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The exploration of a 'model' for understanding the contribution of emotion regulation to students learning. The role of academic emotions and sense of coherence

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Abstract

The present study is exploring a pathway connecting emotion regulation with academic progress. Specifically, the pattern through which emotion regulation is implicated in learning and academic progress through academic emotions and sense of coherence. This cross-sectional study involves of 406 undergraduate social science students recruited from a university in western Greece. Participants anonymously and voluntarily completed a number of self-report measures. The Emotion Regulation Questionnaire, the Sense of Coherence Scale, the Student Experience of Emotions Inventory and the Approaches to Learning and Studying Inventory, were used to measure emotion regulation, sense of coherence, academic emotional experiences and approaches to learning, respectively. A four-stage model was tested with structural equation modelling techniques. In particular, the model examined associations between emotion regulation, sense of coherence, academic emotions, approaches to learning and academic progress. The analysis revealed pathways through which these associations appear to be maintained and driven by emotion regulation. Emotion regulation is associated with students' academic emotions that in turn are linked with approaches to learning and academic progress. Both positive and negative emotions appear to play a role in enabling an adaptive approach to learning. Moreover, sense of coherence may serve as an important meta-cognitive factor enabling students to approach the learning process more effectively. The findings are discussed in the light of the recent literature.

Keywords Emotion regulation · Academic emotions · Sense of coherence · University students · Path analysis

Introduction

The current turn in the research of learning in higher education involves emotions and the exploration of psychosocial variables. Approaches to learning and learning styles have been related to academic emotions (Postareff et al., 2017; Tan et al., 2021). Moreover, in our recent research, learning has been linked to variables traditionally associated with mental health (Karagiannopoulou et al., 2020). This shift can be seen in the context of a broader shift from dis-ease to health-ease in higher education, a salutogenic perspective, revealing a concern about well-being and a perception of universities as sustainable communities (Dooris et al., 2017).

In the last decades, Emotion Regulation (ER) has attracted significant research interest revealing its role in the experience and expression of emotions. Recently it has been associated with students learning. In particular, it has been

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found to be linked to learning strategies and students' emotions (Ben-Eliyahu & Linnenbrink-Garcia, 2013; Webster & Hadwin, 2015). There is an increasing recognition that "Emotion is the foundation of learning" (Zull, 2006). Academic emotions appear a significant aspect of the learning process and are related to learning and educational achievement (Pekrun et al., 2002; Postareff et al., 2017). However, the focus in educational research has predominantly centred on emotions contribution to motivation (Pekrun, 2019) along with self-efficacy and well-being (Pekrun & Perry, 2014; Putwain et al., 2013). At the same time, there is a shortage of studies relating learning and academic emotions to variables traditionally associated with mental health. One notable gap is, Sense of Coherence (SOC), a factor that modulated one's agency in learning which has been studied in association to mental health (Krok, 2020) but its effect on learning has been relatively unexplored (Davidson et al., 2012; Salamonson et al., 2016). However, recently, many studies discuss salutogenesis as an umbrella term for mental health raising the issue of "healthy universities" and "healthy learning" (Dooris et al., 2017). The exploration of the link between ER and learning through academic emotions and SOC has the potential to support our understanding of the complex picture of learning in higher education.

If we accept the argument that academic emotions are "real" and relevant to the study of learning, we should assume that they are both experienced and regulated similarly to any other emotions humans experience. ER therefore is of particular importance in the educational context where students experience a wide range of emotions that influence not only their learning and retention, but also their well-being (Pekrun & Perry, 2014). To our knowledge, there is scarce evidence of associations between ER and academic emotions in higher education (Rentzios et al., 2019; Webster & Hadwin, 2015). Previous studies indicated such associations. However, factors associated with mental health variables (e.g. SOC) along with academic emotions does not appear in previous studies. These associations are of particular importance for our understanding of the contribution of both academic emotions and factors associated with mental health on learning.

While, motivational and learning variables have been at the heart of this research tradition, there is now a growing interest in associations between psychosocial factors, traditionally studied in the context of mental health, and learning (Milienos et al., 2021). This interest draws on recent suggestions that in order to promote students' learning and success more emphasis should be laid on personality-individual traits rather than environmental factors (Hampson, 2012; Moreau et al., 2019). The focus of the present paper is the exploration of the interplay between academic progress and emotion regulation, academic emotions, sense of coherence and approaches to learning in university students. In particular, it explores whether emotion regulation is associated with academic emotions and sense of coherence that in turn are linked with learning and academic progress.

