypothesis 3b, the path analysis results showed that PSMU (withdrawal, compulsion) generally mediates the relationship between perceived academic context-related factors (academic engagement/connectedness) and academic procrastination for the three student groups. This finding concurs with other studies, which provide some justification for but do not confirm the mediating role of PSMU in the above relationship. Specifically, the present result is in line with the previously reported negative predictive role of students' perceived academic engagement and connectedness in their problematic Internet and online game use, on the one hand (Li & Zhu, 2020; Li et al., 2021; Wei et al., 2019), and the positive predictive role of students' PSMU in their academic procrastination, on the other hand (Andangsari et al., 2018; Aznar-Díaz et al., 2020; Yang et al., 2019).

In other words, it is implied that when students engage poorly in classrooms and academic/school life generally at the emotional, cognitive, and behavioral level, they are likely to succumb to the temptation to find interest in and spend time on social media. Within this context, they can be fully absorbed (sign of withdrawal) and/or lose control (sign of compulsion). This situation, in turn, could increase the possibility of students' procrastination regarding their academic/school duties, without being fully aware of the problematic nature of this behavior and without admitting that they should stop it. These findings are considered significant and innovative, considering the excessive Internet and social media use reported among students and young adults during the pandemic period (Nilsson et al., 2022; Vanherle et al., 2022).

However, within a more comparative perspective, some similarities and differences should be highlighted among the mediation models for the three student groups. For example, it is worth emphasizing that only in the case of secondary school students did PSMU (withdrawal, compulsion) prove to be a fully mediating factor between all types of students' academic engagement and connectedness, on the one hand, and their academic procrastination, on the other hand. This full mediation could be explained by the fact that social media constitute an integral part of adolescents' daily lives, especially during these last two years when live social interaction was significantly limited due to the COVID-19 pandemic (Nilsson et al., 2022; Vanherle et al., 2022). This dominance of social media use in adolescents' daily routine seems to act as a necessary underlying mechanism, which "translates" their context-related psychological states (e.g., low academic engagement/connectedness) in a maladaptive pattern of academic behavior (procrastination). The latter could be a key dimension (e.g., promoting safe social media use) in relevant prevention actions aimed at enhancing adolescents' learning motivation and academic engagement.

Compared to students of secondary education, elementary school students' PSMU seemed to mediate the relationship between their academic engagement and procrastination not only fully (e.g., behavioral engagement→withdrawal→extent of procrastination, cognitive engagement→compulsion→extent of procrastination) but partially as well (e.g., emotional engagement→withdrawal→extent of procrastination). The importance of emotional academic engagement for elementary school students' achievements (Aviles et al., 2006; Goldberg et al., 2019), as described in the previous subsection, may explain the direct effect of this type of engagement on their academic procrastination (and consequently the partial moderation of PSMU). However, the progressive excessive use of social media at younger and younger ages (Touloupis & Athanasiades, 2014, 2022a) could justify to some extent why elementary school students' withdrawal and compulsion (aspects of PSMU) act at the same time as necessary filters (fully mediating) that "transform" students' poor engagement at school into academic procrastination.

The mediation model for university students is similar to that for elementary school students. For example, withdrawal seems to mediate both fully (e.g., emotional engagement/academic connectedness→withdrawal→extent of procrastination/procrastination as a problem/desire to reduce it) and partially the relationship between academic context-related factors and procrastination (e.g., cognitive

engagement/academic connectedness→withdrawal→extent of procrastination/procrastination as a problem/desire to reduce it). Accordingly, compulsion mediates fully (e.g., emotional engagement→compulsion→extent of procrastination/procrastination as a problem/desire to reduce it) and partially the above relationship (e.g., cognitive engagement→compulsion→extent of procrastination/procrastination as a problem/desire to reduce it). As it has already been mentioned, the frequent use of cognitive/metacognitive strategies (e.g., self-controlling, self-regulating) among university students to meet their academic obligations (Binali et al., 2021) could account for the direct effect of their cognitive engagement in their academic procrastination (and consequently the partial moderation of PSMU). Furthermore, the fact that excessive/problematic Internet use usually declines to some extent from adolescence (intense period of experimentation) to the more "crystalized" period of emerging adulthood (Arnett, 2014), which usually coincides with university students' academic life, might explain the following: PSMU may sometimes have an important (partially mediating) and other times a critical role (fully mediating) in the way university students' poor engagement in and connectedness to the academic context lead to procrastination. In other words, it seems that withdrawal and compulsion, although influencing university students' daily routine, probably do not constantly dominate their lives to such an extent that always effect their academic behaviors.