Approaches to learning and achievement

Approaches to learning is a concept introduced by Marton and Säljö in the late 1970s to explore the way students go about learning in higher education. Their research was expanded by Entwistle (2018) and Biggs (2003) leading to the identification of three approaches to learning: deep, surface, and strategic. The notion of approaches to learning has been widely used to explore university students' learning (Entwistle, 2018; Parpala et al., 2013; Säljö, 2009). Students who adopt a deep approach, study with the intention to understand the material for themselves and to construct meaning of the material through relating ideas or using evidence. Students using a surface approach study with the intention to meet exam demands without necessarily aiming to understand the material; they rely on memorizing and reproducing information, which often leads to fragmented knowledge. The strategic approach, an equivalent to the achieving approach described by Biggs (2003) also referred to as organized studying, involves planned effort and time management (Lindblom-Ylänne et al., 2018). This last approach has been argued to be similar to the concept of self-regulation (Postareff et al., 2017).

Several studies, including our own research, demonstrated links between approaches to learning and achievement (Karagiannopoulou et al., 2020; Herrmann et al., 2017). The deep and strategic approaches have been associated with higher achievement and the surface approach with poor performance (Postareff et al., 2017; Trigwell et al., 2012). However, this line of research has been criticised for showing inconsistent results (Dinsmore & Alexander, 2012), and a few studies revealed weak associations (Richardson et al., 2012) failing to replicate a positive relationship between the deep approach and academic achievement (Karagiannopoulou & Milienos, 2015; Rytkönen et al., 2012).

Academic emotions and learning

Academic emotions are classified according to their valence and emotional activation; emotions can be either positive or negative and activating or deactivating (Pekrun et al., 2011). Academic emotions in the current study are thought as emotions that university students experience during learning activities. Overall, positive emotions appear to facilitate learning while negative emotions tend to curb students' success (Rentzios & Karagiannopoulou, 2021; Trigwell et al., 2012). Although numerous studies in the past have focused

on the effect of negative emotions on learning,- especially the extensive research on test anxiety (Zeidner, 2014), the interest in the role of positive emotions in learning is comparatively recent (Villavicencio & Bernardo, 2013).

This new interest can be seen in the context of positive psychology and the broader shift from a "disease paradigm" to one of self-strengths (Dooris et al., 2017). Many studies have focused on this dichotomous dimension however, Boekaerts (2003) suggests that positive and negative emotions may arise simultaneously making the interplay between them more complex. For example, studies indicated that positive affect is negatively related to achievement, when positive emotions act as an indicator of overconfidence (Robinson et al., 2017). Negative emotions also present some complex relations to learning-related outcomes (Pekrun & Linnenbrink-Garcia, 2012). While negative emotions are assumed to be associated with poor academic achievement (Pekrun et al., 2002), they may at times serve as signals that more effort and attention is needed, and in turn result in a more adaptive learning outcome (Robinson et al., 2017).

Recent studies have revealed the contribution of academic emotions along with a variety of individual variables to students learning, indicating a complex picture of learning (Rentzios & Karagiannopoulou, 2021; Sander et al., 2020). Individual variables treated as both trait and state-like characteristics, e.g. 'need for cognition' and 'sense of coherence' have been found to be associated with academic emotions and contribute to the understanding of learning.

Sense of coherence

SOC is a global orientation that indicates the extent to which a person perceives her world as comprehensive, manageable, and meaningful. It stands for individual's coping ability to face with daily routine stressors and demands. Comprehensibility involves one's confidence that demands arising from internal and external environments are predictable and explicable; Manageability involves the perception that personal resources (e.g. personal beliefs, skills, networks) are available to meet the demands; Meaningfulness is the perception that demands and challenges are worthy of investment, commitment and engagement (Antonovsky, 1987). SOC has been consistently explored along with other emotional factors and was found to contribute to affectional models in both health and educational context (Mato & Tsukasaki, 2017). Scholars have also argued about the contribution of SOC as a substantive model in understanding the complexity of systemic relations in environments such as education (Davidson et al., 2012).

In line with this, SOC was found to be associated with coping strategies (Amirkhan et al., 2003), test anxiety, self-regulation and overall performance of university students (Salamonson et al., 2016).

In our recent study we brought together the contribution to students' learning from multiple factors (SOC, emotion regulation, need for cognition, academic emotions and approaches to learning) revealing the contribution of self-strengths to the way students go about learning (Karagiannopoulou et al., 2020).

Emotion regulation

Despite the difficulties in untangling emotion from its regulation, most researchers agree that emotions can become the target of self-regulatory efforts (Butler, 2011). Emotion regulation refers to conscious or unconscious attempts people make to influence which emotions they have, when they have them, and how they express and experience them (Harley, Pekrun et al., 2019). ER is considered as the process through which individuals shape and modify the experience and expression of emotions. Consequently, the way students approach learning and academic success is influenced by emotions (Rentzios et al., 2019). The effective use of ER strategies can enhance learning by helping students to adapt positively when negative emotions arise, improving achievement and cognitive functioning (Harley, Jarrell et al., 2019). ER has also been found to affect learning strategies and students' emotions (Ben-Eliyahu & Linnenbrink-Garcia, 2015).

There are various ER strategies distinguished by the point in time at which they can be deployed and by the primary impact they have on the emotion generation process. Reappraisal and suppression are two ER strategies frequently associated with adaptive behaviours and positive outcomes in social and mental health domains (McRae & Gross, 2020). Reappraisal involves reframing the situation to reduce undesired emotions, while suppression describes not overtly expressing one's emotions (Gross & John, 2003). Reappraisers usually alter the meaning of an ongoing emotional condition to reduce its emotional impact before the emotion fully emerges (cognitive early deployment): students for example, may choose to perceive a difficult task as a challenge rather than a daunting situation (Gross, 2015). On the contrary, suppressors inhibit their emotional expressive behavior when the emotion has already gathered force (late deployment): a student tries not to show his/her anxiety during a difficult presentation. Whereas reappraisal is typically thought as an adaptive strategy and suppression as maladaptive, literature suggests the importance of the context in which the emotion emerged (Desatnik et al., 2017; Rottweiler et al., 2018).

The recurrent use of reappraisal has been found to increase study-related behaviours that in turn promote

academic achievement (Leroy et al., 2012). Further, recent studies reveal the role of ER in students' approaches to learning (Reindl et al., 2020). As we have showed in our previous study, surface learners scored low on reappraisal and high on suppression while the reverse was the case for deep learners (Karagiannopoulou et al., 2020). Moreover, ER functions as an antecedent of academic emotions that can help students manage successfully their emotions during learning (Harley, Jarrell et al., 2019).

The present study

While it is argued that ER plays an important role in one's capacities to learn, persevere and achieve in the context of education, to date the root of this connection remains relatively unexplored. This study explores a pathway to elucidate this connection.

The theoretical perspective underlying the model explored in the present study assumes that ER is an early developing ability in goal-directed management of internal first representations and external expressions of emotions (Gross, 1998). It is presented at the first stage of our model. As such, it modifies emotions acting as a health-promoting factor and a mental health characteristic (Berking & Wupperman, 2012; Koole, 2009). Besides, poor ER may lead to distortions in the perception of the social context in which emotion is experienced having a further effect on SOC, implying defensive or ineffective coping (Schwarzer et al., 2021). In this line of thinking, academic emotions and SOC are explored at the second stage of the hypothesized model. It is assumed that the emotions students experience have an impact on their choice of learning strategies and thus also on academic progress (Postareff et al., 2017; Pekrun & Perry, 2014). SOC is expected to be linked with approaches to learning. Previous studies have indicated that SOC is linked with good physical and mental wellbeing and a stronger interest in learning (Lindström & Eriksson, 2011; Karagiannopoulou et al., 2020). Besides, the exploration of it at the same level with the students emotional experience draws on the debate about the malleability of personality traits and their developmental nature (Moreau et al., 2019). The students' academic progress appears at the last stage giving ecological validity to the model that involves emotional paths in learning.

Methodology

Participants and Procedure

The sample consists of 406 undergraduate social science students enrolled for the same major - Psychology, aged 18 to 22, of whom 12.7% (N = 51) were men and 87.3% (N = 351) were women. The students attended a four-year course at a Greek University. Participants were distributed between the years of study. The 1st-year students were the largest group (34.1%), followed by the 2nd-year (27.6%) and the 4th-year students (21.6%); the 3rd-year students were the smallest group (16.7%). All ethical protocols were taken into consideration. Students anonymously and voluntarily completed the questionnaires before the beginning of a lecture. Written informed consent was obtained from all participants. Ethics approval was received in line with the standards of the Greek university. The completion of the questionnaires lasted about 25 min.

Instruments

Emotion regulation questionnaire

Emotion Regulation was measured with the Emotion Regulation Questionnaire (Gross & John, 2003). This is a 10-item instrument that assesses two emotion regulation strategies (a) reappraisal (6 items, e.g. When I want to feel more positive emotion, I change the way I'm thinking about the situation) and (b) expressive suppression (4 items, e.g. I control my emotions by not expressing them). Answers are given in a 7 point Likert Scale ranged from Strongly Disagree to Strongly Agree.

Student experience of emotions inventory

Students' emotional responses to academic situations were measured by the Students Experience of Emotions Inventory (Trigwell et al., 2012). It comprises 18 items that correspond to three scales (a) Positive emotions (pride, hope and confidence) (b) Negative emotions I (anger and boredom) and (c) Negative emotion scale II (anxiety and shame). The scales consist of six, five and seven items, respectively. Indicative items: Positive emotions (e.g. I feel proud of my progress in this course), Negative I (e.g. I am bored by this course), Negative-II (e.g. Contributing to discussions in class makes me anxious).

Approaches to learning and studying inventory

Approaches to learning have been measured by a short altered version of the Approaches to Learning and Studying Inventory (ALSI) developed by the Finnish research group in higher education (Parpala et al., 2013). The instrument consists of 16 items that measure a deep (8 items, e.g. I look at evidence carefully to reach my own conclusion about what I'm studying), a surface (4 items, e.g. Often I have to

learn over and over things that don't really make sense to me) and a strategic approach/organised effort (4 items, e.g. I organize my study time carefully to make the best use of it). A high score on the five-point Likert scale is indicative of students' adoption of each approach.