Finally, another comparison among the mediation models concerns the specific aspects of PSMU that seem to mediate (fully or partially) the relationship between students' academic engagement and procrastination. Based on Figs. 2, 3, and 4, it seems that for elementary school students, withdrawal (due to PSMU) mediates the above relationship to a greater extent compared to the dimension of compulsion. This could be associated with the fact that signs of withdrawal, such as disobedience, anger, coercion, and verbal protest (in the case of prohibition from/removal of Internet access by parents), are more frequently reported among preadolescent young children (Greenfield, 2011), such as elementary school students. On the other hand, compulsion (e.g., uncontrollable social media use) is reported to a greater extent among older adolescents (secondary school students) and young adults (university students) (Rich et al., 2017), as setting boundaries and exercising control (e.g., for time spent on social media) by parents are more difficult in these age groups (Fletcher et al., 2004; Harris-McKoy & Cui, 2013).

4.5 Limitations, future research, and contribution of the present study

Due to specific limitations of the present study, the findings should be interpreted cautiously. First, the use of a self-reported questionnaire and the possibly resulting socially acceptable responses may influence the validity of the results. Also, the data collection that is only from Greece, is likely to affect the generalizability of the findings. Additionally, the use of a cross-sectional research design does not allow inferences regarding strictly causal relationships among the variables involved. Furthermore, the applied quantitative method did not allow the reflection of more qualitative information regarding students' behaviors/experiences under study.

The above limitations constitute a fertile ground for future transnational studies examining this issue both quantitively and qualitatively (by focus groups) to enhance the validity, wealth, and generalizability of the results. Furthermore, the adoption of a longitudinal research design could confirm the proposed mediation model for the three levels of education or examine possibly different directions in the structure of the relationships among the variables involved (e.g., the negative predictive role of PSMU in academic engagement/connectedness). Also, the inclusion of factors related to the family contextual system in the proposed path model could provide a more holistic approach to the explanation of students' academic procrastination.

Nevertheless, the present study contributes to the international literature, as incorporating the recent framework of the PBT (Boyd et al., 2009; Jessor, 2001) it depicts for the first time cross-sectionally the structure of the relationships between perceived academic context-related factors and the current issue of PSMU to better explain the pattern of procrastination behaviors among students of the three levels of education. The present findings have implications for school (teachers, parents, educational/school psychologists) and university communities (instructors, counseling centers) regarding students' academic procrastination and its underlying mechanisms. Furthermore, the proposed mediation model for each student group could inform about the different dimensions that could be emphasized when planning prevention actions in elementary, secondary, and tertiary education aimed at enhancing students' learning motivation. For example, within prevention actions, specific practices to improve emotional and cognitive interaction in the classroom context could prove to be effective protective factors against procrastination behaviors among elementary and university students, respectively. Finally, encouraging actions to promote prudent social media use with an emphasis on the prevention of specific dysfunctional behaviors (withdrawal, compulsion) could limit the possibility of academic procrastination, especially for secondary school students.

5 Conclusion

To summarize it is concluded that, regardless of gender, academic procrastination seemed to concern students at all levels of education but especially in elementary and secondary education. However, university students seemed to be more aware of the dysfunctional nature of this behavior. Based on the theoretical framework of PBT, elementary school students' perceived emotional engagement and academic connectedness and university students' perceived cognitive engagement proved significant direct and negative predictors of their academic procrastination, respectively. Finally, for the three student groups, but mainly for secondary school students, PSMU proved a negative mediator between perceived academic context-related factors and academic procrastination.

Data availability Authors select to not share data (Due to the specificity of the sample and the sensitive nature of the research topic, the participating students and parents/guardians were assured raw data and material would remain confidential and would not be shared.)

Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to report.

Ethics approval Ethics approval by the Institute of Educational Policy of the Greek Ministry of Education.

Consent to participate Consent to participate was secured for all participants according the ethical standards of the Institute of Educational Policy of the Greek Ministry of Education.

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