Sense of coherence

The Sense of Coherence is measured by the 13 items short version (Antonovsky, 1993). This emerged from the original 29 item instrument 'Orientation to Life Questionnaire' developed by Antonovsky (1987). The scores of the 13 items add up to a whole score. Example of items are: "Do you have very mixed-up feelings and ideas?" or "How often do you have the feeling that there is little meaning in the things you do in your daily life?" Responses are rated on a 7-point Likert scale from 1 (very rarely) to 7 (very often).

Academic progress

The academic progress was measured through failure rate. Participants were asked in how many courses they had failed until the time the data collection took place. Failure rate was computed by the proportion of failures to the number of courses they have already attended.

Data Analysis

Path analysis (using SEM) was used to specify and assess the associations among ALSI approaches, Student Experience of Emotions Inventory subscales, Emotion Regulation Questionnaire subscales, Sense of Coherence scale and courses Failure Rate.

To evaluate the fitting of the SEM to our data we, firstly, examined the null hypothesis of the chi-square test, that investigates this assumption. If this null hypothesis is not rejected at a significance level of 0.01, then the model fits well to our data (Kline, 2016; Tabachnick & Fidell, 2019). Moreover, we examined values of the Root means square error of approximation (RMSEA), the Comparative Fit Index (CFI) and the standardized root mean square residual (SRMR). For RMSEA, values < 0.05, indicate a well-fit, and values < 0.08 are considered acceptable (Kline, 2016). The CFI indicates a good model fit for values in the range between 0.95 and 1.00, whereas values in the range between 0.90 and 0.95 signify acceptable fit (Raykov & Marcoulides, 2012). Finally, values of the SRMR < 0.05, indicate a good fit, whereas values < 0.08 are generally considered favourable (Kline, 2016). Moreover, power analysis was performed in order to justify the sample size used for model structure (Cohen, 1988; Westland, 2010).

All analyses were performed using IBM SPSS v.26 and STATA 14 (StataCorp. 2015. Stata Statistical Software: Release 14. College Station, TX: StataCorp LP).

For confirmatory Factor analysis and the assessment of the latent structure of ALSI, Student Experience of Emotions Inventory, Emotion Regulation Questionnaire and Sense of Coherence scale, as well as for Cronbach's alpha for the measurement of internal consistency of the data please see Karagiannopoulou et al. (2020). Due to the high number of female participants, gender differences were not taken into account. The Descriptive statistics of the latent variables can be found in Supplementary Table 1. The results from Confirmatory Factor analysis are presented in Supplementary Table 2. Briefly, the latent structures of the instruments have been verified, as most of the indices are established in an acceptable range of values. Cronbach's alpha values ranged from moderate ($\alpha = 0.624$ for Sense of Coherence) to high levels ($\alpha = 0.858$ for the Reappraisal subscale of the Emotion Regulation Questionnaire) (Supplementary Table 3). Pearson correlations coefficients among the latent variables are presented in Supplementary Table 4.

Results

We examined a four-stage model to assess the associations among ALSI approaches, Student Experience of Emotions Inventory subscales, Emotion Regulation Questionnaire subscales, Sense of Coherence scale and courses Failure Rate. The Emotion Regulation Questionnaire subscales (reappraisal and suppression) were placed in the first stage. In the second stage of the model were placed the Sense of Coherence scale and the three subscales of Student Experience of Emotions Inventory (Positive Emotions, Negative Emotions I and Negative Emotions II), before the three ALSI approaches (Deep, Surface, Strategic). Finally, the fourth stage comprised of the courses Failure Rate (i.e. academic progress) as the outcome variable. Every variable in our model was directly associated only by the variables of the previous stage. The parameters of our model were estimated using the asymptotically distribution-free method, as the multivariate normality was not assumed in our data.

The fit indices of our model are presented in Table 1. The model fits well to our data, as the null hypothesis that tests this assumption is not rejected at significance level of 0.01. Moreover, the indices of the model meet the requirements of an acceptable fit.

Unstandardized and standardized parameter estimates of model are presented in Table 2. Figure 1 also represents our model graphically.

Table 1 *The fit indices of the model**

Chi-square (p-value)	Chi-square/df	RMSEA	CFI	SRMR
31.18 (0.019)	1.83	0.047	0.944	0.056

*A fourth-stage model; Emotion Regulation Questionnaire subscales (reappraisal, suppression) are placed in the first stage; Sense of Coherence scale (SOC) and the three subscales of Student Experience of Emotions Inventory (Positive, Negative_I, Negative_II) in the second stage; ALSI factors (Deep, Surface, Strategic approach) in the third stage; courses failure rate in the fourth stage

Table 2 *The unstandardized and standardized parameter estimates of the model*

	Parameter Estimate	Standard Error	Standardized Parameter Estimate	p-value
On SOC ($R^2 = 0.1164$)				
Reappraisal	**0.2358**	**0.0772**	**0.1851**	**0.002**
Suppression	**−0.4611**	**0.0810**	**−0.3018**	**< 0.001**
On Positive ($R^2 = 0.096$)				
Reappraisal	**0.2508**	**0.0460**	**0.2742**	**< 0.001**
Suppression	**−0.1876**	**0.0573**	**−0.1711**	**0.001**
On Negative_I ($R^2 = 0.0577$)				
Reappraisal	**−0.1500**	**0.0419**	**−0.1785**	**< 0.001**
Suppression	**0.1772**	**0.0512**	**0.1759**	**0.001**
On Negative_II ($R^2 = 0.0266$)				
Reappraisal	0.0111	0.0643	0.0095	0.862
Suppression	**0.2265**	**0.0750**	**0.1623**	**0.003**
On Deep($R^2 = 0.2147$)				
SOC	0.0378	0.0306	0.0765	0.217
Positive	**0.2284**	**0.0324**	**0.3315**	**< 0.001**
Negative I	**−0.1626**	**0.0381**	**−0.2168**	**< 0.001**
Negative II	**0.0878**	**0.0258**	**0.1623**	**0.001**
On Surface ($R^2 = 0.3068$)				
SOC	**−0.0610**	**0.0187**	**−0.1523**	**0.001**
Positive	**−0.1192**	**0.0243**	**−0.2135**	**< 0.001**
Negative I	**0.2311**	**0.0254**	**0.3803**	**< 0.001**
Negative II	**0.0795**	**0.0188**	**0.1813**	**< 0.001**
On Strategic ($R^2 = 0.3484$)				
SOC	**0.0687**	**0.0216**	**0.1612**	**0.001**
Positive	**0.2815**	**0.0273**	**0.4739**	**< 0.001**
Negative I	**−0.1105**	**0.0282**	**−0.1710**	**< 0.001**
Negative II	**0.0448**	**0.0211**	**0.0960**	**0.034**
On Failure Rate ($R^2 = 0.1103$)				
Deep	−0.0001	0.0016	−0.0061	0.91
Surface	**0.0074**	**0.0020**	**0.1988**	**< 0.001**
Strategic	**−0.0077**	**0.0021**	**−0.2195**	**< 0.001**

i) Reappraisal was positively and significantly associated with Sense of Coherence scale and Positive Emotions.
ii) Suppression was negatively and significantly associated with Sense of Coherence scale and Positive Emotions and also, positively and significantly associated with both Negative Emotions.
iii) Sense of Coherence was significantly and negatively associated with Surface Approach and positively and significantly associated with Strategic Approach.
iv) Positive Emotions were positively and significantly associated with Deep Approach and Strategic Approach; positive emotions were also negatively and significantly associated with Surface Approach.
v) Negative_I Emotions were negatively and significantly associated with Deep Approach and Strategic Approach was positively and significantly associated with Surface Approach.
vi) Negative_II Emotions were positively and significantly associated with ALSI factors (Deep, Surface and Strategic Approach).
vii) Surface and Strategic Approach were significantly, positively and negatively, associated with Failures rate, respectively.

Table 3 contains the standardized direct and indirect effects of all independent variables to the dependent ones in our selected model. Reappraisal has positive significant indirect effects on the Deep and the Strategic Approach and positive significant indirect effects on the Surface Approach. Suppression has negative significant indirect effects on the Deep and the Strategic Approach and positive significant indirect effects on Surface Approach. As Failure rate concerned, positive significant indirect effects were observed for Suppression and Negative_I emotions, and negative significant effects for Reappraisal, Sense of Coherence and Positive emotions.

The decomposition of the significant indirect effects on ALSI factors (Deep, Surface, Strategic Approach) and Failure rate are presented in Table 4. We can assume that the significant effects of Reappraisal and Suppression on the Deep and the Strategic Approach are mainly caused by their effect on Positive Emotions, and their significant effects on the Surface Approach are mainly caused by their effect on Negative_I Emotions. Moreover, the significant effects of Reappraisal, Sense of Coherence and Positive Emotions on Failure rate are mainly caused by their effects on the Strategic Approach, and the significant effects of Suppression and Negative_I Emotions on Failure Rate are mainly caused by their effects on the Surface Approach.

Discussion

The present study aimed to explore the pattern through which ER is implicated in learning and academic progress. The study investigates α pathway to shed light on this

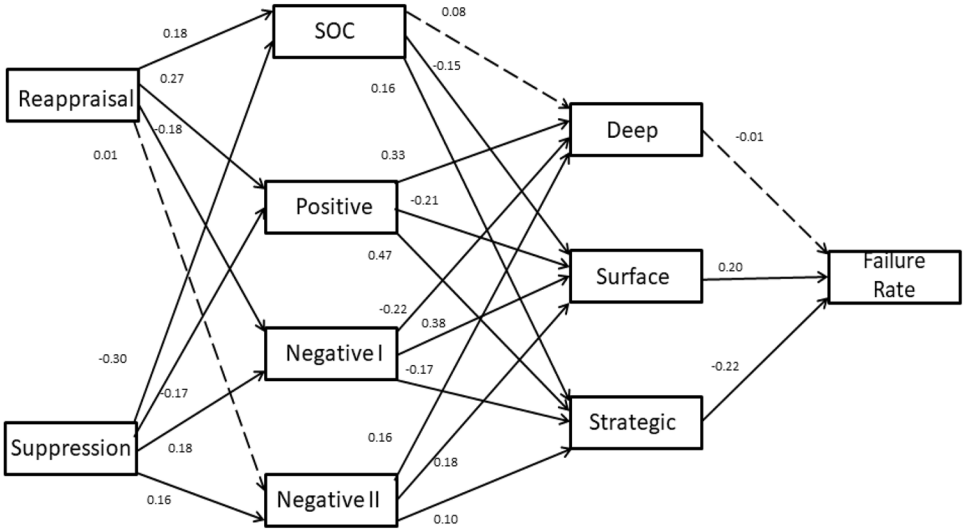

Fig. 1 *The 4-stage path model of the study. Emotion regulation (reappraisal,suppression) at the 1st level, academic emotions (positive, negative I, negative II) and sense of coherece (SOC) at the 2nd level, approaches to learning (deep, surface, strategic approach) at the 3rd level and failure rate at the 4th level. Standardized coefficients are presented (the covariances among independent and error variables are not mentioned, for typographical convenience)*

relationship. The hypothesized model assumed that the quality of the students' emotion regulation will be associated with both academic emotions and sense of coherence. Those in turn would be related to their preferred approach to learning, which previous studies found to be predictive of academic progress (Entwistle, 2018). SOC seems to function at the same stage with emotions possibly contributing to the discussion about its context-related nature.

The results of this study indicates that ER is indeed deeply implicated in the process of learning. The present study both confirmed previously known associations between student emotions, learning styles and academic progress as well as introduced an important pathway through which these associations appear to be maintained and driven by emotion regulation.

Approaches to learning and academic emotions

The findings are in line with the previously discovered associations between approaches to learning and academic progress (Herrmann et al., 2017). The strategic approach appeared to be linked with better academic progress of students, while the surface approach appeared to hinder it. Similar to previous research, the deep approach was not significantly associated with academic progress (Karagiannopoulou & Milienos, 2015; Rytkönen et al., 2012).

Further, it was confirmed that broadly speaking positive emotions and SOC are conducive to academic progress while negative emotions and reduced SOC can hinder students' success (Trigwell et al., 2012; Salamonson et al., 2016; Zeidner, 2014).

Overall the results of the present study successfully replicated the associations between student emotions and academic progress. When students deal with negative emotions, they appear to opt for a surface approach, as being fast may help them to better regulate stress (Chamorro-Premuzic et al., 2007). This particular approach to learning can be seen as a compensatory way to simply pass a course and deal with the task in a less stressful way (Lindblom-Ylänne et al., 2018). In other words, negative attitudes to learning may result in the wish to simply pass the exam and be "done with it" which could result in a choice of a surface study strategy.

Sense of coherence and learning

The positive association of SOC with a strategic approach, and its negative association with a surface approach to learning is consistent with the suggestion that the strategic approach is a proxy of self-regulation in the context of learning (Pekrun & Perry, 2014). One needs to experience the world as comprehensible, manageable and meaningful (Antonovsky, 1987) in order to be able to act as an active agent, able to plan and organize one's life in general and learning in particular; an ability which a decreased level of SOC is likely to compromise.

In this line of thinking, the Sense of Coherence can be seen as a personal resource, buffering stressors and negative effect on psychological wellbeing (Cohen et al., 2008). In our previous research, we found that low sense of coherence may prevent students' adjustment eventually leading to negative emotions and in turn, to academic failure (Karagiannopoulou et al., 2020).

Further, it is possible that the positive association between reappraisal and the negative association with suppression to SOC has to do with the degree of intentionality each regulation strategy requires. Possibly, a student who is able to reappraise, i.e. dynamically modify the impact of the emotion as it occurs, is more likely to feel as an agent both in

Table 3 *The standardized direct and indirect on dependent variables of the selected model*

	Standardized Direct Estimate	Indirect Estimate	95% CI of Indirect Estimate	Standardized Indirect Estimate	p-value
On SOC					
Reappraisal	**0.1851**			.	**0.002**
Suppression	**−0.3018**			.	**< 0.001**
On Positive					
Reappraisal	**0.2742**			.	**< 0.001**
Suppression	**−0.1711**			.	**0.001**
On Negative_I					
Reappraisal	**−0.1785**			.	**< 0.001**
Suppression	**0.1759**			.	**0.001**
On Negative_II					
Reappraisal	0.0095			.	0.862
Suppression	**0.1623**			.	**0.003**
On Deep					
Reappraisal	.	**0.0916**	**0.0553, 0.1279**	**0.1453**	**< 0.001**
Suppression	.	**−0.0692**	**−0.1131, −0.0254**	**−0.0916**	**0.002**
SOC	0.0765				0.217
Positive	**0.3315**			.	**< 0.001**
Negative I	**−0.2168**			.	**< 0.001**
Negative II	**0.1623**			.	**0.001**
On Surface					
Reappraisal	.	**−0.0780**	**−0.1116, −0.0445**	**−0.1529**	**< 0.001**
Suppression	.	**0.1095**	**0.0715, 0.1474**	**0.1788**	**< 0.001**
SOC	**−0.1523**				**0.001**
Positive	**−0.2135**			.	**< 0.001**
Negative I	**0.3803**			.	**< 0.001**
Negative II	**0.1813**			.	**< 0.001**
On Strategic					
Reappraisal	.	**0.1039**	**0.0675, 0.1403**	**0.1912**	**< 0.001**
Suppression	.	**−0.0940**	**−0.1354, −0.0526**	**−0.1442**	**< 0.001**
SOC	**0.1612**				**0.001**
Positive	**0.4739**			.	**< 0.001**
Negative I	**−0.1710**			.	**< 0.001**
Negative II	**0.0960**			.	**0.034**
On Failure Rate					
Reappraisal	.	**−0.0014**	**−0.0007, −0.0020**	**−0.0732**	**< 0.001**
Suppression	.	**0.0015**	**0.0008, 0.0022**	**0.0678**	**< 0.001**
SOC	.	**−0.0009**	**−0.0014, −0.0005**	**−0.0661**	**< 0.001**
Positive	.	**−0.0031**	**−0.0036, −0.0025**	**−0.1485**	**< 0.001**
Negative I	.	**0.0026**	**0.0020, 0.0031**	**0.1144**	**< 0.001**
Negative II	.	0.0002	−0.0001, 0.0006	0.0139	0.285
Deep	−0.0061				0.91
Surface	0.1988				**< 0.001**
Strategic	−0.2195				**< 0.001**

terms of regulating their emotion and in terms of organizing and monitoring their study and learning. On the contrary, the habitual use of suppression, often used once the emotion is "fully expressed", can be associated with reduced SOC and leads to a more "avoidant", surface approach to learning. This interpretation is partially supported by the findings from longitudinal studies demonstrating that a strong SOC predicted good physical and mental wellbeing and a stronger interest in learning (Lindström & Eriksson, 2011; Togari et al., 2008). It is possible that SOC may serve as an important meta-cognitive trait enabling students to approach the learning process more effectively.

Table 4 *The decomposition of the significant indirect effects on Deep approach, Surface approach, Strategic approach and Failure Rate*

	Through				Total Indirect Effect
	SOC	Positive	Negative_I	Negative_II	
From Reappraisal to Deep	0.0142	0.0909	0.0387	0.0015	0.1453
From Suppression to Deep	−0.0231	−0.0567	−0.0381	0.0263	−0.0916
From Reappraisal to Surface	−0.0282	−0.0585	−0.0679	0.0017	−0.1529
From Suppression to Surface	0.0460	0.0365	0.0669	0.0294	0.1788
From Reappraisal to Strategic	0.0298	0.1299	0.0305	0.0010	0.1912
From Suppression to Strategic	−0.0486	−0.0811	−0.0301	0.0156	−0.1442
	Through				
		Deep	Surface	Strategic	
From Reappraisal to Failure Rate		−0.0009	−0.0304	−0.0419	−0.0732
From Suppression to Failure Rate		0.0006	0.0355	0.0317	0.0678
From SOC to Failure Rate		−0.0004	−0.0303	−0.0354	−0.0661
From Positive to Failure Rate		−0.0021	−0.0424	−0.1040	−0.1485
From Negative_I to Failure Rate		0.0013	0.0756	0.0375	0.1144

The role of emotion regulation

The results illustrate the contribution of reappraisal and suppression to students learning through their effect on positive and negative academic emotions, as well as on SOC, respectively indicating a positive/adaptive and a negative/maladaptive (Karagiannopoulou et al., 2018) paths of associations.

One may argue that a degree of frustration is inevitable in the process of learning and mastering something new. Therefore, in order to maintain positive emotions towards learning, one has to reappraise the negative emotions arising from the required efforts and inevitable failures in the process of acquiring new knowledge. However, when these emotions are continually suppressed negative emotions towards learning are likely to arise. ER can be expected to mitigate the influence of emotions that stand in the way of students' engagement with learning and could enhance the experience of emotions that can bolster it (Harley, Pekrun et al., 2019).

This is in line with previous studies indicating that reappraisal is associated with pleasant emotions and adaptive outcomes (Burić et al., 2016; Gross & John, 2003). Further, the use of reappraisal to induce positive emotions appears to facilitate the use of both deep and strategic learning suggesting the beneficial effect of this emotion regulation strategy on learning. It may be argued that once a student experiences an overall positive emotion towards the learning process they are able to remain curious and motivated, allowing for both deep and strategic learning.

The findings indicate that reappraisal and suppression have an almost equal negative and positive effect respectively, on surface approach though Negative I academic emotions (frustration: anger and boredom). Negative emotions in turn enhance the use of a surface approach that is positively associated with students' failures.

Reappraisal influences learning style through positive emotions, SOC and reduction of anger and boredom but not through anxiety and shame. This may indicate that students are less able to use reappraisal to deal with the sense of anxiety and shame. This is particularly interesting considering the finding that a degree of anxiety and shame appears to facilitate all styles of learning. It is plausible that all learning requires not only pride, hope, confidence and SOC but also a degree of anxiety and shame. This argument is consistent with the suggestion that negative emotions may serve as "signals" that more attention or effort may be needed, facilitating a more adaptive learning approach (Robinson et al., 2017). Unlike reappraisal, suppression influences learning styles through the entire range of positive and negative emotions as well as through SOC. This might be associated with the fact that students who use suppression to down-regulate unpleasant emotions actually experience such emotions to a greater extent (Burić et al., 2016), while also not experiencing as many positive emotions nor displaying SOC, subsequently showing poorer academic performance.

The study seems to suggest that there are two possible pathways to strategic learning: one stemming from positive

attitudes to learning and the less expected one stemming from shame and anxiety. This may suggest that there are two possible drivers to motivate careful organization of one's learning process, one is the overall motivation to succeed through positive emotions, and the other one is anxiety around planning and shame in relation to possible failure. It is possible that the latter triggers a more "obsessive" way of learning aimed at reducing uncertainty and the perceived chance of failure. It may also be argued that for some people a combination of both pathways could be true. Although, we cannot argue that such an "obsessive" way of learning is adaptive, since emotion regulation is context specific (Desatnik et al., 2017), one may argue that students may at times "functionally" suppress emotion to manage certain aspects of learning.

Overall, the findings of the present study support the argument that both positive and negative emotions are implicated in the learning process (Villavicencio & Bernardo, 2013). The interplay between both negative and positive emotions in adopting a strategic approach to learning further supports the suggestion that the impact of positive and negative emotions is complex and should not be explored dichotomously (Boekaerts, 2003).

Finally, much has been written about the significant association between ER and mental health (Butler, 2011). Building on this well-established association, the findings of the present study further underline the importance of the variables associated with mental health not only to students' well-being but also to their capacity to progress in their education. Most recent research clearly emphasizes that education policy and practice should pay more attention to affective factors associated with learning and performance (Camacho-Morles, 2021). Equipping students with strategies for upregulating positive emotions and downregulating negative emotion during learning could enhance performance on academic activities (Camacho-Morles, 2021).

Limitations

There are some limitations to the present study that need to be considered. Firstly, the self-report methodology although widely-used does not allow further elaboration of the parsimonious observed effects of ER on academic emotions; neuroimaging methodology could significantly complement the results of the present study and our understanding of particular associations e.g. between ER and academic emotions.

Another significant limitation is the disproportionate number of female participants in the study. This is due to a significant imbalance in favour of women in Schools of Social Sciences from where the participants were recruited (Eurostat, 2018). Furthermore, the fact that most of the study participants were recruited from the area of social studies further restricts the extent to which the results of the present study can be generalised in other departments. Further, as all the study participants were Greek the potential cultural differences in the phenomena examined were not captured as part of this study. It must be noted that the cross-sectional design does not allow to explore causal relationships among the variables; limitations in causality and generalizations are apparent. A longitudinal data could offer a proper testing of the proposed mediation effects. Overall, these results should be treated with a degree of caution until a replication on a more heterogeneous sample have taken place.

Many of the variables explored in the present study are thought to be changing and developing across the life span and especially during the transition to early adulthood (ER: Brewer et al., 2016; Desatnik et al., 2021, Collins, 2015). The present study only explored two ER strategies utilized by university students, therefore the extent to which the current findings can be extrapolated to learning in both younger and older age groups is limited. Future research should take into account that "emotion-regulation develops in an emotion-specific manner and in line with a life-span perspective including stability, growth, and decline" (Zimmermann & Iwanski, 2014), and attempt to replicate the current findings in wider age groups as well as researching a broader range of emotion regulation strategies.

Conclusion

The present study is amongst the first to offer a comprehensive model demonstrating the relationship of ER on academic progress. It was shown that ER is associated with emotions learners experience towards learning that in turn are linked to their chosen approach to learning. These approaches to learning are eventually related to academic progress.

This paper offers a further contribution to the contemporary educational movement positioning the students' well-being in the heart of education (Ng & Vella-Brodrick, 2019), acknowledging the pivotal relationship between academic emotions and students' progress. While teaching emotion regulation strategies is widely used in psychotherapy, there is little use of those techniques in education. The findings of the current study illuminate the importance of introducing ER strategy teaching in schools and colleges to allow student to improve and make better use of study skills that are associated with more substantial and effective learning as well as with measurable academic success.

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